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B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 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. Write short notes on design parameters of a vehicle.

2. What is the general classification of road vehicles?

3. List out the various factors which affect the rolling resistance.

4. How does the gross vehicle weight of the vehicle influences the power required for propulsion?

5. Study of engine characteristics is essential for vehicle performance calculations- Justify.

6. Mention the various factors that influence brake mean effective pressure of an engine.

7. An IC engine runs at 1500 rpm. The length of the connecting rod and crank radius are 480 mm, 120 mm respectively. Find the linear acceleration of the piston, at 45° angular position of the crank.

8. Show the various forces acting on the piston, connecting rod and crank mechanism with the help of simple sketch.

9. How are intermediate gears decided?

10. What limits the maximum possible road speed?

PART B — (5 × 16 = 80 marks)

11. (a) Discuss about the design variables and operating variables which are affecting performance of a vehicle.

Or

(b) Plot and discuss the typical road performance curves with respect to acceleration gradiability and draw bar pull.

12. (a) A motor car weighing 13.3 kN and has an engine developing 40.5 kW at 4000 rpm. The transmission system has an efficiency of 90 % in top gear and 85 % in second gear. The top gear ratio is 1:1 and the second gear ratio 1.64:1, when running on level road with wide open throttle, the car reaches 112 km/h at 4000 rpm and at the same engine speed in second it will climb a hill of 1 in 12. If the resistance to motion on level road is given by the formula $R=A+BV^2$, calculate A and B. Compute the maximum speed with which the car can climb a grade of 1 in 12 in top gear and the corresponding engine speed. Assume the engine power is proportional to the speed in the above range.

Or

(b) The coefficient of rolling resistance for a truck weighing 62 kN is 0.018 and the coefficient of air resistance is 0.028 in the formula $R = KW + K_sAV^2$ in N where A is m^2 of frontal area and V the speed in km/h. The transmission efficiency in top gear of 6.2 : 1 is 90 % and that in the second gear of 15: 1 is 80%. The frontal area is 5.5 m^2. The truck has to have a maximum speed of 88 km/hr in top gear.

(i) Find the engine BP required

(ii) Find the engine speed if the driving wheels have an effective diameter of 0.80 m

(iii) Calculate the maximum grade the truck can negotiate at the above engine speed in second gear and

(iv) Calculate the maximum draw bar pull available on level road at the above engine speed in second gear.

13. (a) While testing a four cylinders automobile petrol engine of bore 85 mm and stroke 92.2 mm at 3000 rpm on a test stand, the following data were obtained;

Indicated mean effective pressure ;

Fuel consumption = 1.36 kg = 96.14×10^4 N/m^2

Engine torque developed = 135.6 N-m ;

Duration of test = 5 min

Heating value of petrol is 46.40 MJ/kg, calculate

(i) indicated power of the engine

(ii) Brake power

(iii) mechanical efficiency

(iv) overall thermal efficiency of the engine.

Or

(b) The following data refers to an automobile engine running under certain operating conditions:

Thermal efficiency = 22% Volumetric efficiency= 80 %

Mechanical efficiency = 82% Heating value of petrol = 46.4 MJ/kg

Theoretical air required per kg petrol = 14.5; Excess of air =25%

Gas constant for air =287J/kg K; Rated engine power = 66 kW @4200 rpm

Assume stroke is 25 % greater than the diameter.

Petrol vapour has density twice the density of air and mixture at the end of the suction stroke is at a pressure of 82.4 kN/m^2 and a temperature of 333 K. Find the dimensions of the six cylinder engine.

14. (a) Derive the equations for calculating the displacement, velocity and acceleration of piston and connecting rod of an IC engine.

Or

(b) The turning moment diagram for a multi cylinder engine has been drawn to a vertical scale of 1 mm = 650 N-m and a horizontal scale of 1 mm = 4.5°. The areas above and below the mean torque line are -28, +380,-260, +310, -300,+242, -380,+265 and -229 mm^2. The fluctuation of speed is limited to ± 1.8% of the mean speed which is 400 rpm. Density of the rim material is 7000 kg/m^3 and width of the rim is 4.5 times its thickness. The centrifugal stress (hoop stress) in the rim material is limited to 6 N/mm^2. Neglecting the effect of boss and arms, determine the diameter and cross section of the flywheel rim.

15. (a) A four speed gear box is to have the following gear ratios 1.00:1, 1.50:1 2.48: and 3.93:1. The centre distance between the lay shaft and the main shaft is 73.12 mm and the smallest pinion is to have at least 12 teeth with a diametral pitch of 3.25 mm. Find the number of teeth of the various gear wheels. Also find the exact gear ratios.

Or

(b) (i) Plot and discuss the curves between the road speed and the power available at road wheels at different gear ratios. (8)

(ii) A truck has a gross vehicle weight of 89 kN. Engine displacement is 10 m^3, power 77.3 kW at governed speed of 2400 rpm and maximum torque 346 N-m at 1400 gear reduction is 6.16:1, drive line losses amount to 10.7 kW at 2400 rpm and 6.3kw at 1400 rpm. Effective wheel diameter is 0.95 m, frontal area of the truck is 6.95 m^2.Calculate the grade which the vehicle can climb in fourth gear in still air condition at governed engine speed. (8)