# MAHARSHI DAYANAND UNIVERSITY, ROHTAK

**SCHEME OF STUDIES & EXAMINATIONS**
**B.TECH (Minor inElectric Vehicles)**
**w.e.f. 2026-2027**

| Sr. No. | Sem-ester | Course Code | Subject | Teaching Schedule | | | Examination Schedule(Marks) | | | | Duration of Exam(Hours) | No. of Hours /Week |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | P | Total Credits | Internal Assessment | Theory | Practical | Total | | |
| 1. | 3rd | 26EVM-201-H | Hybrid Vehicles | 3 | - | 3 | 25 | 50 | - | 75 | 3 | 3 |
| 2. | 3rd | 26EVM-203-H | Hybrid Vehicles Lab | - | 2 | 1 | 5 | - | 20 | 25 | 3 | 2 |
| 3. | 4th | 26EVM-202-H | Automobile Systems | 3 | - | 3 | 25 | 50 | - | 75 | 3 | 3 |
| 4. | 4th | 26EVM-204-H | Automobile Systems Lab | - | 2 | 1 | 5 | - | 20 | 25 | 3 | 2 |
| 5. | 5th | 27EVM-301-H | Energy Storage Systems | 3 | - | 3 | 25 | 50 | - | 75 | 3 | 3 |
| 6. | 5th | 27EVM-303-H | Energy Storage Systems Lab | - | 2 | 1 | 5 | - | 20 | 25 | 3 | 2 |
| 7. | 6th | 27EVM-302-H | Power Electronics and Drives for Automobiles | 3 | - | 3 | 25 | 50 | - | 75 | 3 | 3 |
| 8. | 6th | 27EVM-304-H | Power Electronics and Drives for Automobiles Lab | - | 2 | 1 | 5 | - | 20 | 25 | 3 | 2 |
| 9. | 7th | 28EVM-401-H | Vehicle Safety | 3 | - | 3 | 25 | 50 | - | 75 | 3 | 3 |
| 10. | 7th | 28EVM-403-H | Mini Project | - | 2 | 1 | 5 | - | 20 | 25 | 3 | 2 |
| | | Total | | | | 20 | | | | 500 | 30 | 25 |

# Hybrid Vehicles(26EVM-201-H)

**L T P CREDIT** **SESSIONAL:25Marks**
**3 0 0 3** **THEORY :75 Marks**
**TOTAL :100 Marks**
**DURATION OF EXAM.:3 Hrs.**

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV01.1** | Understand the fundamentals of electric and hybrid electric vehicles and their components. |
| **EV01.2** | Explain the architecture, operation, and performance of hybrid electric vehicles. |
| **EV01.3** | Analyse vehicle dynamics, tractive effort, and performance characteristics of electric vehicles. |
| **EV01.4** | Understand electric propulsion systems, power electronic converters, and motor drives used in electric vehicles. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EV01.1 | 3 | 2 | 1 | - | 1 | 2 | 1 | - | - | - | 1 | 3 | 2 | 2 |
| EV01.2 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | - | - | - | 1 | 3 | 3 | 3 |
| EV01.3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | - | - | - | 1 | 3 | 3 | 3 |
| EV01.4 | 3 | 2 | 3 | 2 | 3 | 2 | 1 | - | - | - | 2 | 3 | 3 | 3 |
| WT. AVG | 3 | 2.5 | 2.25 | 2 | 2 | 2.25 | 1 | | | | 1.25 | 3 | 2.75 | 2.75 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.25 | |

## UNIT-I

**Electric Vehicles :**History, Components of Electric Vehicle, General Layout of EV, EV classification Comparison with Internal combustion Engine: Technology, Advantages & Disadvantages of EV, Overview of Tesla car.

## UNIT-II

**Hybrid Electric Vehicles:**History, Components of Hybrid Electric Vehicle, General Layout of Hybrid EV, Comparison with Electric Vehicles, Advantages & Disadvantages of Hybrid EV, Overview of Toyota prius. Vehicle FundamentalsHybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, EV. Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Propulsion systems and components. Regenerative Braking, Economy, Vibration and Noise reduction. Hybrid Electric Vehicles System – Analysis and its Types, Controls.

