

Engineering Program

Specialization	Hybrid Vehicle Technology
Course Number	20220141
Course Title	Electric Vehicle
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Configurations of EVs , Performance of EVs, Traction Motor Characteristics,
Tractive Effort and Transmission Requirement, Vehicle Performance, Tractive
Effort in Normal Driving, Energy Consumption, Basic Terms of Battery
Performance and Characterization, Battery Charging Methods and EV
Charging Scheme, EV Charging Schemes

أهداف المادة الدراسية:

Upon the completion of the course, the student will be able to:

1. Study the Configurations of EVs.
2. Study the Performance of EVs and Traction Motor Characteristics.
3. Study the Tractive Effort in Normal Driving.
4. Study the Energy Consumption.
5. Defined the Basic Terms of Battery Performance and Characterization.

رقم الوحدة	اسم الوحدة	محتويات الوحدة	الزمن
1.	Introduction	<ul style="list-style-type: none"> ▪ differences between ICEVs and EVs . ▪ advantages of EV over the conventional internal combustion engine vehicle (ICEV) 	1 week
2.	Configurations of EVs	<ul style="list-style-type: none"> ▪ Primary EV power train ▪ general EV configuration ▪ electric propulsion characteristics and energy sources 	2 weeks
3.	Performance of EVs	<ul style="list-style-type: none"> ▪ Vehicle Resistance . ▪ Rolling Resistance ▪ Aerodynamic Drag ▪ Grading Resistance 	2 weeks
4.	Traction Motor Characteristics	<ul style="list-style-type: none"> ▪ Base speed ▪ Speed ratio x ▪ Motor torque ▪ Motor power ▪ Traction motor ▪ Vehicle speed 	2 weeks

5.	Vehicle Performance	<ul style="list-style-type: none"> ▪ Maximum cruising speed ▪ Grade ability ▪ Acceleration ▪ Tractive effort on the driven wheels ▪ Tire rolling resistance ▪ Aerodynamic drag ▪ Acceleration time ▪ Tractive power ▪ Vehicle rotational inertial factor ▪ Average drag power during acceleration 	2 weeks
6.	Tractive Effort in Normal Driving	<ul style="list-style-type: none"> ▪ Driving cycles ▪ Urban Cycle ▪ Highway cycle ▪ US06 cycle ▪ J227a schedule B ▪ J227a schedule C ▪ J227a schedule D ▪ Specific drive cycle 	1 week
7.	Energy Consumption	<ul style="list-style-type: none"> ▪ Unit of energy ▪ Energy consumption per unit distance ▪ Power losses ▪ Electric motor efficiency characteristics ▪ Regenerative braking factor ▪ Net energy consumption from the batteries 	2 week
8.	Basic Terms of Battery Performance and Characterization	<ul style="list-style-type: none"> ▪ Cell, Module, and Pack ▪ C-rate, Specific energy Specific Power, Energy, Density, Power Density ▪ , Internal Resistance ,Peak Power, Cut-off Voltage ▪ State of Charge, Depth of Discharge ▪ State of Health, Cycle Life, Calendar Life ▪ Battery reversal, Battery Management System, Thermal Management System 	2 week

9.	Battery Charging Methods and EV Charging Scheme	<ul style="list-style-type: none"> ▪ Charging Methods ,constant Voltage, Constant Current, The combination of constant voltage and constant current methods ▪ methods to stop charging ▪ Standards related to electric vehicle charging ▪ EV charging power level ▪ EV charging schemes ▪ Battery Chemistry ▪ Basic Operation of a Rechargeable Battery ▪ Run-Time Battery Characterization and Management ▪ SOC Estimation ▪ Run-Time and Cell-Level Individualized Battery Characterization ▪ Cell Balancing.(Speed of Balancing, Energy Efficiency, Voltage Balancing ▪ Battery Aggregation ▪ Virtual Power Plant Realizations and Control(Direct Control, Hierarchical Control, Distributed Control. 	2 weeks
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طرق التقييم المستخدمة:

التاريخ	نسبة الامتحان من العلامة الكلية	الامتحانات
/ / التاريخ:	40%	الامتحان المتوسط
/ / التاريخ:	10%	أعمال الفصل
/ / التاريخ:	50%	الامتحانات النهائية

طرق التدريس:

❖ Lecture

الكتب و المراجع:

الكتاب المقرر:

1. Modern Electric, Hybrid Electric,
and Fuel Cell Vehicles
Fundamentals, Theory, and Design

SECOND EDITION

. 2010 by Taylor and Francis Group, LLC
CRC Press is an imprint of Taylor & Francis Group, an Informa business

2. Howell D (2011) 2010 Annual progress report for energy storage R&D, Vehicle Technologies Program, Energy Efficiency and Renewable Energy. U.S. Department of Energy, Washington, DC

المراجع: