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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Fifth Semester

Automobile Engineering

AT 2303/AU 53/10122 AU 505 — VEHICLE DESIGN AND DATA CHARACTERISTICS

(Regulation 2008/2010)

Time : Three hours

Maximum : 100 marks

Graph sheet is to be supplied.

Assume reasonable data wherever necessary.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the important assumptions to be made in designing a vehicle?
2. Define gradability of the vehicle.
3. Give the values of rolling resistances for different types of road.
4. "When the vehicle speed doubles, the air resistance quadruples" — Justify.
5. How will you estimate the mechanical efficiency?
6. Write typical values of the weight of reciprocating parts corresponding to cylinder bore.
7. "Piston velocity and acceleration are inter related"-Justify.
8. What is the significance of combined turning moment produced inside the engine?
9. Derive the expression for vehicle speed in terms of Engine speed.
10. Define drawbar pull.

PART B — (5 × 16 = 80 marks)

11. (a) Explain the steps involved in vehicle design. (16)

Or

(b) An eight cylinder automobile engine of 85.7 mm bore and 82.5 mm stroke with a compression ratio of 7 is tested at 4000 rpm on a dynamometer which has a 0.5335 m arm. During a 10 minute test at a dynamometer scale beam reading of 400 N, 4.55 kg of gasoline for which the heating value is 46,000 kJ/kg are burnt, and air is supplied to the carburetor at the rate of 5.44 kg/mm. Find (i) the b.p delivered, (ii) the b.m.e.p, (iii) the b.s.f.c, (iv) the specific air consumption, and (v) the brake thermal efficiency. (16)

12. (a) A motor car weighs 11212.8 N and the engine develops 41 kW brake power at 4500 r.p.m. The combined air and rolling resistance is given by the formula $R = 408.2 + 0.0515\ V^2$, where R is in N and V in km/hr. The performance characteristics are such that it will reach 120.5 km per hour at 4500 r.p.m. and full throttle when engine is running in still air and at the same speed in second gear it will just climb a gradient of 1 in 10. The top and the second gear ratios are 5:1 and 8:1 respectively.

(i) Calculate the efficiency of transmission on top and second gear. (8)

(ii) Calculate the engine power required for second gear with same efficiency of transmission as in the earlier case when climbing up the gradient of 1 in 20 at 48 km/hr. (8)

Or

(b) A truck weighing 101010 N and the engine develops 97 kW brake power at 2400 rpm. The transmission efficiency is 90% in top gear of 3.4:1 and 85% in third gear of 8.4:1 The performance of the vehicle is such that it will just reach a speed of 86.8 km/hr at 2400rpm at wide open throttle when running on the level in still air, and at the same engine speed in third gear it will just climb a gradient of 1 in 14. If the total resistance in N is given by the formula $R = KW + K_aAV^2 + W \sin\theta$ where A is in m^2 and W in N, calculate K and K_a and hence the engine power required for climbing a grade of 1 in 40 at 48 km/hr in top gear.

13. (a) Assuming suitable data, plot the variation of Torque and Mechanical efficiency with respect to different vehicle speeds. (16)

Or

(b) Explain the procedure to find the displacement, velocity, Acceleration and inertia forces with help of relevant sketches. (16)

14. (a) The engine of a truck gave the following results on testing:

Speed (rpm)	600	1200	2000	2800	3600	4000	4300	4600
Power developed (kW)	22.1	46.3	86.1	129.4	164.8	175.8	177.3	169.2

The transmission efficiency is 85%, the truck has a projected frontal area of 5.5 m^2 and gross vehicle weight of 266741N, coefficient of rolling resistance K = 0.012 and coefficient of air resistance Ka = 0.0045. Find, what is the maximum possible gradability of the vehicle at 60 km/hr, if N/V ratio is 125. Also find what will be the gradability if N/V is 80. (16)

Or

(b) Derive the expressions for turning moment and side thrust with help of suitable diagrams and plot them against displacement. (16)

15. (a) (i) Explain the need for a gear box in the automobile. (8)

(ii) Briefly explain the procedure of calculation of gear ratios for a small car. (8)

Or

(b) A vehicle with a normal laden weight of 10 kN gives the following acceleration in top gear:

Vehicle speed km/hr	20	40	60	80	110
Acceleration m/s^2	0.75	0.84	0.77	0.55	0

When the vehicle is running at 110 km/hr, the engine develops 35.6 BHP. The vehicle tyres were changed and the new tyres have their rolling radius 0.9 times the rolling radius of old tyres. Find the gradability of the vehicle in top gear with new tyres. (16)