## UNIT-III

**Vehicle resistance, Types:** Rolling Resistance, grading resistance, Aerodynamic drag vehicle performance, Calculating The Acceleration Force, maximum speed, FindingThe Total Tractive Effort, Torque Required OnThe Drive Wheel, Transmission: Differential, clutch &gear box, Braking performance.

**INDIAN and GLOBAL Scenario :**Technology Scenario, Market Scenario, Policies and Regulations, Payback and commercial model, Payback and commercial model, Polices in India

## UNIT-IV

**Motors :**Principle and working of DC motor, Characteristics and Types of DC Motors Overview (Speed torque characteristics) of Permanent Magnet motor, BLDC Motor, Induction motor. Comparison of all motors.

**Converts:**Introduction of DC-DC, AC-AC AC-DC,DC-AC, four-quadrant operation, Driver circuits. Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors, Inverters. Safety – Risks and Guidance, Precautions, High Voltage safety, Hazard management. Sensors - Autonomous EV cars, Self Drive Cars.

**Reference Books:**

1."Electric Vehicle Technology Explained", by Author John Lowry and James Larminie
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design , Mehrdad Ehsani and Yimin, Power Electronics And Applications Series, second edition.
3. Electric and Hybrid Vehicles: Design Fundamentals , Iqbal Husain
4. Build Your Own Electric Vehicle, Seth Leitman and Bob Brant
5. Introduction to Hybrid Vehicle System Modeling and Control .

# Hybrid Vehicles Lab(26EVM-203-H)

| L | T | P | CREDIT |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**SESSIONAL:25 Marks**
**Practical :25 Marks**
**TOTAL :50 Marks**
**DURATION OF EXAM.:3 Hrs.**

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV01.LAB 1** | Identify the components and operating principles of electric and hybrid vehicles. |
| **EV01.LAB 2** | Perform experiments on electric motor drives, battery charging, and vehicle subsystems. |
| **EV01.LAB 3** | Diagnose common faults and carry out servicing and maintenance of electric and hybrid vehicles. |
| **EV01.LAB 4** | Analyse the performance of hybrid vehicles through experiments, field visits, and technical reports. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EV01.1** | 3 | 2 | 1 | 2 | 2 | 1 | - | - | - | - | 1 | 3 | 2 | 3 |
| **EV01.2** | 3 | 3 | 2 | 3 | 3 | 1 | - | - | - | - | 1 | 3 | 3 | 2 |
| **EV01.3** | 3 | 3 | 2 | 3 | 2 | 2 | - | - | - | - | 1 | 3 | 3 | 3 |
| **EV01.4** | 3 | 2 | 3 | 3 | 2 | 2 | - | - | - | - | 2 | 3 | 3 | 3 |
| **WT. AVG** | 3 | 2.5 | 2 | 2.75 | 2.25 | 1.5 | | | | | 1.25 | 3 | 2.75 | 2.75 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.375 | |

**List of Experiments :**

1. Demonstration of construction and working of components of an electric vehicle
2. Demonstration of construction and working of components of an hybrid vehicle
3. Demonstration of 4 co-ordinate speed control operation for DC motor drive

4. Demonstration of 4 co-ordinate speed control operation for induction motor drive
5. Servicing of hybrid vehicles Engine tuning and adjustment for hybrid vehicles
6. Identification of starting troubles and their rectifications for electrical vehicles
7. Identification of starting troubles and their rectifications for hybrid vehicles
8. Battery servicing and charging.
9. Study of a electrical vehicle servicing centre: (a) Layout (b) Instruments/ Tools used (c) Servicing procedures.
10. Visit of a local hybrid vehicle service centre and prepare a report in respect of: (a) Layout (b) Instruments/ Tools used (c) Servicing/ Reconditioning/ Maintenance procedure.
11. Collect specifications for available hybrid vehicles and prepare a comparison table and their manuals.

**Note :**

1. At least eight experiments are to be performed in the Semester.
2. At leastsix experimentsshould beperformed fromthe above list. Remaining two experiments may either be performed from the above list or as designed & set by the concerned institution as per the scope of the syllabus.

