

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (Old) EXAMINATION – WINTER 2019****Subject Code: 151905****Date: 06/12/2019****Subject Name: Machine Design - I****Time: 10:30 AM TO 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) What are the salient features used in the design of forging? Explain. **07**
(b) Explain the following terms: **07**
(i) Preferred numbers (ii) Standardization (iii) Endurance limit (iv) Hertz's Contact stress (v) Creep (vi) Autofrettage (vii) Notch sensitivity
- Q.2** (a) What is endurance limit? Explain design criteria with solderberg's line. **07**
(b) A circular bar of 500mm length is supported freely at its ends. It is acted upon by a cyclic load having a minimum value of 20 kN and a maximum value of 50kN. Determine the diameter of bar by taking factor of safety of 1.5, size effect of 0.85, surface finish factor of 0.9. The material properties of bar is given by : Ultimate strength of 650 Mpa, Yield strength of 500 Mpa and Endurance strength of 350 Mpa. **07**
- OR**
- (b) Design a self-aligning ball bearing for a radial load of 7000 N and a thrust load of 2100 N. The desired life of the bearing is 160 millions of revolutions at 300 r.p.m. Assume uniform and steady load, **07**
- Q.3** (a) What is A.M. Wahl's factor in spring? Why it is used? **07**
(b) A semi-elliptic leaf spring used for automobile suspension consists of three extra full –length leaves and 15 graduated-length leaves, including master leaf. The center-to-center distance between two eyes of the spring is 1 m. The maximum force that can act on the spring is 75 KN. For each leaf, the ratio of width to thickness is 9:1. The modulus of elasticity of the leaf material is 207000N/mm². The leaves are pre-stressed in such a way that when the force is maximum, the stresses induced in all leaves are same and equal to 450 N/mm². Determine:
(i) The width and thickness of the leaves;
(ii) The initial nip; and
(iii)The initial pre-load required to close the gap C between extra full-length leaves and graduated-length leaves. **07**
- OR**
- Q.3** (a) Explain the factors affecting selection of antifriction bearings **07**
(b) The piston rod of a hydraulic cylinder exerts an operating force of 10 kN. The friction due to piston packing and stuffing box is 10 % of the operating force. The pressure in the cylinder is 10 N/ mm². The cylinder is made of C.I. having allowing tensile stress of 40 N/ mm². Determine the diameter and thickness of the cylinder. **07**
- Q.4** (a) Discuss: Selection of Chain drives and design steps for it. **07**
(b) A belt 100 mm wide and 10 mm thick is transmitting power at 1000 meters/min. The net driving tension is 1.8 times the tension on the slack side. If the safe **07**

permissible stress on the belt section is 1.6 MPa, calculate the maximum power that can be transmitted at this speed. Assume density of the leather as 1000 kg/m³. Calculate the absolute maximum power that can be transmitted by this belt and the speed at which this can be transmitted.

OR

- Q.4 (a)** Explain in brief the design procedure for v-belt drives. **07**
- (b)** Design a journal bearing for a centrifugal pump from the following data : **07**
Load on the journal = 20 000 N;
Speed of the journal = 900 r.p.m.;
Type of oil is SAE 10, for which the absolute viscosity at 55°C = 0.017 kg/ m-s;
Ambient temperature of oil = 15.5°C ;
Maximum bearing pressure for the pump = 1.5 N / mm².
Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m²/°C.
- Q.5 (a)** How does the function of a brake differ from that of a clutch? Also Describe with the help of a neat sketch the principle of operation of an internal expanding shoe brake. **07**
- (b)** A high-pressure cylinder consists of a steel tube with inner and outer diameters of 20 and 40 mm respectively. It is jacketed by an outer steel tube, having an outer diameter of 60 mm. The tubes are assembled by a shrinking process in such a way that maximum principal stress induced in any tube is limited to 100 N/mm². Calculate the shrinkage pressure and original dimensions of the tubes (E=207 KN/mm²) **07**

OR

- Q.5 (a)** What is thick cylinder? When do you use Lamé's equation for cylinder wall thickness? **07**
- (b)** A multi-disc clutch has three discs on the driving shaft and two on the driven shaft. The inside diameter of the contact surface is 120 mm. The maximum pressure between the surface is limited to 0.1 N/mm². Design the clutch for transmitting 25 kW at 1575 r.p.m. Assume uniform wear condition and coefficient of friction as 0.3. **07**
