Q. Code:464106

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Sixth Semester

AE18604 – VEHICLE DESIGN DATA CHARACTERICTICS

(Automobile Engineering)

(Regulation 2018/2018A)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Examine the assumptions in basic design of vehicle and discuss the effect of design and operating variables on performance and emission.	**3**
CO 2	Examine and compare the various resistances acting on the vehicle.	**3**
CO 3	Investigate the performance characteristics of internal combustion engines.	**4**
CO 4	Solve velocity and acceleration of piston against crank angle and examine the performance characteristic of forces and moments acting on the piston.	**3**
CO 5	Use the basic principles to design the gearbox of the vehicle.	**4**

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	How dry weight of a vehicle is determined and why is it crucial for shipping and transporting via large trucks?	**1**	**3**
2.	Identify any two design considerations of a vehicle.	**1**	**2**
3.	How the weight of the vehicle influences the gradient resistance?	**2**	**2**
4.	With the help of suitable illustration, how will you determine the vehicle speed at maximum acceleration for a small passenger car?	**2**	**2**
5.	Compare the under square and over square engine.	**3**	**3**
6.	Interpret how the variation in stroke length influences the power output.	**3**	**2**
7.	Illustrate the turning moment diagram for a typical single cylinder four stroke engine.	**4**	**2**
8.	Identify the significance of side thrust acting on the piston.	**4**	**2**
9.	In what way automatic transmission system is advantageous over a manual transmission system.	**5**	**3**
10.	Elucidate the importance of the over drive in a transmission system.	**5**	**2**

PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	Investigate the most influencing design and operating variables affecting	**(14)**	**1**	**3**

the performance of a compression ignition engine.

(OR)

(b)	**(i)**	Discover and explain the method to measure the frictional power of a multi cylinder SI engine.	**(7)**	**1**	**3**
	(ii)	Determine the brake thermal efficiency, indicated thermal efficiency, mean effective pressure of cyliner and petrol consumption per bkWh of a four stroke four cylinder inline engine with the following specifications. Bore = 101 mm, Stroke = 114 mm, Speed = 1600 rpm , Fuel consumption = 0.204 kg/mm, Heating value of the fuel = 41800 kJ /kg, Difference in tension on either side of brake pulley = 378 N, Brake circumference = 3.35 m and mechanical efficiency = 83 %.	**(7)**	**1**	**3**

12. (a)		A fully loaded truck weighs 100111 N and the engine develops 97 kW 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/h at 2400 rpm 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 R in N is given by the formula. $R = KW + K_a AV^2 + W \sin \theta$ Where K is Coefficient of Rolling resistance, K_a is Coefficient of Air resistance, A is m^2 of frontal area and V the speed in km/h. calculate i) K, K_a and hence the engine power required for climbing a grade of 1 in 40 at 48 km/h in top gear. ii) How much more weight can be added to the vehicle to use the engine power fully under the above condition. Frontal area of truck is given as 5.575 m^2.	**(14)**	**2**	**3**

(OR)

(b)		With the specification of a model car, calculate the rolling resistance, air resistance, total resistance and tractive force at any velocity.	**(14)**	**2**	**3**

13. (a) It is assumed that an automobile engine can operate at a thermal efficiency of 22 % when operating conditions are as follows: **(14) 3 4**

Volumetric efficiency is 80%, Mechanical efficiency is 82 %, Heating value of petrol is 46400 kJ/kg, Theoretical air required per kg of petrol 14.5, Excess air supplied is 25 %, Petrol vapour has density twice the density of air, the mixture at the end of suction stroke is at a pressure of 8.24 x 10^4 N/m² and a temperature of 333 K, Gas constant for air is 287.14 kJ/kgK. Find the cylinder dimensions of a six cylinder engine for the above conditions when the engine develops its rated power of 66 kW at 4200 rpm. Assume that the stroke is 25 % greater than the diameter.

(OR)

(b) With the help the pressure-volume diagram, determine the mean effective pressure of a four stroke petrol engine with a compression ratio 8:1 and the suction pressure 0.97 MPa. **(14) 3 4**

14. (a) With the suitable illustration identify the various forces acting on the piston and connecting rod and derive the expressions for the same. **(14) 4 3**

(OR)

(b) The following details are given for the piston, during expansion stroke. **(14) 4 3**

Crank angle	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
Gas pressure (kg/cm²)	50.5	52.5	32.5	24.9	14.5	11.2	9.4	7.5	5.8	4.5	4	3.5	2.25

Find the gas force, inertia force and resultant force. Assume Bore area as 49cm² stroke length as7.9 cm.

15. (a) Sketch a section through a sliding type gearbox with four forward and one reverse speeds and explain clearly how the different speed ratios will be obtained in the following cases: **(14) 5 4**

Gear ratio on top gear = 1:1
Gear ratio on third gear = 1:38:1
Gear ratio on second gear = 2.24:1
Gear ratio on first gear = 3.8:1
Gear ratio on reverse gear = 3.8:1

Assume counter shaft or layout shaft speed is half that of the engine speed and the smallest gear is not to have less than 15 teeth.

(OR)

(b)	How is the vehicle speed related to engine rotation? For typical motor car, the road resistance is given by 23 N per 1000 N, the air resistance by the expression 0.0827 V^2, transmission efficiency 88 % in top speed; car weight 20 kN when fully loaded. Calculate i) The brake power required for a top speed of 144 km/h (The acceleration in m/s^2 at 48 km/h, assuming. the torque at 48 km/h, in the top gear 25% more than at 144 km/h. ii) The brake power required to drive the car up a gradient of 1 in 5 at 48 km/h, transmission Efficiency 80% in bottom gear. The resistance being in N and V the speed in km/h and g = acceleration due to gravity = 9.81 m/s^2.	**(14)**	**5**	**4**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	How does the inclusion of a gearbox enhance automotive functionality? Summarize the methodology employed to derive gear ratios, particularly in the context of optimizing performance for compact vehicles.	**(10)**	**5**	**4**

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