# Automobile Systems (26EVM-202-H)

**L T P CREDIT** **SESSIONAL:25Marks**
**3 0 0 3** **THEORY :75 Marks**
**TOTAL :100 Marks**
**DURATION OF EXAM.:3 Hrs.**

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV02.1** | Identify the different parts of the automobile. Understand the function of each automobile component and also have a clear idea about the overall vehicle performance. |
| **EV02.2** | Explain the working of various parts like engine, transmission, clutch, brakes. |
| **EV02.3** | Describe how the steering and the suspension systems operate. |
| **EV02.4** | Understand the environmental implications of automobile emissions. The student will understand how passenger comfort is achieved along with vehicle stability. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EV01.1** | 3 | 2 | 1 | - | 2 | 2 | 1 | - | - | - | 1 | 3 | 2 | 2 |
| **EV01.2** | 3 | 3 | 2 | 2 | 3 | 2 | 1 | - | - | - | 1 | 3 | 3 | 3 |
| **EV01.3** | 3 | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | 2 | 3 | 3 | 3 |
| **EV01.4** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | - | - | - | 2 | 3 | 3 | 3 |
| **WT. AVG** | 3 | 2.75 | 2.25 | 2 | 2.5 | 2.25 | 1.25 | | | | 1.50 | 3 | 2.75 | 2.75 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.23 | |

## UNIT-I

Evolution of Automotive Electronics -Basic Control System Theory applied to Automobiles - Overview of the Operation of ECUs -Infotainment, Body, Chassis, and Powertrain Electronics-Advanced Driver Assistance Systems-Autonomous Vehicles

## UNIT-II

Basics of Radar Technology and Systems -Ultrasonic Sonar Systems -LIDAR Sensor Technology and Systems -Camera Technology -Night Vision Technology -Use of Sensor Data Fusion -Kalman Filters

## UNIT-III

Computer Vision Fundamentals -Advanced Computer Vision -Neural Networks for Image Processing –TensorFlow -Overview of Deep Neural Networks -Convolutional Neural

Networks, Connectivity Fundamentals - DSRC (Direct Short Range Communication) - Vehicle-to-Vehicle Technology and Applications -Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications -Security Issues.

**UNIT-IV**

Driverless Car Technology-Different Levels of Automation -Localization - Path Planning. Controllers to Actuate a Vehicle - PID Controllers -Model Predictive Controllers, ROS Framework, Technical Issues, Security Issues, Moral and Legal Issues.

Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the automobile, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation ( PVC) Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation ( ECR ) Systems, Air Injection System and Catalytic Converters; Purpose construction & operation of lead acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

**Text Books:**


1. Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
2. Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.
3. Rajesh Rajamani, “Vehicle Dynamics and Control”, 1st edition, Springer, 2005
4. Singiresu S. Rao, “Mechanical Vibrations”, 5th Edition, Prentice Hall, 2010
5. Thomas D. Gillespie, “Fundamentals of Vehicle Dynamics”, Society of Automotive Engineers Inc, 1992
6. Wong. J. Y., “Theory of Ground Vehicles”, 3rd Edition, Wiley-Interscience, 2001


**Reference Books:**


1. Automotive Mechanics – Crouse / Anglin, TMH.
2. Automotive Technology – H.M. Sethi, TMH, New Delhi.
3. Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
4. Automotive Mechanics – Joseph Heitner, EWP.
5. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
6. The Motor Vehicle – Newton steeds Garrett, Butter Worths.
7. Dean Karnopp, “Vehicle Stability”, 1st edition, Marcel Dekker, 2004
8. Hans B Pacejka, “Tire and Vehicle Dynamics”, 2nd edition, SAE International, 2005

9. John C. Dixon," Tires, Suspension, and Handling", 2nd edition, Society of Automotive Engineers Inc, 1996

# Automobile Systems Lab(26EVM-204-H)

| L | T | P | CREDIT | SESSIONAL:25 Marks |
|---|---|---|---|---|
| 0 | 0 | 2 | 1 | Practical :25 Marks |

