Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII (old) - EXAMINATION – SUMMER 2017

Subject Code:181902 Date:29/04/2017

Subject Name: Machine Design II

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.**
4. **Use of only PSG Design Data Book is permitted in exam.**

Q.1 **(a)** Why trapezoidal cross section is preferred in design of crane hook? Also Draw the neat sketch of single crane hook and show the critical cross section on it. **04**

(b) A 3 stage 12 speed gearbox is to be used in machine tool for spindle speeds ranging between 25 rpm and 1500 rpm. The second stage of gear box consists of three speed steps. If the gear box is driven by 3.7 kW, 750 rpm electric motor through the belt drive: **10**

(i) Draw the ray diagram (ii) Select diameter of pulley for belt drive

(ii) Determine the maximum torque acting on all shafts.

Q.2 **(a)** Classify the conveyors. Explain the design procedure for belt conveyors with neat sketch. **07**

(b) A belt conveyor is to be designed to carry the bulk material at the rate 300 x 103 kg/hr with following details: **07**

Bulk density of the material = 800 kg/m^3

Angle of repose of bulk material=15^0

Surcharge factor = 0.075

Belt speed = 10 km/hr

Material factor for plies, K1 = 2

Belt tension and arc of contact factor, K2 = 63

No. of plies for the belt = 4

Available standard belt widths = 600, 650, 750, 800, 900, 1000, 1200, 1400 mm

Effective width of material storage on belt = (0.9B-0.05), m

Determine: (i) Suitable width for belt (ii) Diameter and length of drive pulley.

OR

(b) Explain different types of idlers used in conveyors with neat sketches. **07**

Q.3 **(a)** A pair of spur gear with 20^0 full-depth involute teeth consists of a 19 teeth pinion meshing with a 40 teeth gear. The pinion is mounted on a crankshaft of 7.5 kW single cylinder diesel engine running at 1500 rpm. The driven shaft is connected to a two stage compressor. Assume the service factor as 1.5. The pinion as well as the gear is made of steel 40C8 (σ_{ut}=600 N/mm^2). The module and face width of the gears are 4 and 40 mm respectively. Take deformation factor C = 11400 N/mm^2. Consider Lewi's tooth form factor (Y) = 0.314. (i) Using the velocity factor to account for the dynamic load, determine FOS. (ii) If the Factor of safety is 2 for pitting failure, recommend surface hardness for the gears. (iii) If the gears are machined to meet the specifications of Grade 8, determine the FOS for bending using Buckingham's equation for dynamic load. (iv) Is the gear design satisfactory? If not, what is the method to satisfy the design conditions? How will you modify the design? **12**

(b) Define: (i) Pressure angle (ii) Backlash **02**

OR

Q.3 **(a)** A pair of helical gears with pinions 26 teeth and gear 100 teeth supplies power 5 kW at 2000 rpm of pinion (n_p). Normal pressure angle is 20^0 and helix angle of teeth is 15^0. Both pinion and gears are made of hardened steel with σ_{ut} = 660 N/mm^2. Gears are finished to the accuracy of grade 8. Assuming service factor = 1.5, factor of safety 1.8, and pitch line velocity of gears as 10 m/s, determine normal module of gear teeth as per beam strength. Specify the hardness of the surface of gears if wear strength (S_w) = b*S_b (beam strength) = 12m_n, where b= face width. Check the safety of design as per Spott's equation for accuracy of grade 8. Given Error, e (micron) = 16.0 + 1.25Ø, where Ø = $m_n + 0.25\sqrt{d}$. Take tooth form factor (Y) =0.351. **10**

Use Spott's equation for Dynamic load (P_d) = $\dfrac{en_p z_p b r_1 r_2}{2530\sqrt{r_1^2 + r_2^2}}$

Where, Z_p = virtual number of teeth, $r_1$and r_2 = Pitch circle radius for pinion and gear respectively.

(b) Discuss briefly on gear lubricants and gear lubrications. **04**

Q.4 **(a)** A pair of bevel gear has the following data: **10**
Number of teeth on pinion = 20, number of teeth on gear = 36, module =4 mm, and face width = 25 mm.
Materials for pinion and gear is steel with gears are machined to the accuracy of grade 10 and surface hardness obtained by heat treatment is 360 BHN. Pinion rotates at 750 rpm receiving power from electric motor. Consider service factor 1.5 and factor of safety is 1.75. Take tooth form factor (Y) = 0.3326. Determine the horse power which can be safely transmitted by the pair of bevel gears.
Take error (e) = 32 +2.5Ø, where Ø = m + $0.25\sqrt{d}$.

(b) Derive the Lewi's equation for finding beam strength of spur gear tooth using usual notations. **04**

OR

Q.4 **(a)** A worm gearbox with an effective surface area of 1.5 m^2 is operating in still air with a heat transfer coefficient of 15 W/m^2 ^{0}C. The temperature rise of the lubricating oil above the atmospheric temperature is limited to 50 ^{0}C. The worm gears are designated as 1/30/10/8. The worm shaft is running at 1440 rpm and the normal pressure angle is 20^0. Take coefficient of friction is 0.024. Calculate the following: **07**
(i) Power transmitting capacity based on thermal considerations
(ii) Efficiency of worm gear drive (iii) Centre distance (iv) Speed reduction
(v) Power lost in friction

(b) (i) What are the merits and demerits of dry and wet cylinder liners? **03**
(ii) Explain in detail the accuracy of gear and gear materials. **04**

Q.5 **(a)** A vertical four stroke compression ignition engine has the following specifications: **07**
Brake power = 4.5 kW
Speed = 1200 rev/min
Indicated mean effective pressure=0.35 N/mm^2
Mechanical efficiency = 80%
Determine the dimensions of the cylinder.

(b) **(i)** Describe the criteria for deciding size of suction and exhaust valve of an IC engine. **04**

(ii) Which cross section is most preferable in design of connecting rod? Why? **03**

OR

Q.5 **(a)** Following data has been given for a cast iron piston for a single acting four stroke engine. **10**

Cylinder bore=100 mm, stroke = 125 mm, Maximum gas pressure=5 N/mm^2, Brake mean effective pressure=0.75 N/mm^2, Fuel consumption = 0.15 kg per brake power per hour, speed=2000 rpm, Higher calorific value of fuel = 42 x 10^3 kJ/kg. Mechanical efficiency = 80%. Any other data required for design may be assumed. Take for Cast iron Piston σ_t = 38 MPa

Design the following parts of a piston.

(i) Piston head (ii) Piston rings (iii) Piston barrel (iv) Piston skirt.

(b) What are the design requirements for Piston? **04**

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