GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering (Electric Vehicle Technology)

Subject Code : 3726403

Subject Name : Automotive Thermal Systems

WEF Academic Year:	2023-24
Semester:	2
Category of the Course:	Program Elective

Prerequisite: None
Rationale:

Course Scheme:

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Course Content:

Sr. No.	Course Content	No. of Hours	% of Weightage
1	**Refrigeration system** Vapor compression refrigeration system, Automobile air conditioning, Air conditioning for passengers, isolated &transport vehicles, Applications related with very low temperatures, Classification, properties and selection criteria of commonly used refrigerants for automobiles, eco-friendly refrigerants for mobile AC, Automatic Climate Control System	7	18
2	**Air Conditioning Systems and Load Analysis** Classification and layouts of mobile air conditioning systems, Components like compressors, evaporators, condensers, expansion devices, fan blowers, heating systems etc. Load Analysis: Load calculations for automobiles, Effect of air conditioning load on engine performance **Air Distribution Systems** Distribution duct system, sizing, supply / return ducts - Types of grills, diffusers, ventilation, air noise level - Layout of duct systems for automobiles and their impact on load calculations	12	26
3	**Battery Thermal Management and Power Electronics:** Electric vehicle technology trends, Requirement of thermal management system for electrical system, Effect of temperature on battery performance, Requirement of battery thermal management system,	18	42

	Failure of battery due to temperature - a case study Thermal resistance concept, Series thermal layers, parallel thermal layers, General resistance networks, Thermal contact resistance, Different battery construction, battery module design parameters Types of battery cooling system for HEV and EV, Active cooling and passive cooling, Air cooling system (Natural / Force), liquid cooling system (Channel- Fin Size and shapes), Phase change material, Heat pipe, hybrid cooling system Battery thermal parameters, Impact of SOC, Voltage and Current effects, Chagrining and Discharging cycles, cycle life analysis, battery capacity degradation, Different battery testing **Battery Heat Transfer, Introduction to battery modeling**: tracking current demand, voltage, and State of Charge as functions of time for given drive cycles Development of thermodynamic relationships for cell heat generation, Lumped cell and pack models for transient temperature response to drive cycles, Model parametric study results		
4	**Thermal Management of Motors:** Motor Sizing vs Heat Generation - Operational Temperature Limitations of Electrical Insulation - Design concepts for Heat Extraction in Motors for EV systems - Modelling and simulation of heat transfer in motors - Rendering of Heat extraction solutions - Sensors and Protection solutions.	8	14
	Total	**45**	**100**

Reference Book:

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Apprise basicknowledge about functional and operational aspects of Refrigeration System.	20%
02	Explain air conditioning system and make calculations for load analysis of Automobile.	20%
03	Evaluate types of automobile batteries for proper functioning and design thermal management system of them.	20%
04	Comprehend the Performance and Battery modeling system of Automobile.	20%
05	Modelling and simulation of heat transfer in motors used in EV Vehicles.	20%

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Suggested Course Practical List:

1. To understand different components of automobile air-conditioning system and to determine its COP.
2. To study about ATC in Modern Automobile.
3. To study about Air Conditioning Systems and Load Analysis of Automobile.
4. To study about duct systems for automobiles and their impact on load calculations.
5. To study about Thermal control in vehicular battery systems.
6. To calculate about heat generation in battery.
7. To study about Heat Extraction in Motors for EV.

List of Laboratory/Learning Resources Required:

- Automobile air-conditioning test rig
- Sectional models of various type of compressors
- Battery modeling system

Activity to be carried out

- Visit of any Electric Vehicle automobile industry

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