**TOTAL :50 Marks**
**DURATION OF EXAM.:3 Hrs.**

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV02.LAB1** | Identify the different parts of the automobile. Understand the function of each automobile component and also have a clear idea about the overall vehicle performance. |
| **EV02.LAB2** | Explain the working of various parts like engine, transmission, clutch, brakes. |
| **EV02.LAB3** | Describe how the steering and the suspension systems operate. |
| **EV02.LAB4** | Understand the environmental implications of automobile emissions. The student will understand how passenger comfort is achieved along with vehicle stability. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EV01.1 | 3 | 2 | 1 | 2 | 2 | 1 | - | - | - | - | 1 | 3 | 2 | 2 |
| EV01.2 | 3 | 3 | 2 | 2 | 2 | 1 | - | - | - | - | 1 | 3 | 3 | 2 |
| EV01.3 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | - | 1 | 3 | 3 | 3 |
| EV01.4 | 3 | 2 | 3 | 3 | 2 | 2 | 1 | - | - | - | 2 | 3 | 3 | 3 |
| WT. AVG | 3 | 2.5 | 2.00 | 2.50 | 2.25 | 1.50 | 1 | | | | 1.25 | 3 | 2.75 | 2.50 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.17 | |

**List of Experiments :**

1. Study of an Automobile Chassis
2. Study of Differential Mechanism of an Automobile
3. Study of Multiple Clutch of an Automobile
4. Study of Braking System (Hydraulic / Air Brake)
5. Study and Demonstration of different circuit of carburetor
6. Checking the spark plug and setting the port and check the ignition in the spark plug
7. Study the Electrical System of an Automobile
8. Study the assembly of Car Engine.

**Note :**

3. At least six experiments are to be performed in the Semester.

## Energy storage systems(27EVM-301-H)

Theory: 75 Marks
L T P Class work : 25 Marks
3 0 - Total: 100 Marks

Duration of Exam: 3 Hours

**Note**: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV02.1** | Discuss about the different types of energy storage system. |
| **EV02.2** | Describe about the battery characteristic & parameters. |
| **EV02.3** | Model different types of batteries |
| **EV02.4** | Apply the concepts of battery management system and design the battery pack. |
| **EV02.5** | Explain about the battery charging technology. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EV02.1** | 3 | 2 | 1 | - | 2 | 2 | - | - | - | - | 1 | 3 | 2 | 2 |
| **EV02.2** | 3 | 3 | 2 | 2 | 2 | 2 | - | - | - | - | 1 | 3 | 3 | 2 |
| **EV02.3** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | - | - | 1 | 3 | 3 | 3 |
| **EV02.4** | 3 | 2 | 3 | 2 | 3 | 3 | - | - | - | - | 2 | 3 | 3 | 3 |
| **WT. AVG** | 3 | 2.5 | 2.25 | 2 | 2.5 | 2.25 | | | | | 1.25 | 3 | 2.75 | 2.5 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.40 | |

UNIT I

ENERGY STORAGE SYSTEM : Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zine Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System.

UNIT II

BATTERY CHARACTERISTICS & PARAMETERS: Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters- Heat generation- Battery

design- Performance criteria for Electric vehicles Recycling, disposal and second use of batteries.

UNIT III

BATTERY PACK AND BATTERY MANAGEMENT SYSTEM:

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Introduction to Battery Management System.

UNIT IV

EV CHARGING TECHNOLOGIES: Classification of different charging technology for EV charging station, introduction to Grid-to-Vehicle, Vehicle to Grid (V2G) or Vehicle to Buildings (V2B) or Vehicle to Home (V2H) operations, bi-directional EV charging systems, energy management strategies used in hybrid and electric vehicle, Wireless power transfer (WPT) technique for EV charging.

TEXT BOOK 1.

1. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", John Wiley& Sons Ltd., 2016.
2. Chris Mi, Abul Masrur& David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric Hybrid Electric and Fuel Cell Vehicles", Taylor& Francis Group, 2010.
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.

REFERENCES

1. G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN: 0-444-50562-8)
2. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)
3. T R Crompton, "Battery Reference Book-3rd Edition", Newnes- Reed Educational and Professional Publishing Ltd., 2000.
4. Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer, 2018. (ISBN: 978-3-319-70571-2).

