Nirma University
Institute of Technology
M.Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester – I

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	I
Course Code:	6EE101
Course Title:	Electric Motors for Vehicle Propulsion
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -

1. distinguish constructional and operational aspects of electric motors for vehicle propulsion **BL2**
2. analyze characteristics and performance of electric motors for vehicle propulsion **BL4**
3. examine properties and characteristics of permanent magnet materials **BL4**
4. select appropriate machines based on application requirements **BL5**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	I
Course Code:	6EE102
Course Title:	Automotive Power Electronics
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-

1. analyze operation of devices and choose the same suitable for EV application **BL4**
2. evaluate various performance parameters of converters **BL5**
3. implement and analyze different control techniques for power electronic converters **BL4**
4. choose and apply converter topology suitable for EV application **BL6**

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**I**
Course Code:	**6EE103**
Course Title:	**EV Architecture and Systems**
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	PW	W	S	
3	**0**	**2**	**-**	**-**	**-**	**4**

Course Outcomes (CLOs):

At the end of the course, students will be able to –

1. correlate electric vehicles with fossil fuel driven vehicles   **BL4**
2. apply the concept of Electric Vehicle powertrain and drivetrain   **BL3**
3. analyze hybrid electric vehicles, communication protocols and grid integration   **BL4**
4. examine energy management strategies and HVAC systems in Electric Vehicles and Hybrid Electric Vehicles   **BL5**

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**I**
Course Code:	**6EE104**
Course Title:	**Energy Storage and Battery Charging Systems**
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	PW	W	S	
3	**0**	**2**	**-**	**-**	**-**	**4**

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -

1. select appropriate energy storage system   **BL6**
2. analyse battery characteristics and parameters   **BL4**
3. apply the concept of battery management systems   **BL3**
4. design battery charging system   **BL6**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	I
Course Code:	6EE105
Course Title:	Vehicle Dynamics
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
3	0	0	-	-	-	3

Course Outcomes (CLOs):

At the end of the course, students will be able to -

1. analyze mechanics involved in vehicle operation **BL4**
2. interpret by evaluating forces as well as moments working and affecting vehicle operation and performance **BL5**
3. analyze the effect on the steering dynamic and predict stability of vehicles in various conditions **BL4**
4. select appropriate suspension as well as braking and evaluate parameters with its properties **BL6**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	I
Course Code:	6EE181
Course Title:	Communication Skills and Technical Writing
Course Type:	(☐ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / √ **Any other (supplementary course)**
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
0	1	0	-	-	-	-

Course Outcomes (CLOs):

At the end of the course, students will be able to-

1. practice verbal and non-verbal communication skills **BL3**
2. apply speaking skills for Group Discussion, Personal Interview and Seminar Presentation **BL3**
3. compose and effectively write abstract, structure the research paper and dissertation, summarize technical material. **BL6**

Semester – II

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE151
Course Title:	Vehicular Control Systems and Instrumentation
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-

1. appreciate the various components of an automobile system **BL2**
2. analyse the control system of electric vehicle **BL4**
3. evaluate various safety systems associated with electric vehicle **BL5**
4. comprehend various sensors used in the operation of an electric vehicle **BL5**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE161
Course Title:	Electronic System Design
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
2	0	4	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-

1. understand practical design aspects and fabricate power electronic converters of chargers **BL6**
2. design and fabricate inverters of motors used for electric vehicles **BL6**
3. design thermal and protection circuits **BL6**
4. investigate the various output waveforms with necessary troubleshooting **BL5**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE162
Course Title:	Design of Advanced Electric Motors
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
2	0	4	-	-	-	4

Course Outcomes (CLOs):

At the end of the course, students will be able to -

1. understand and apply design aspects of advanced electrical motors **BL3**
2. select appropriate materials for design of advanced electrical motors **BL5**
3. design advanced electrical motors **BL6**
4. estimate and analyze performance of advanced electrical motors **BL4**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE163
Course Title:	Automotive Embedded Systems and Communication Protocols
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
2	0	4	-	-	-	4

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-

1. appraise the components and architecture of Embedded system **BL2**
2. explain the design process of an embedded system **BL2**
3. illustrate building blocks of Embedded system and its characteristics **BL4**
4. compare and contrast communication protocols of EVs **BL3**

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Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE164
Course Title:	Artificial Intelligence and Algorithms
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
2	0	2	-	-	-	3

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -
1. make use of basic techniques of AI / optimization **BL6**
2. identify AI/ optimization related complex problems of electric vehicle systems. **BL5**
3. apply knowledge of various AI / optimization techniques in electric vehicle technology **BL4**
4. develop AI / optimization-based solutions **BL6**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE165
Course Title:	Control of Power Electronic Converters
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
2	0	2	-	-	-	3

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -
1. design controllers for power electronic converters **BL6**
2. implement control techniques for dc-dc converters **BL6**
3. apply appropriate current PWM technique for inverters **BL4**
4. apply appropriate voltage PWM technique for inverters **BL4**

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Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**II**
Course Code:	**6EE166**
Course Title:	**Control of Electric Drives**
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	**PW**	**W**	**S**	
2	**0**	**2**	**-**	**-**	**-**	**3**

Course Outcomes (CLOs):

