BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M. Tech, M.Sc. **SEMESTER : III/I**
BRANCH: CSE/BT **SESSION : MO/2024**

SUBJECT: EE629 HYBRID ELECTRIC VEHICLE

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Compare the advantages and disadvantages of hybrid electric vehicle (HEV) with IC engine-based vehicle and pure electric vehicle (EV). What are the major components of a HEV?	[5]	I	I
Q.1(b)	What do you mean by series hybrid electric vehicle architecture. Explain with proper block diagram.	[5]	II	II
Q.2(a)	Why variable gear system is required in IC engine based vehicle with manual transmission? Explain with proper torque speed, power-speed characteristics curves of IC engine and an ideal vehicle power plant.	[5]	III	III
Q.2(b)	What is gradeability in vehicle performance? Derive the expression of gradeability using dynamic equation of vehicle motion. How the acceleration performance of any vehicle is obtained.	[5]	IV	III
Q.3(a)	Explain the working principle of four stroke spark ignited (4S SI) IC engine with pressure volume diagram (P-V diagram).	[5]	III	II
Q.3(b)	What is mean effective pressure (mep)? What is the unit of mep? Derive the relation between mep and engine torque.	[5]	III	III
Q.4(a)	Draw a torque-speed and power-speed characteristics of an ideal Electric motor. Does Electric motor directly match the ideal requirement of vehicle power plant characteristics? Explain with appropriate diagrams.	[5]	I	III
Q.4(b)	For a pure EV application, an electric motor of 50 kW power rating having maximum speed of 6000 RPM is required. Draw the torque-speed and power-speed characteristics for the motor indicating peak torque, base speed for three different x values (where x is the speed ratio) as x=2, 4, 6. What arrangements in transmission need to be done in the vehicle having motor with x=2 to achieve similar wheel torque characteristics as the vehicle having motor with x=6 (single gear system).	[5]	IV	V
Q.5(a)	Draw the block diagram of parallel HEV to show the configuration and possible directions of power flow. Also, discuss the advantages and disadvantages of parallel HEV architecture over series HEV.	[5]	V	III
Q.5(b)	What is speed coupling and torque coupling in HEV? Draw the generic characteristics of tractive effort vs speed for a torque-coupled HEV, where IC engine with single gear and electric motor with one gear having x=4 are used.	[5]	V	IV

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