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Enrollment No.....



Faculty of Engineering  
End Sem Examination Dec-2023  
AU3EL06 Hybrid Vehicles

Programme: B.Tech.

Branch/Specialisation: AU

Duration: 3 Hrs.

Maximum Marks: 60

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

- Q.1 i. Tractive effort in an EV is generated by: **1**  
(a) Battery (b) Converter  
(c) Driving shaft (d) Motor
- ii. In series hybrid vehicle \_\_\_\_\_ is coupled with the Internal **1**  
combustion engine to produce electricity for propulsion:  
(a) Diesel engine (b) Gas engine  
(c) Hydrogen engine (d) Generator
- iii. Fuel Cell use combination of: **1**  
(a) Zinc & sulphur  
(b) Sulphur & oxygen  
(c) Hydrogen & oxygen  
(d) Sodium & sulphur
- iv. The ultra-capacitors are characterized by: **1**  
(a) Low specific energy  
(b) High specific power and low specific energy  
(c) High specific energy and high specific power  
(d) Low specific power and Low specific Energy
- v. Energy Storage allocation on an EV, \_\_\_\_\_ is the first **1**  
consideration since it limits the vehicle range.  
(a) Specific energy  
(b) Specific power  
(c) Specific power and energy  
(d) None of these

vi.	In case of a C filter, the AC is not allowed to pass to the load by:	1			
	(a) Offering it high impedance				
	(b) Offering it low impedance				
	(c) Short circuiting the AC component				
	(d) Open circuiting the AC component				
vii.	Which motor is suitable for high starting torque?	1			
	(a) DC series motor				
	(b) DC shunt motor				
	(c) DC separately excited motors				
	(d) Synchronous Motor				
viii.	Permanent magnet motors with sinusoidal air gap flux distribution are called:	1			
	(a) Permanent Magnet Synchronous Motors				
	(b) Brushless DC motors				
	(c) Brushless AC motors				
	(d) Permanent Magnet induction Motors				
ix.	For series HEV the relation between acceleration power requirement $P_a$ grade climbing power requirement $P_g$ is:	1			
	(a) $P_a > P_g$ (b) $P_a < P_g$ (c) $P_a = P_g$ (d) Not related				
x.	For Hybridness $H=100\%$ the vehicle is a pure _____ Vehicle:	1			
	(a) Hybrid (b) Mechanical				
	(c) Electric (d) Gasoline				
Q.2	i. Define EV and HEV.	2			
	ii. What is the need and importance of EV and HEV?	3			
	iii. Draw and explain the configurational block diagram of EV.	5			
OR	iv. Draw and explain the architecture of Series -Parallel hybrid electric drive train.	5			
Q.3	Attempt any two:				
	i. State and define the key battery parameters.	5			
	(a) Battery capacity (b) Charging rate				
	(c) State of Charge (d) Specific Energy				
	(e) Energy Density				
	ii. Explain fuel cell as energy source elements in electric and hybrid	5			
	electric vehicles.				
	iii. Explain ultra-capacitors with neat sketch.	5			
Q.4	i. Write the advantages of bidirectional battery charging.	3			
	ii. Explain the battery charging methods used HEV in detail.	7			
OR	iii. Draw & explain high frequency transformer based isolated charger topology.	7			
Q.5	i. What are the considerations to be taken while selecting the motor for EV/HEV applications?	4			
	ii. Elaborate with neat sketch the configuration and control of Induction motor drives.	6			
OR	iii. Explain with sketch the configuration and control of permanent magnet motor drive.	6			
Q.6	Attempt any two:				
	i. Brief about the design of series hybrid electric vehicles.	5			
	ii. Explain power rating of traction motor used in EV/HEV.	5			
	iii. Explain power rating of generator used in EV/HEV.	5			
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**Marking Scheme**  
**Hybrid Vehicles (T) - AU3EL06 (T)**

Q.1	i)	d) Motor		<b>1</b>
	ii)	d) Generator		<b>1</b>
	iii)	c) Hydrogen & oxygen		<b>1</b>
	iv)	b) High specific power and low specific energy		<b>1</b>
	v)	a) Specific energy		<b>1</b>
	vi)	(c) Short circuiting the AC component		<b>1</b>
	vii)	a) DC series motor		<b>1</b>
	viii)	a) Permanent Magnet Synchronous Motors		<b>1</b>
	ix)	b) $P_a < P_g$		<b>1</b>
	x)	c) Electric		<b>1</b>

Q.2	i.	EV	1 Mark	<b>2</b>
		HEV	1 Mark	
	ii.	Need of EV and HEV	1.5 Mark	<b>3</b>
		Importance of EV and HEV	1.5 Mark	
	iii.	Sketch	2 Marks	<b>5</b>
		Explanation	3 Marks	
OR	iv.	Sketch	2 Marks	<b>5</b>
		Explanation	3 Marks	

Q.3	i.	(i) Battery capacity	1 Mark	<b>5</b>
		(ii) Charging rate	1 Mark	
		(iii) State of Charge	1 Mark	
		(iv) Specific Energy	1 Mark	
		(v) Energy Density.	1 Mark	

	ii.	Fuel cell as energy source elements in EV	2.5 Marks	<b>5</b>
		Fuel cell as energy source elements in HEV	2.5 Marks	
OR	iii.	Sketch	1 Mark	<b>5</b>
		Explanation	4 Marks	

Q.4	i.	Any 3 advantages	(1 Mark*3)	<b>3</b>
	ii.	HEV Explanation	(As per explanation)	<b>7</b>
OR	iii.	Sketch	2 Marks	<b>7</b>
		Explanation	5 Marks	

Q.5	i.	Any 4 considerations	(1 Mark*4)	<b>4</b>
	ii.	Configuration of Induction motor	2 Marks	<b>6</b>
		Control of Induction motor drives	2 Marks	
		Sketch	2 Marks	
OR	iii.	Configuration of PM motor	2 Marks	<b>6</b>
		Control of PM motor drives	2 Marks	
		Sketch	2 Marks	

Q.6	i.	Series hybrid electric vehicles.	5 Marks	<b>5</b>
		Explanation		
	ii.	Rating of traction motor used in EV/HEV.		<b>5</b>
		Explanation	5 Marks	
	iii.	Power rating of generator used in EV/HEV.		<b>5</b>
		Explanation	5 Marks	

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