

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VII (NEW) EXAMINATION – WINTER 2020

Subject Code:2170202

Date:25/01/2021

Subject Name:Automobile Component Design

Time:10:30 AM TO 12:30 PM

Total Marks: 47

Instructions:

1. Attempt any **THREE** questions from Q.1 to Q.6 .
2. **Q.7 is compulsory.**
3. **Make suitable assumptions wherever necessary.**
4. **Figures to the right indicate full marks.**
5. **Use of Design Data Handbook is permitted.**

MARKS

- Q.1** (a) Explain the situations, where creep is a serious problem. **03**
 (b) What are the general principles to be followed for the design of machined parts? **04**
 (c) Find out the numbers of $R20/4(100, \dots, 1000)$ derived series **07**

- Q.2** (a) What is Stribeck's equation? Mention the assumptions made for its derivation. **03**
 (b) What are the guidelines for selecting a suitable lubricant for bearings? **04**
 (c) A ball bearing is required to operate on following work cycle **07**

Element No.	Radial load (N)	Speed (rpm)	Element time (%)
1	1500	720	30
2	3500	1440	50
3	2500	900	20

The dynamic load capacity of the bearing is 8300N. Determine

- i) Average speed of rotation.
- ii) The equivalent radial load.
- iii) Bearing life in millions of revolution

- Q.3** (a) What are the advantages of using oil instead of grease in bearings? **03**
 (b) What are the major surface wear failures of rolling contact bearings? Explain. **04**
 (c) A pair of spur gears consist of 24 teeth pinion rotating at 1000 rpm and transmitting power to a 48 teeth gear. The module is 6mm. Both the gears are made of steel with ultimate tensile strength of 450N/mm^2 . They are heat treated to a surface hardness of 250 BHN. Assume velocity factor to account for dynamic load, Calculate
 (i) beam strength, (ii) wear strength, (iii) the rated power that the gears can transmit, if service factor and factor of safety are 1.5 and 2 respectively. Assume Lewis form factor = 0.337 **07**

- Q.4** (a) What are the conditions in which non metallic gears are preferred? **03**
 (b) Explain why all standard systems prefer involute profile for gear tooth. **04**
 (c) A pair of parallel helical gears consists of 24 teeth pinion rotating at 5000 rpm and supplying 2.5kW power to a gear. The speed reduction is 4:1. The normal pressure angle and helix angle are 20° and 23° respectively. Both the gears are made of hardened steel ($S_{ut}=750\text{N/mm}^2$). The service factor and factor of safety are 1.5 and 2 respectively. The gears are made to specifications of grade 4. Take $Y=0.36$. Error for grade 4 is given by $e=3.2+0.25\phi$, where $\phi=mn+0.25\sqrt{d}$ **07**
 (i) Assume pitch line velocity to be 10 m/s, estimate normal module
 (ii) Determine the dynamic load considering the grade of gears and find out the effective load. What is the correct factor of safety for bending?
 (iii) Specify surface hardness for the gears, assuming factor of safety of 2 for wear considerations.

- Q.5** (a) What are the reasons for introduction of dynamic forces between two mating gear teeth? **03**
- (b) Explain the following terminologies related to gears **04**
(i) interference, (ii) undercutting
- (c) A pair of straight bevel gears is mounted on shafts, which are intersecting at right angles. The number of teeth on the pinion and gear are 21 and 28 respectively. The pressure angle is 20° . The pinion shaft is connected to an electric motor developing 5kW rated power at 1440 rpm. The service factor can be taken as 1.5. The pinion and gear are made of same material ($S_{ut}=750\text{N/mm}^2$) and heat treated to surface hardness of 380BHN. The gears are machined by manufacturing process, which limits the error between meshing teeth to $10\mu\text{m}$. The module and face width are 4mm and 20mm respectively. Assume $Y=0.345$, Determine (i) Beam strength (ii) Wear strength (iii) Tangential force due to rated torque and (iv) Dynamic load. **07**
- Q.6** (a) What are the main functions of piston? **03**
- (b) Explain the following related with gear tooth **04**
(i) Abrasive wear (ii) Corrosive wear (iii) Initial pitting and (iv) Scoring
- (c) The following data is given for the piston of a four-stroke diesel engine **07**
Cylinder bore=250 mm, Maximum gas pressure= 4MPa
Bearing pressure at small end of connecting rod=15MPa
Length of the piston pin in bush of small end=0.45D
Ratio of inner to outer diameter of piston pin=0.6
Mean diameter of piston boss=1.4 x outer diameter of piston pin
Allowable bending stress for piston pin= 84N/mm^2
Calculate: (i) outer diameter of the piston pin (ii) inner diameter of piston pin
(iii) mean diameter of the piston boss (iv) check the design for bending stresses.
- Q.7** (a) What are the desirable properties for cylinders and cylinder liners? **05**
- Q.7** (a) What is meant by 'crush' and 'shim' related to big end of connecting rod? **05**

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