## Energy Storage Systems Lab(27EVM-303-H)

| L T P | Practical Exam: 25 Marks |
|---|---|
| - - 2 | Lab work : 25 Marks |
| | Total: 50 Marks |
| | Duration of Exam: 3 Hour |

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV02.LAB1** | Discuss about the different types of energy storage system. |
| **EV02.LAB2** | Describe about the battery characteristic & parameters. |
| **EV02.LAB3** | Model different types of batteries |
| **EV02.LAB4** | Apply the concepts of battery management system and design the battery pack. |
| **EV02.LAB5** | Explain about the battery charging technology. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EV02.1** | 3 | 2 | 1 | 2 | 2 | 1 | - | - | - | - | 1 | 3 | 2 | 2 |
| **EV02.2** | 3 | 3 | 2 | 3 | 3 | 1 | - | - | - | - | 1 | 3 | 3 | 3 |
| **EV02.3** | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | 1 | 3 | 3 | 3 |
| **EV02.4** | 3 | 2 | 3 | 2 | 3 | 2 | - | - | - | - | 2 | 3 | 3 | 3 |
| **WT. AVG** | 3 | 2.5 | 2 | 2.5 | 2.5 | 1.25 | | | | | 1.25 | 3 | 2.75 | 2.75 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.35 | |

**List of Experiments :**

1. Study of different types of batteries with their characteristics & detailed specifications.
2. Develop a simulation model for Lead-acid and Li-ion Batteries.
3. SOC Estimation by Open Source voltage for Lead-Acid battery, Ni-MH battery and Liion battery.
4. SOC Estimation by specific gravity for Lead-Acid battery.
5. SOC Estimation by Coulomb counting method for Lead-Acid battery and Li-ion battery.
6. Design a circuit for Battery monitoring System for Lead acid battery.
7. Study of Battery parameters and Testing of batteries for electric vehicle.
8. Modeling and Simulating Battery Performance for Design Optimization.
9. Study of fuel cells and their characteristics.
10. Understand battery management systems.
11. To study the thermal management of battery pack.

12. Case Studies: Design of a Battery Electric Vehicle (BEV).

**Note: A minimum of eight practical will be performed by the students.**

## Power Electronics and Drives for Automobiles(27EVM-302-H)

L T P
3 0 -

Theory: 75 Marks
Class work : 25 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

**Note**: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV02.1** | Describe about the motor & device characteristics & parameters. |
| **EV02.2** | Explain about various electric drive concepts |
| **EV02.3** | Understand the DC drive mechanism |
| **EV02.4** | Understand the AC drive mechanism. |
| **EV02.5** | Explain about drives for special electrical machines. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EV02.1** | 3 | 2 | 1 | - | 2 | 1 | - | - | - | - | 1 | 3 | 2 | 2 |
| **EV02.2** | 3 | 3 | 2 | - | 2 | 1 | - | - | - | - | 1 | 3 | 3 | 2 |
| **EV02.3** | 3 | 3 | 3 | 2 | 3 | 2 | - | - | - | - | 1 | 3 | 3 | 3 |
| **EV02.4** | 3 | 2 | 3 | 2 | 2 | 3 | - | - | - | - | 2 | 3 | 3 | 3 |
| **WT. AVG** | 3 | 2.5 | 2.25 | 2 | 2.25 | 1.75 | | | | | 1.25 | 3 | 2.75 | 2.5 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.325 | |

UNIT I

BASIC POWER ELECTRONIC DEVICES : Diodes, Thyristors, Bipolar Junction Transistors, Metal–Oxide–Semiconductor Field Effect Transistors, Insulated Gate Bipolar Transistors, Ultracapacitors.

DC/DC CONVERTER L –Basic Principle of DC–DC Converter, Step-Down (Buck) Converter, Step-Up (Boost) Converter, Buck–Boost Converter, DC–DC Converters Applied in Hybrid Vehicle Systems, Isolated Buck DC–DC Converter, Four-Quadrant DC–DC Converter.

UNIT II

RECTIFIERS AND INVERTERS: Single-phase Diode Rectifiers, Three-phase Diode Rectifiers, Poly-phase Diode Rectifiers, Filtering Systems in Rectifier Circuits, High-

frequency Diode Rectifier Circuits. Voltage Source Inverters, Current Source Inverters, Closed-loop Operation of Inverters.

