

Academic Course Description

BHARATH UNIVERSITY
 Faculty of Engineering and Technology
 Department of Electrical and Electronics Engineering

BEE033 ELECTRIC AND HYBRID VEHICLES
Seventh Semester (Odd Semester)

Course (catalog) description

This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles.

Compulsory/Elective course: Elective for EEE students

Credit & Contact hours : 3 and 45 hours

Course Coordinator : Mr.P.Kathiravan

Instructors : Mr.P.Kathiravan

Name of the instructor	Class handling	Office location	Office phone	Email (domain:@bharathuniv.ac.in)	Consultation
Mr.P.Kathiravan	Final year EEE	KS 304	04422290125	kathirped@gmail.com	12.00 to 12.30 pm

Relationship to other courses:

Pre –requisites : BEE101 (Basic electrical and electronics engineering)

Assumed knowledge : This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles.

Syllabus Contents

- UNIT I ELECTRIC VEHICLES 9**
 Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.
- UNIT II BATTERY 9**
 Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.
- UNIT III DC & AC ELECTRICAL MACHINES 9**
 Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV ELECTRIC VEHICLE DRIVE TRAIN**9**

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

UNIT V HYBRID ELECTRIC VEHICLES**9**

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

Text book(s) and/or required materials

T1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.

T2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

Reference Books:

R1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.

R2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000
[.http://nptel.ac.in/courses/108103009/](http://nptel.ac.in/courses/108103009/)

Computer usage:**Nil****Professional component**

General	. 0%
Basic Sciences	. 0%
Engineering sciences & Technical arts	. 0%
Professional subject	0%
Major elective	100%

Broad area : Circuit theory | **Electrical machines** | Electronic | Power system | Control & **Instrumentation**

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	August 1 st week	Session 1 to 19	2 Periods
2	Cycle Test-2	September 2 nd week	Session 17 to 28	2 Periods
3	Model Test	October 2 nd week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles	Correlates to program outcome		
	H	M	L
1. Understand working of different configurations of electric vehicles,	d,i	b,c,d,e g,j,l	f,h,k
2. Understand hybrid vehicle configuration and its components, performance analysis	a,b,c,d,e,i	g,i	f,k
3. Understand the properties of batteries and its types	a,b,c,d,e,i	g,h,j,l	f,l
4. Understand of electric vehicle drive systems.	c,d,e,i	a,b,g,h,j,l	f,k
5. Understand of hybrid electric vehicles.	a,b,c,d,e,i	g,h,j,l	f,k

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

S.NO	Topics	Problem solving (Yes/No)	Text / Chapter
UNIT I ELECTRIC VEHICLES			
1.	Introduction	No	(T1)
2.	Components,	No	
3.	vehicle mechanics	No	
4.	Roadway fundamentals	No	
5.	vehicle kinetics,	No	
6.	Dynamics of vehicle motion	no	
7.	class test	No	
8.	Propulsion System Design.	Yes	
9.	Review of unit-I	No	
UNIT II BATTERY			
10.	Basics Types	No	(T2)
11.	Parameters- Capacity, Discharge rate	No	
12.	State of charge	No	
13.	state of Discharge	No	
14.	Depth of Discharge	No	
15.	Technical characteristics,	No	
16.	Battery pack Design,	No	
17.	Battery pack Design,	No	
18.	Properties of Batteries.	No	
UNIT III DC & AC ELECTRICAL MACHINES			
19.	Motor and Engine rating	Yes	(T1)
20.	Requirements	Yes	
21.	DC machines	No	
22.	Three phase A/c machines	Yes	
23.	Induction machines	No	
24.	permanent magnet machines	No	
25.	switched reluctance machines	Yes	
26.	Review of unit-III	No	
27.	surprise Test	No	
UNIT IV ELECTRIC VEHICLE DRIVE TRAIN			
28.	Transmission configuration	No	(R1)
29.	Components – gears	No	
30.	differential clutch	No	
31.	differential clutch	No	
32.	brakes regenerative braking	No	

33.	brakes regenerative braking	No	
34.	motor sizing	No	
35.	Review of unit-V	No	
36.	surprise Test	No	
UNIT V HYBRID ELECTRIC VEHICLES			
37.	Types	No	(T1)
38.	series configuration	No	
39.	parallel configuration	No	
40.	series and parallel configuration	No	
41.	Design – Drive train	No	
42.	sizing of components.	No	
43.	Review of unit-V	No	
44.	surprise Test	No	
45.	Discussion about University Exam	No	

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Tutorials, which allow for exercises in problem solving and allow time for students to resolve problems in understanding of lecture material.
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignment	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by: Mr.P.Kathiravan

Dated :

Addendum

ABET Outcomes expected of graduates of B.Tech / EEE / program by the time that they graduate:

- a) An ability to apply knowledge of mathematics, science, and engineering fundamentals.
- b) An ability to identify, formulate, and solve engineering problems.
- c) An ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- d) An ability to design and conduct experiments, as well as to analyze and interpret data.
- e) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- f) An ability to apply reasoning informed by the knowledge of contemporary issues.
- g) An ability to broaden the education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- h) An ability to understand professional and ethical responsibility and apply them in engineering practices.
- i) An ability to function on multidisciplinary teams.
- j) An ability to communicate effectively with the engineering community and with society at large.
- k) An ability in understanding of the engineering and management principles and apply them in project and finance management as a leader and a member in a team.
- l) An ability to recognize the need for, and an ability to engage in life-long learning.

Program Educational Objectives

PEO1: PREPARATION

Electrical Engineering Graduates are in position with the knowledge of Basic Sciences in general and Electrical Engineering in particular so as to impart the necessary skill to analyze and synthesize electrical circuits, algorithms and complex apparatus.

PEO2: CORE COMPETENCE

Electrical Engineering Graduates have competence to provide technical knowledge, skill and also to identify, comprehend and solve problems in industry, research and academics related to power, information and electronics hardware.

PEO3: PROFESSIONALISM

Electrical Engineering Graduates are successfully work in various Industrial and Government organizations, both at the National and International level, with professional competence and ethical administrative acumen so as to be able to handle critical situations and meet deadlines.

PEO4: SKILL

Electrical Engineering Graduates have better opportunity to become a future researchers/ scientists with good communication skills so that they may be both good team-members and leaders with innovative ideas for a sustainable development.

PEO5: ETHICS

Electrical Engineering Graduates are framed to improve their technical and intellectual capabilities through life-long learning process with ethical feeling so as to become good teachers, either in a class or to juniors in industry.

Course Teacher	Signature
Mr.P.Kathiravan	

Course Coordinator
(Mr.P.Kathiravan)

HOD/EEE

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