

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER– VII (New) EXAMINATION – WINTER 2019****Subject Code: 2170202****Date: 28/11/2019****Subject Name: Automobile Component 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. Use of data book is permitted.

MARKS

- Q.1** (a) Explain how metal concentration can be avoided at junctions in a casting? **03**
- (b) Discuss the design considerations for welding **04**
- (c) It is required to standardize load carrying capacities of dumpers in a manufacturing unit. The minimum and maximum capacities of such dumpers are 40 and 630kN respectively. The company is interested in developing seven models in this range. Specify their load carrying capacities. **07**
- Q.2** (a) What are the guidelines for selecting suitable lubricant for rolling contact bearings? **03**
- (b) Why preloading is necessary in cylindrical roller bearing and how this is achieved? **04**
- (c) A single row deep groove ball bearing is subjected to one-minute work cycle that consist of following two parts. Refer Table 1 for radial and axial factors. **07**

	Part 1	Part2
Duration(s)	15	45
Radial load(kN)	54	18
Axial load(kN)	15	7.5
Speed (r.p.m)	800	1600

Table1

$[F_a/C_0]$	$[F_a/F_r] \leq e$		$[F_a/F_r] \geq e$		e
	X	Y	X	Y	
0.025	1	0	0.56	2.0	0.22
0.040	1	0	0.56	1.8	0.24
0.070	1	0	0.56	1.6	0.27
0.130	1	0	0.56	1.4	0.31
0.250	1	0	0.56	1.2	0.37
0.500	1	0	0.56	1.0	0.44

The static and dynamic load capacities of the ball bearing are 60 and 88 kN respectively. Calculate the expected life of bearing in hours.

OR

- (c) List down the assumptions on which Reynold's equation for hydrodynamic lubrication is derived. **07**
- Q.3** (a) Explain the following terminologies related with gear **03**
- i) module ii) circular pitch iii) pressure angle
- (b) Which are the factors responsible for the introduction of dynamic forces between two mating gear teeth and mention the methods to account for it during gear design? **04**

- (c) A pair of spur gears consists of 24 teeth pinion rotating at 1000 rpm and transmitting power to a 48 teeth gear. The module is 6mm, while the face width is 60mm. Both the gears are made of steel with an ultimate tensile strength of 450N/mm². They are heat treated to a surface hardness of 250BHN. Assume the velocity factor to account for dynamic load. Calculate
 (i) Beam strength (ii) Wear strength (iii) The rated power that the gears can transmit
 Service factor = 1.5, Factor of safety = 2, Lewis form factor = 0.337

OR

- Q.3** (a) What are the objectives of providing backlash in a pair of gear teeth? **03**
 (b) Why involute profile is preferred for gear tooth? **04**
 (c) A helical pinion having 21 teeth to be made of plain carbon steel 55C8 ($S_{ut} = 720 \text{ N/mm}^2$) is to mesh with a gear to be made of plain carbon steel 40C8 ($S_{ut} = 580 \text{ N/mm}^2$). The gear pair is required to transmit 10kW power from an electric motor running at 1000 rpm to a machine running at 300 rpm. The starting torque of the motor is 125% of the rated torque. The factor of safety required is 1.25. The face width is 10 times the normal module and tooth system is 20° full depth involute. The helix angle is 25°. The gears are machined to meet the specifications of grade 6. The gear and pinion are to be case hardened to 300BHN and 350BHN respectively. Design the gear by using the velocity factor and Buckingham's equation for dynamic load. The deformation factor 'C' for gear pair is 11500N/mm². Use the following formulae
 $Y = 0.484 - 2.87/z$, $C_v = 5.6 / (5.6 + \sqrt{v})$, $K = 0.16 [\text{BHN}/100]^2$

$$P_d = \frac{21v[bC_e \cos^2 \psi + P_{t \max}] \cos \psi}{21v + \sqrt{bC_e \cos^2 \psi + P_{t \max}}}$$

For grade 6, $e = 8 + 0.63[m_n + 0.25\sqrt{d}]$, μm

- Q.4** (a) A pair of bevel gears transmitting 10kW at 400 rpm. The pressure angle is 20°. The diameter of pinion and gear are 150 and 200 mm respectively and face width is 40mm. Determine the axial and radial component of resultant gear tooth force. **03**
 (b) A worm gear pair is used to transmit power from an electric motor running at 1500 rpm to the machine running at 60 rpm. The axial pitch of the worm is 18.85mm, while the diametral quotient is 10. If the centre distance is to be fixed at 180 mm, designate the gear pair. **04**
 (c) What are the design requirements for piston? **07**

OR

- Q.4** (a) What is meant by 'whipping stress' and how this is induced? **03**
 (b) Differentiate full-floating and semi floating type of connections between piston pin and connecting rod. **04**
 (c) Determine the dimensions of cross-section of the connecting rod for a diesel engine with the following data: **07**
 Cylinder bore = 100mm
 Length of connecting rod = 350mm
 Maximum gas pressure = 4MPa
 Factor of safety = 6, Assume $\sigma_c = 300 \text{ N/mm}^2$, $a = 1/7500$

- Q.5** (a) What are the advantages of using separate cylinder liners? **03**
 (b) List down the steps involved in the selection of rolling contact bearings from manufacturers catalogue. **04**
 (c) Design an exhaust valve for a horizontal diesel engine using the following data: **07**

Cylinder bore=150mm, Length of stroke=275mm, Engine speed=500 rpm, Maximum gas pressure=3.5MPa, Seat angle=45°, Mean velocity=50m/s, $w=(0.05 \text{ to } 0.07)d_p$, $k=0.42$, $\sigma_b=50\text{N/mm}^2$

Calculate:

(i) diameter of the valve port, (ii) diameter of valve head, (iii) thickness of valve head, (iv) diameter of valve stem and (v) maximum lift of the valve.

OR

- Q.5** (a) What are the purposes of gearbox? **03**
- (b) Explain the following terminologies related with big end bearings of connecting rod **04**
 (i) Crush (ii) Shim
- (c) The following data is given for the cap and bolts of the big end of connecting rod. **07**
 Engine speed=1800 rpm, Length of connecting rod=350mm
 Length of stroke=175mm, Mass of reciprocating parts=2.5kg
 Length of crank pin=76mm, Diameter of crank pin=58mm
 Thickness of bearing bush=3mm
 Permissible tensile stress for bolts=60N/mm²
 Permissible bending stress for cap=80N/mm²
 Calculate the nominal diameter of bolts and thickness of cap for the big end.

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