UNIT III

ELECTRIC MOTOR DRIVES: DC motor operation and its types, BLDC Motor and Control, Operation of BLDC Motor, Torque and Rotating Field Production, BLDC Motor Control, BLDC Motor Torque–Speed Characteristics and Typical Technical Parameters, Sensorless BLDC Motor Control, AC Induction Motor and Control, Basic Principle of AC Induction Motor Operation, Controls of AC Induction Motor.

UNIT IV

Power Electronics and Control for Hybrid and Fuel Cell Vehicles: Series Hybrid Vehicle Propulsion System, Parallel Hybrid Vehicle Propulsion System, Fuel Cell Vehicles, Power Electronics Requirements, Propulsion Motor Control Strategies, APU Control System in Series Hybrid Vehicles, Fuel Cell for APU Applications.

TEXT BOOK

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India,Third Edition, New Delhi, 2011.
2. Ali Emadi, “Handbook of Automotive Power Electronics and Drives”, Taylor & Francis Group, First Edition, USA, 2005.
3. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education, second Edition, 2003.
4. Dubey. G.K., "Thyristorised power controllers", new age International, New Delhi, 2002.
5. Bhimbhra P.S., "Power Electronics", Khanna Publishers, New Delhi, 2005. 6. P.C. Sen, “Modern Power Electronics”, Wheeler Publishing Co, Third edition, New Delhi,2008.

References :

1. Gopal K D, “Fundamentals of Electric Drives”, Narosa Publishing House Pvt. Ltd., 2011.
2. Pillai S K, “A first course on Electrical Drives”, Wiley Eastern Ltd, Bombay 2011.
3. Krishnan R, “Permanent Magnet synchronous and Brushless DC Motor Drives”, CRC Publishers, 2010.
4. Krishnan R, “Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design and Applications”, CRC Publishers, 2012.

**Power Electronics and Drives for Automobiles Lab (27EVM-304-H)**

L T P
- - 2

Practical Exam: 25 Marks
Lab work : 25 Marks
Total: 50 Marks
Duration of Exam: 3 Hour

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV02.LAB1** | Describe about the motor & device characteristics & parameters. |
| **EV02.LAB2** | Explain about various electric drive concepts |
| **EV02.LAB3** | Understand the DC drive mechanism |
| **EV02.LAB4** | Understand the AC drive mechanism. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EV02.1** | 3 | 2 | 1 | 2 | 2 | 1 | - | - | - | - | 1 | 3 | 2 | 2 |
| **EV02.2** | 3 | 3 | 3 | 2 | 3 | 1 | - | - | - | - | 1 | 3 | 3 | 2 |
| **EV02.3** | 3 | 3 | 2 | 3 | 2 | 1 | - | - | - | - | 1 | 3 | 3 | 3 |
| **EV02.4** | 3 | 2 | 3 | 3 | 3 | 1 | - | - | - | - | 2 | 3 | 3 | 3 |
| **WT. AVG** | 3 | 2.5 | 2.25 | 2.5 | 2.5 | 1 | | | | | 1.25 | 3 | 2.75 | 2.5 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.325 | |

Note: A minimum of eight practical will be performed by the students.

1. To draw the VI Characteristics of DIODES.
2. To draw the VI Characteristics of BJT.
3. To draw the VI Characteristics of MOSFET & IGBT
4. Design of step up and step down chopper
5. Three phase IGBT based PWM inverter control of induction motor.
6. Study of driver circuits and generation of PWM signals for three phase inverters
7. Load test on D.C shunt motor.
8. Speed control of D.C shunt motor.
9. Modeling and Simulation of Switched Reluctance Motor with MATLAB/ Simulink.
10. To obtain Speed-Torque characteristics of DC Series Motor and DC Shunt Motor.
11. To determine the various losses in a D.C. machine and separation of its core losses
12. Modeling and Simulation of Permanent Magnet Brushless Motor with MATLAB/Simulink.

