

PART - A

Comprehensive Examination

Second Semester 2021-2022

Name:

Id:

Birla Institute of Technology and Science, Pilani
ME F441: Automotive Vehicles

Close Book 12 Marks

08:00-11:00 AM, 13/05/2022

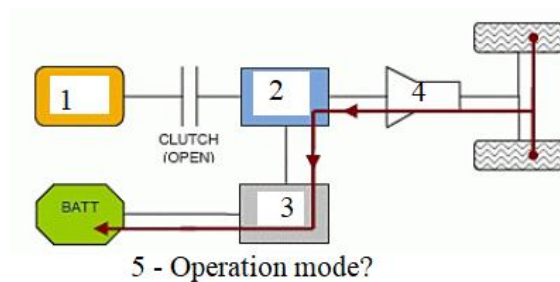
- Instructions:** 1. Please write concisely, legibly and in the space provided only.
2. It is advised to use pencils for drawings due to limited space.
3. All questions are compulsory.

Q1. Match List I with the most suitable items from List II

[2M]

List I	List II	Correct match corresponding to List I
Steam engine	Intake and exhaust valves	
Diesel engine	Low NOx and PM emissions	
Four stroke engine	External combustion engine	
Low temperature combustion engine	Cut-off ratio	

Q2. Shown below is the particular operating mode of a parallel hybrid electric vehicle. Find out each components numbered from 1-4 and the operating mode (number 5) [2.5M]



- | | |
|----|----|
| 1. | 4. |
| 2. | 5. |
| 3. | |

Q3. List the major regulated pollutants in the BS VI emission norm.

[2.5M]

Answer:

Q4. Which type of joint is used to connect the propeller shaft to differential and wheel hubs to the wheels and why? **[2.5M]**

Answer:

Q5. Draw a schematic diagram of MacPherson Struts suspension system showing major components and joints. **[2.5M]**

PART - B
Comprehensive Examination
Second Semester 2021-2022

Name:

Id:

Birla Institute of Technology and Science, Pilani
ME F441: Automotive Vehicles

Open Book 28 Marks

08:00-11:00 AM, 13/05/2022

- Instructions:** 1. Please write concisely and legibly. Final answers should be clearly marked.
2. Draw neat labelled diagrams wherever necessary.
3. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
4. Assumptions made if any, should be stated clearly at the beginning of your answer.
5. All questions are compulsory.
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Q1. A goods carrying vehicle of gross weight 12400 N is travelling on a wet road with a coefficient of adhesion of 0.3 and brakes are fitted on all wheels. It has wheel base 4.9 m and its CG is 0.76 m above the ground and 3.04 m behind the front axle. If the vehicle is going up an incline given by $\sin \theta = 0.1$. Determine the following: **[8M]**

- (i) Ratio of braking forces on front and rear wheels if skidding is just avoided.
(ii) The stopping distance from speed of 50 km/h

Note: You need to show all the calculation steps (don't use direct formulae) and schematic diagram of the system.

Q2. How a hybrid electric vehicle is different from an electric vehicle? Explain the system architecture of a combined hybrid electric vehicle with the help of diagrams. **[5M]**

Q3. A rear-wheel drive automobile weighing 14715 N is powered by an engine producing 80.2 kW at the speed of 2400 rpm. The vehicle has a frontal area of 2.23 m² and has a wheel diameter of 0.71 m. The rolling resistance coefficient is 0.021 and the air resistance coefficient is 0.03679 in the formula, total resistance = $K_r W + K_a A V^2 N$, where A is in m² and V in km/h.

The automobile has a four speed manual synchronous gearbox. With transmission efficiency of 80% at the first gear, maximum gradient that it has to negotiate is 1 in 4. On the other hand, with transmission efficiency of 90% at the top gear, the car is expected to go over a gradient of 1 in 40. **[10M]**

- (i) Assuming unit (one) gear ratio for the top gear, find out the gear ratio for first gear.

(ii) Based on the results obtained, draw a schematic diagram of this gearbox.

Hint: You may assume appropriate gear ratios for the remaining gears.

(iii) Draw a schematic diagram of the complete powertrain for this system.

Q4. A 2.1 litre, four stroke, four-cylinder CI engine is tested at 3000 rpm. It was found that the engine produces 36 kW brake power at 30% efficiency. The calorific value of fuel is 42000 kJ/kg, Air-fuel ratio is 24:1, mechanical efficiency is 80%, combustion efficiency is 98% and density of air is 1.181 kg/m^3 . Then determine the following: **[5M]**

(i) Fuel flow rate (kg/s)

(ii) Air flow rate (kg/s)

(iii) Brake output per displacement (kW/l)

(iv) Brake specific fuel consumption (kg/kWh)

(v) Brake mean effective pressure (kPa)