At the end of the course, students will be able to-
1. comprehend purpose of electric drives and its control aspects   **BL2**
2. select appropriate control strategy for given application   **BL6**
3. integrate schematic blocks to control electric drives   **BL3**
4. analyze performance of electric drives for applications concerned   **BL4**

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**II**
Course Code:	**6EE167**
Course Title:	**Advanced Control Systems**
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	**PW**	**W**	**S**	
2	**0**	**2**	**-**	**-**	**-**	**3**

Course Outcomes (CLOs):

At the end of the course, students will be able to-
1. represent different dynamical systems in state space form and understand the concept of controllability and observability   **BL4**
2. gain familiarity with sample theory, z-transform, and to decide system stability in a discrete domain   **BL5**
3. use system identification methods to design adaptive controllers and use input-output experimental data for identification of mathematical dynamical models   **BL4**
4. control a dynamical system over a period of time such that an objective function is optimized   **BL6**

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**II**
Course Code:	**6EE168**
Course Title:	**Automotive Safety, Testing and Certification**
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	**PW**	**W**	**S**	
3	**0**	**0**	**-**	**-**	**-**	**3**

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -

1. analyse and evaluate performance of the battery   **BL5**
2. make use of various standards for testing of electric motors   **BL6**
3. comprehend standards for vehicles   **BL4**
4. perform the tests for certification of various chargers   **BL4**

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**II**
Course Code:	**6EE169**
Course Title:	**Electromagnetic Interference and Electromagnetic Compatibility**
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	**PW**	**W**	**S**	
3	**0**	**0**	**-**	**-**	**-**	**3**

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -

1. identify EMI/EMC problems in electrical systems   **BL4**
2. analyze the effects of EMI on system performance   **BL4**
3. select appropriate technique to reduce the EMI effects on electrical systems   **BL6**
4. design of EM compatible electrical systems   **BL6**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE170
Course Title:	Electric Vehicles in Smart Grid
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
3	0	0	-	-	-	3

Course Outcomes (CLOs):

At the end of the course, students will be able to-
1. elaborate about vehicle electrification and impact of charging strategies **BL2**
2. analyze the influence of EVs on power system **BL5**
3. distinguish the frequency control and voltage support from EVs **BL4**
4. interpret the ICT solutions for EV deployment **BL3**
5. understand the EV charging facility planning **BL3**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE171
Course Title:	Autonomous and Connected Vehicles
Course Type:	(☐ Core/ ☐ Value Added Course / √ **Department Elective** / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
3	0	0	-	-	-	3

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to -
1. classify various types of advanced driver assistance systems **BL2**
2. explain the concept of fully autonomous vehicles **BL2**
3. relate the concept of the connected vehicle and its role in ADAS and automated vehicles **BL3**
4. illustrate the sensor technology for autonomous and connected vehicles **BL3**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE152
Course Title:	Research Methodology and IPR
Course Type:	(☐ Core / ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / √ Any other (soft skill))
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
2	0	0	-	-	-	2

Course Learning Outcomes (CLOs):

At the end of the course, students will be able to-
1. appraise data collection methods and tools; and research methodology **(BL2)**
2. organize research related information and plan for research problem formulation **(BL4)**
3. develop research writing skills; and practice research ethics **(BL6)**
4. contrast research outcomes suitable for publications or IPR **(BL5)**
5. Infer the basic IPR needs, protections, law, process and trends in IPR **(BL2)**

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	II
Course Code:	6EE191
Course Title:	Minor Project
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
0	0	10	-	-	-	5

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to -
1. select the area / sub – domain of choice to pursue research **(BL4)**
2. develop hands – on expertise on a relevant electrical engineering software / hardware **(BL4)**
3. analyze performance of a specific electrical network with a detailed insight into its various functional components / models **(BL4)**
4. evaluate any electrical network problem / issue with domain related applications **(BL5)**

Semester – III

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	III
Course Code:	7EE191
Course Title:	Major Project Part - I
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2023 – 24

L	T	Practical component				C
		LPW	PW	W	S	
-	-	-	-	-	-	14

Course Learning Outcomes (CLO):
After successful completion of the course, student will be able to -
1. understand the issues related with the recent trends in the field of engineering and its applications **(BL2)**
2. formulate the problem definition, analyze and carry out functional simulation **(BL4)**
3. design, implement, test and verify the engineering solution related to problem definition **(BL6)**
4. compile, comprehend and present the work carried out **(BL5)**
5. manage project **(BL5)**

Semester – IV

Institute:	Institute of Technology
Name of Programme:	M. Tech. in Electrical Engineering (Electric Vehicular Technology)
Semester:	IV
Course Code:	7EE192
Course Title:	Major Project Part - II
Course Type:	(√ **Core**/ ☐ Value Added Course / ☐ Department Elective / ☐ Institute Elective/ ☐ University Elective/ ☐ Open Elective / ☐ Any other)
Year of Introduction:	2023 – 24

L	T	Practical component				C
		LPW	PW	W	S	
-	-	-	-	-	-	14

Course Learning Outcomes (CLO):
After successful completion of the course, student will be able to -
1. understand the issues related with the recent trends in the field of engineering and its applications **(BL2)**
2. formulate the problem definition, analyze and carry out functional simulation **(BL4)**
3. design, implement, test and verify the engineering solution related to problem definition **(BL6)**
4. compile, comprehend and present the work carried out **(BL5)**
5. manage project **(BL5)**