# Vehicle Safety**(28EVM-401-H)**

**L T P CREDIT** **SESSIONAL:25Marks**
**3 0 0 3** **THEORY :75 Marks**
**TOTAL :100 Marks**
**DURATION OF EXAM.:3 Hrs.**

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV03.1** | Comprehend application of passive and active safety for vehicle. |
| **EV03.2** | Describe importance of ergonomics in automotive safety and human response to impact |
| **EV03.3** | Design vehicle safety systems |
| **EV03.4** | Describe various regulations of vehicle safety and safety testing methods. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EV02.1** | 3 | 2 | 2 | 1 | 2 | 3 | 1 | - | - | - | 1 | 3 | 2 | 2 |
| **EV02.2** | 3 | 2 | 3 | 2 | 3 | 3 | 2 | - | - | - | 1 | 3 | 3 | 2 |
| **EV02.3** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | - | - | - | 2 | 3 | 3 | 3 |
| **EV02.4** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | - | - | - | 2 | 3 | 3 | 3 |
| **WT. AVG** | 3 | 2.5 | 2.75 | 1.75 | 2.5 | 1 | 1.75 | | | | 1.50 | 3 | 2.75 | 2.5 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.28 | |

## UNIT-I

Introduction Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

## UNIT-II

Safety Equipments Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

## UNIT-III

Collision Warning and Avoidance Collision warning system, causes of rear end collision,

frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

**UNIT-IV**

Safety: Motor vehicle safety standards, bio-mechanics Structural safety, energy absorption, ergonomic consideration in safety, Occupants safety systems – seat belts, head retrain, air bags, roll-over protection system, Electronic stability program.

**Text Books**:


1. Bosch, Automotive Handbook, 8th Edition, SAE publication, 2011.
2. Powloski. J., Vehicle Body Engineering, Business books limited, London, 1969.


**Reference Book:**


1. J. Y. Wong, Theory of Ground Vehicles, A wileyInterscience Publications
2. Hans Herman Braess, Ulrich Seiffert, Handbook of Automotive Engineering, SAE Publications.
3. Rao V. Dukkipati, Jian Pang, Road Vehicle Dynamics, SAE Publications.
4. Wolt, Heinrich Hucho, Aerodynamics of road vehicles, SAE Publications.
5. Bosch, Automotive Handbook, SAE Publications
6. George Pieters Barbara Pieters, Automotive Vehicle Safety.
7. Michel Plint Engine Testing Theory and Practice.
8. Gousha H. M., Engine performance Diagnosis and Tune Up Shop Manual
9. J. G. Giles, Vehicle Operation and Performance.
10. W. H. Crouse and D. L. Anglin, Motor Vehicle Inspection.

# MINI PROJECT(28EVM-403-H)

| L | T | P | CREDIT | SESSIONAL:25Marks |
|---|---|---|---|---|
| 0 | 0 | 2 | 1 | EXTERNAL PRACTICAL :25 Marks |
| | | | TOTAL :50 Marks | DURATION OF EXAM.:3 Hrs. |

**Course Outcomes: At the end of the Course, the student will have the ability to:**

| | |
|---|---|
| **EV06.PJ1** | Identify various technologies and fields for practical training. |
| **EV06.PJ2** | Understand the process to make reports and presentations. |
| **EV06.PJ3** | Applying engineering knowledge to solve industrial problems. Analyze ethical practices and tools used in different technologies. |
| **EV06.PJ4** | Design and develop the solution for complex engineering problems. |

**Mapping of Course Outcomes to Program Outcomes:**

| CO/PO | PO 1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EV02.1** | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 2 | 2 |
| **EV02.2** | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| **EV02.3** | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 |
| **EV02.4** | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| **WT. AVG** | 2.5 | 2.5 | 2.5 | 2.5 | 2.25 | 1.50 | 1.75 | 2 | 2.25 | 2 | 2.25 | 2.75 | 2.75 | 2.75 |
| | | | | | | | | Overall Mapping of Subject | | | | | 2.31 | |

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full semester. The students may be asked to work individually or in a group normally not more than four –six students in a group(If any large/big projects occurs then strength of

students increases as per guide supervision). Viva- voce must be based on the preliminary report submitted by students related to the project.