Q. Code:504046

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

B. E / B. TECH.DEGREE EXAMINATION, MAY 2023

Sixth Semester

AE18601 - AUTOMOTIVE COMPONENTS DESIGN

(Automobile Engineering)

(Regulation 2018)

(Use of Approved Design Data Book is permitted)

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

CO1 Students will be able to discuss the design procedure for cylinder, piston and connecting rod o engines.

CO2 Students will be able to design and examine the engine crankshaft and flywheel.

CO3 Students will be able to design and analyze the clutch and gear box of automotive vehicles.

CO4 Students will be able to design and compare the various drive line components.

CO5 Students will be able to classify and design the various types of vehicle frame and suspensioı elements.

PART- A (10x2=20Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Identify the most commonly used materials for engine cylinder.	**1**	**3**
2.	What is the function of a piston used in an internal combustion engine?	**1**	**2**
3.	Identify the various stresses acting on crankshaft.	**2**	**3**
4.	Draw the turning moment diagram of a flywheel for a four-stroke internal combustion engine.	**2**	**2**
5.	Compare single plate clutch with multi plate clutch.	**3**	**2**
6.	What is the main function of gearbox? List out its types.	**3**	**3**
7.	Write down the expression for calculating critical speed of propeller shaft.	**4**	**3**
8.	Elucidate four main differences between semi floating rear axle and full floating rear axle.	**4**	**2**
9.	List out the different types of chassis frames and loads transfer on chassis.	**5**	**2**
10.	What do you infer from full length and graduated leaves of a leaf spring?	**5**	**2**

PART- B (5x 14=70Marks)

		Marks	CO	RBT LEVEL
11. (a)	Design a cast iron trunk type piston for a single acting four stroke diesel engine developing 100 kW per cylinder when running at 2800 r.p.m. The other available data is as follows: Cylinder bore = 120 mm; Maximum gas pressure = 5 N/mm^2; Indicated mean effective pressure = 0.8 N/mm^2; Mechanical efficiency = 92%; Stroke length = 130 mm; Fuel consumption = 0.4 kg/BP/hr; Higher calorific value of fuel = 42×10^3 kJ/kg; Difference of temperatures at the centre and edges of the piston head = 200ºC; Allowable stress for the material of the piston head = 40 N/mm^2; Allowable bearing pressure on the piston barrel = 0.4 N/mm^2; Coefficient of friction is 0.3. Any other data required for the design may be assumed.	**(14)**	**1**	**3**
	(OR)			
(b)	Design a connecting rod for an I.C. engine running at 1800 r.p.m. and developing a maximum pressure of 3.15 N/mm^2. The diameter of the piston is 100 mm; mass of the reciprocating parts per cylinder 2.25 kg; length of connecting rod 380 mm; stroke of piston 190 mm and compression ratio 6:1. Take a factor of safety of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2 and the corresponding bearing pressures as 10 N/mm^2 and 15 N/mm^2. The density of material of the rod may be taken as 8000 kg/m^3 and the allowable stress in the bolts as 60 N/mm^2 and in cap as 80 N/mm^2. The rod is to be of I-section for which you can choose your own proportions. Draw a neat dimension sketch showing provision for lubrication. Use Rankine formula for which the numerator constant may be taken as 320 N/mm^2 and the denominator constant 1/7500. Any other data required for the design may be assumed.	**(14)**	**1**	**3**
12. (a)	Design a plain carbon steel centre crankshaft with a bending moment for a single acting four stroke single cylinder engine for the following data: Bore = 400 mm; Stroke = 600 mm; Engine speed = 200 r.p.m.; Mean effective pressure = 0.5 N/mm^2; Weight of flywheel used as a pulley = 50 kN; Total belt pull = 6.5 kN. When the crank has turned through 35° from the top dead centre, the pressure on the piston is 1N/mm^2; Maximum combustion pressure = 2.5 N/mm^2 and the torque on the crank is maximum. The ratio of the connecting rod length to the crank radius is 5. Distance between the bearings 1 and 2 is equal to twice the piston diameter. Permissible bearing pressure is 10 N/mm^2. Allowing space for gearing and clearance is 800 mm. Bending stress in the crank pin is 75 N/mm^2. Shear stress in the crank pin is 35 N/mm^2. Shear stress in the crank arm is 42 N/mm^2. Assume any other data required for the design.	**(14)**	**2**	**3**
	(OR)			

