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

Sixth Semester

AE18601 – AUTOMOTIVE COMPONENTS DESIGN

(Automobile Engineering)

(Regulation 2018/2018A)

(Use of Approved Design Data Book is permitted)

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

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Discuss the design procedure for cylinder, piston and connecting rod of engines.	**3**
CO 2	Design and examine the engine crankshaft and flywheel.	**3**
CO 3	Design and analyze the clutch and gear box of automotive vehicles.	**3**
CO 4	Design and compare the various drive line components.	**3**
CO 5	Classify and design the various types of vehicle frame and suspension elements.	**3**

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Discuss the design considerations for pistons in an internal combustion engine.	**1**	**2**
2.	What are the various forces acting on the connecting rod in an internal combustion engine?	**1**	**2**
3.	What materials are most commonly utilized for constructing crankshafts?	**2**	**2**
4.	Write an equation for the coefficient of fluctuation of the speed of the flywheel.	**2**	**2**
5.	Mention any two material properties for designing a friction clutch.	**3**	**2**
6.	Compare constant mesh box with sliding mesh gear box?	**3**	**3**
7.	Write down the expression for calculating critical speed of propeller shaft.	**4**	**2**
8.	Elucidate four main differences between three quarter floating rear axle and full floating rear axle.	**4**	**3**

9.	List out the different types of chassis frames and loads transfer on chassis.	**5**	**2**	
10.	Identify the most commonly used materials for leaf springs.	**5**	**2**	

PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	Design a aluminium alloy trunk type piston for a single acting four stroke petrol engine developing 100 kW per cylinder when running at 2800 r.p.m. The other available data is as follows: Cylinder bore is 100 mm; maximum gas pressure is 6 N/mm^2; indicated mean effective pressure is 0.7 N/mm^2; mechanical efficiency of the engine is 90%; stroke length is 130 mm; fuel consumption of the petrol engine is 0.5 kg/BP/hr; higher calorific value of fuel of the petrol is 47×10^3 kJ/kg; difference of temperatures at the centre and edges of the piston head is 100ºC; allowable stress for the material of the piston head is 35 N/mm^2; allowable bearing pressure on the piston barrel is 0.5 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 wrought iron type of connecting rod for an internal combustion engine running at the speed of 2000 r.p.m. and developing a maximum pressure of 4 N/mm^2. The diameter of the piston is 100 mm; mass of the reciprocating parts per cylinder 3 kg; length of connecting rod is 380 mm; stroke of piston is 190 mm and the compression ratio is 8:1. Take a factor of safety is 5 for the design. Take length to diameter ratio for big end bearing as 1.5 and small end bearing as 2 and the corresponding bearing pressures as 12 N/mm^2 and 15 N/mm^2. The density of material of the rod may be taken as 9000 kg/m^3 and the allowable stress in the bolts as 70 N/mm^2 and in cap as 85 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 350 N/mm^2 and the denominator constant 1/9000. Any other data required for the design may be assumed.	**(14)**	**1**	**3**

12. (a)	Design a alloy cast iron centre crankshaft with a bending moment for a single acting four stroke single cylinder diesel engine for the following data: Cylinder bore is 300 mm; length of the stroke is 600 mm; diesel engine speed is 300 r.p.m.; mean effective pressure is 0.6 N/mm^2; weight of flywheel used as a pulley is 60 kN; total belt pull is 7.5 kN. When the crank has turned through 30° from the top dead centre, the pressure on the piston is 1.5 N/mm^2; maximum combustion pressure is 3 N/mm^2 and the torque on the crank is maximum. The ratio of the connecting rod length to the crank radius is 6. Distance between the bearings 1 and 2 is equal to twice the piston diameter. Permissible bearing pressure is 12 N/mm^2. Allowing space for gearing and clearance is 900 mm. Bending stress in the crank pin is 80 N/mm^2. Shear stress in the crank pin is 40 N/mm^2. Shear stress in the crank arm is 45 N/mm^2. Assume any other data required for the design.	**(14)**	**2**	**3**
	(OR)			
(b)	A single cylinder double acting steam engine develops 150 kW at a mean speed of 80 r.p.m. The coefficient of fluctuation of energy is 0.1 and the fluctuation of speed is ± 2% of mean speed. If the mean diameter of the flywheel rim is 2 meters and the hub and spokes provide 5 percent of the rotational inertia of the wheel. Find the mass of the flywheel and cross-sectional area of the rim. Assume the density of the flywheel material for the cast iron is 7200 kg/m^3. Assume any other data required for the design.	**(14)**	**2**	**3**
13. (a)	A multiple disc clutch, steel on bronze, is to transmit a power of 4.5 kW at 750 r.p.m. The inner radius of the contact is 40 mm and outer radius of the contact is 70 mm. The clutch operates in oil with an expected coefficient of 0.1. The average allowable pressure is 0.35 N/mm^2. Find: 1. the total number of steel and bronze discs; 2. the actual axial force required; 3. the actual average pressure; and 4. the actual maximum pressure. Assume uniform wear condition.	**(14)**	**3**	**3**
	(OR)			
(b)	An automotive gear box gives three forward speeds and one reverse with a top gear of unity and bottom and reverse gear ratio of approximately 3.3:1. The center distance between the shafts is to be 110 mm approximately.	**(14)**	**3**	**3**

Gear teeth module 3.25 mm are to be employed.
Sketch the layout of typical constant mesh gear box for these conditions giving the number of teeth for the various gear wheels and showing closely how the different ratios are obtained.

14. (a)	An automobile engine develops a maximum torque of 150 Nm. The low gear ratio of transmission is 3, while the rear axle ratio is 4.5. The effective wheel radius is 0.4 m and coefficient friction between the tyre and road surface is 0.45. If the permissible shear is 450 N/mm^2. Determine the maximum shaft diameter, assuming that the load is nearly torsional. What is the maximum load permissible on each wheel? Any other data required for the design may be assumed.	**(14)**	**4**	**3**
	(OR)			
(b)	Derive an expression for bearing loads resulting from lateral thrust on a semi-floating axle.	**(14)**	**4**	**3**
15. (a)	Calculate the maximum bending moment and maximum section modulus assuming the following particulars. Wheel base of the vehicle is 200 cm; Overall length = 400 cm; Equal overhang on either side. 2.5 kN acting at CG of load 50 cm in front of front axle. 2 kN acting at CG of load 50 cm behind front axle. 1.8 kN acting at CG of load 50 cm in front of rear axle. 1.1 kN acting at CG of load 50 cm behind the real axle. In addition, there is a uniformly distributed load of 3 kN/m run over the entire length of the chassis. Assume dynamic stress is four times the static stress induced. Also the bending stress is 6.5x10^7 N/m^2. Any other data required for the design may be assumed.	**(14)**	**5**	**3**
	(OR)			
(b)	Design a helical spring for a spring loaded safety valve (Rams bottom safety valve) for the following conditions: Diameter of valve seat is 65 mm; Operating pressure is 0.7 N/mm^2; Maximum pressure when the valve blows off freely is 0.75 N/mm^2; Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm^2 is 3.5 mm; Maximum allowable stress is 550 MPa; Modulus of rigidity is 84 kN/mm; Spring index is 6. Draw a neat sketch of the free spring showing the main dimensions.	**(14)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Determine the maximum, minimum and average pressure in a plate clutch when the axial force is 4 kN. The inside radius of the contact surface is 50 mm and the outside radius is 100 mm. Assume uniform wear.	**(10)**	**3**	**3**

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