GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2024

Subject Code:3170202   **Date:04-12-2024**
Subject Name: Automotive Component and system Design
Time:10:30 AM TO 01:30 PM   **Total Marks:70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **PSG design data book is permitted during university exam.**

                                                                                    MARKS

Q.1 **(a)** Define standardization. Enlist different standards used in mechanical engineering design.   **03**

(b) Explain with suitable example basic series' and 'derived series.   **04**

(c) Select a single row deep groove ball bearing with the operating cycle listed below, which will have a life of 15000 hours.   **07**

Fraction of cycle	Type of load	Radial (N)	Thrust (N)	Speed (RPM)	Service factor
1/10	Heavy shocks	2000	1200	400	3.0
1/10	Light shocks	1500	1000	500	1.5
1/5	Moderate shocks	1000	1500	600	2.0
3/5	No shock	1200	2000	800	1.0

Take radial and axial load factors to be 1.0 and 1.5 respectively and inner race rotates.

Q.2 **(a)** Explain the ergonomic considerations in design.   **03**
(b) Explain different types of fits with neat sketch.   **04**
(c) Design a pair of spur gear to transmit 15 kW power from electric motor shaft running at 1500 rpm to a machine shaft from the following specifications: **07**
Tooth system = 20^0 pressure angle full depth involute.
Number of teeth on pinion = 25
Speed reduction ratio = 3:1
Service factor = 1.25
Material of pinion and gear = FG 200
Design bending stress of the material = 60 MPa
Surface hardness of pinion and gear = 200 BHN
Endurance strength of the material = 84 MPa
Dynamic load factor = 178 N/mm
Modulus of elasticity = 1.1 x 10^5 MPa
Assume pitch line velocity as 7.5 m/sec for initial module calculation.

(c) The cylinder of a four-stroke diesel engine has the following specifications: **07**
Cylinder bore = 150 mm
Maximum gas pressure = 3.5 MPa
Cylinder material = Grey cast iron FG 200 (Sut = 200 N/mm^2)
Factor of safety = 5
Poisson's ratio = 0.25
Determine the thickness of the cylinder wall. Also, calculate the apparent and net circumferential and longitudinal stresses in the cylinder wall.

Q.3 **(a)** Define the following terms with respect to rolling contact bearing.   **03**
(1) Basic static load rating (2) Rating life (3) Minimum life

(b) Define following terms.   **04**
(1) Backlash (2) Diametral pitch (3) Module (4) Dedendum

(c) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a   **07**
100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is
20°, while the helix angle is 25°. The face width is 40 mm and the normal
module is 4 mm. The pinion as well as the gear is made of steel 4OC8 (Sut
= 600 N/mm^2) and heat treated to a surface hardness of 300 BHN. The service
factor and the factor of safety are 1.5 and 2 respectively. Assume that the
velocity factor accounts for the dynamic load and calculate the power
transmitting capacity of gears.

Q.3 **(a)** State the advantages and disadvantages of gear drive over other power   **03**
transmission devices.

(b) With neat sketch explain the different types of roller bearings with their   **04**
importance in industry.

(c) Explain synchromesh gear box with neat sketch.   **07**

Q.4 **(a)** List the various types of steering gearbox.   **03**
(b) State the role of steering knuckle.   **04**
(c) A pair of bevel gears, with 20° pressure angle, consists of a 20 teeth pinion   **07**
meshing with a 30 teeth gear. The module is 4 mm, while the face width is
20 mm. The material for the pinion and gear is steel 50C4 (Sut = 750 N/mm^2).
The gear teeth are lapped and ground (Class-3) and the surface hardness is
400 BHN. The pinion rotates at 500 rpm and receives 2.5 kW power from
the electric motor. The starting torque of the motor is 150% of the rated
torque. Determine the factor of safety against bending failure and against
pitting failure.

Q.4 **(a)** Explain tractive effort.   **03**
(b) State the method of drawing structural diagrams.   **04**
(c) The following data is given for the piston of a four-stroke diesel engine: **07**
Cylinder bore = 250 mm
Material of piston rings = Grey cast iron
Allowable tensile stress = 100 N/mm^2
Allowable radial pressure on cylinder wall = 0.03 MPa
Thickness of piston head = 42 mm

Number of piston rings = 4

Calculate:

(i) radial width of the piston rings;

(ii) axial thickness of the piston rings;

(iii) gap between the free ends of the piston ring before assembly;

(iv) gap between the free ends of the piston ring after assembly;

(v) width of the top land;

(vi) width of the ring grooves;

(vii) thickness of the piston barrel; and

(viii) thickness of the barrel at open end.

Q.5	**(a)**	Give a comparison of disc brake and drum brake.	**03**
	(b)	With neat sketch explain the working of valve gear mechanism of an I.C. engine.	**04**
	(c)	Explain with neat sketch the telescopic type suspension system.	**07**

OR

Q.5	**(a)**	Explain the Ackermann steering principle.	**03**
	(b)	Explain brake efficiency.	**04**
	(c)	With neat schematic diagram explain hydraulic braking system.	**07**

****