(b)	The intercepted areas between the output torque curve and the mean resistance line of a turning moment diagram for a multi cylinder engine, taken in order from one end are as follows: – 45, + 420, – 295, + 335, – 345, + 270, – 375, + 295, – 260 mm^2. The diagram has been drawn to a scale of 1 mm = 75 N-m and 1 mm = 4.5°. The engine speed is 900 r.p.m. and the fluctuation in speed is not to exceed 2% of the mean speed. Find the mass and cross-section of the flywheel rim having 700 mm mean diameter. The density of the material of the flywheel may be taken as 7500 kg / m^3. The rim is rectangular with the width 2.5 times the thickness. Neglect effect of arms, etc. Assume any other data required for the design.	**(14)**	**2**	**3**
13. (a)	A plate clutch having a single driving plate with contact surfaces on each side is required to transmit 110 kW at 1250 r.p.m. The outer diameter of the contact surfaces is to be 300 mm. The coefficient of friction is 0.4. a) Assuming a uniform pressure of 0.17 N/mm^2; determine the inner diameter of the friction surfaces. b) Assuming the same dimensions and the same total axial thrust, determine the maximum torque that can be transmitted and the maximum intensity of pressure when uniform wear conditions have been reached. Assume any other data required for the design.	**(14)**	**3**	**3**
	(OR)			
(b)	Sketch the section through the sliding type gear box with a four forward and reverse speed explain clearly how the different speed ratios will be obtained in the following cases: Gear ratio on the top gear is 1:1, Gear ratio on the 3rd gear is 1.38 :1, Gear ratio on the 2nd gear is 2.24 :1, Gear ratio on the 1st gear is 3.8 :1, Gear ratio on the reverse gear is 3.8 :1, Assume counter shaft or lay shaft speed is half that of the engine speed and the smallest gear is not to have less than 15 teeth. Assume any other data required for the design.	**(14)**	**3**	**3**
14. (a)	An engine develops 30 kw at 2500 rpm when the torque developed is maximum. The bottom gear ratio is 3:1 and back axle reduction is 4.5:1. The load on each driving axle is 8000 N when the car is fully loaded. Diameter of road wheel over the tyre is 0.71 m and coefficient of adhesion between tyre and road is 0.8. if the permissible stress in the material of the shaft is not allowed to exceed 23000 x 10^4 N/m^2. Find the diameter of the axle shaft and frictional force on each wheel. Any other data required for the design may be assumed.	**(14)**	**4**	**3**
	(OR)			

(b)	A six cylinder four stroke cycle engine with a capacity of 2500 x 10^{-6} m^3 is operating at 4500 rpm and developing 650 kN/m^2 brake mean effective pressure. If the final drive ratio is 4.2:1 and the transmission efficiency in top gear is 90%. Determine power at the road wheel when the top gear is engaged. If the vehicle is negotiating a road band and the inside road wheel are making 280 rpm and also calculate the rpm of the outer wheel and torque and power at the both outer and inner wheels. Any other data required for the design may be assumed.	**(14)**	**4**	**3**
15. (a)	Calculate the maximum bending moment and maximum section modulus assuming the following particulars. Wheel base = 200 m; Overall length = 400 m; Equal overhang on either side. 290 kN acting at CG of load 50 m in front of front axle. 200 kN acting at CG of load 50 m behind front axle. 180 kN acting at CG of load 50 m in front of rear axle. 110 kN acting at CG of load 50 m behind the real axle. In addition, there is a uniformly distributed load of 2.5 kN per m run over the entire length of the chassis. Assume dynamic stress = twice the static stress induced. Also bending stress f_b = 500 kN/m^2. Any other data required for the design may be assumed.	**(14)**	**5**	**3**
	(OR)			
(b)	Design a helical compression spring for a maximum load of 1500 N for a deflection of 30 mm using the value of spring index as 5. The maximum permissible shear stress for spring wire is 520 MPa and modulus of rigidity is 90 kN/mm^2. Any other data required for the design may be assumed.	**(14)**	**5**	**3**

PART- C (1x 10=10Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	A truck spring has 12 number of leaves, two of which are full length leaves. The spring supports are 1.05 m apart and the central band is 85 mm wide. The central load is to be 5.4 kN with a permissible stress of 280 MPa. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring. Take Young's modulus of the material is 2.1 x 10^5 N/mm^2. Any other data required for the design may be assumed.	**(10)**	**5**	**3**

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