Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2171909 **Date: 03/12/2018**

Subject Name: Machine 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 Design data book is allowed Bhandari/PSG.**

			MARKS
Q.1	**(a)**	Why pressure angle is generally taken as 20^0? What is its effect?	**03**
	(b)	Explain desirable properties of bearing materials used for sliding contact bearings.	**04**
	(c)	Design a pair of CI spur gear to transmit 12 kW having pinion speed of 200 rpm. The speed reduction required is 2:1. Assume face width as 3 times circular pitch. The minimum number of teeth on pinion is 24. Check your design in all failures considering the following data; Pressure angel 14.5^0 full depth involute, Factor of safety 1.5. The modulus of elasticity for pair is $0.8 * 10^5$ N/mm^2, Error in manufacturing is not to exceed 0.05 mm, Allowable bending stress for CI as 45 N/mm^2, Surface endurance stress as 280 N/mm^2.	**07**
Q.2	**(a)**	What is the function of cylinder liners in IC Engines? List down the reasons for liner distortion.	**03**
	(b)	Give the classification of wire ropes and explain its construction with neat sketches.	**04**
	(c)	Design a helical gear to transmit 30 kW from the following data; Helix angle = 30^0, Speed of pinion = 1500 rpm, Pressure angle = 20^0 FDI, Velocity ratio = 4, No of teeth on pinion = 24, Static stress for CI = 55 N/mm^2, BHN for pinion and gear material = 350, Young's modulus of elasticity for pinion and gear material = $2.1 * 10^5$ N/ mm^2.	**07**
		OR	
	(c)	Draw layout diagram of gear box, ray diagram and speed chart for a multi-speed gear box of a radial drilling machine required to give eight steps. The power from motor to the input shaft of gear box is transmitted by a V-belt drive with a speed reduction of 1:6. The minimum and maximum spindle speeds are 70 rpm and 1800 rpm respectively.	**07**
Q.3	**(a)**	Explain the rang ratio in gear box design.	**03**
	(b)	Explain in brief about mountings of bearings.	**04**
	(c)	Calculate the maximum radial load that the journal can carry and operate at hydrodynamic condition for the following data of a full journal bearing. Journal diameter = 60 mm, bearing length = 60 mm, radial clearance = 0.06 mm, minimum film thickness = 0.006 mm, journal speed = 1440 rpm, viscosity of lubricant = 20 cP. For the above calculated load, find the power lost in friction.	**07**
		OR	

Q.3	**(a)**	Differentiate between Arithmetic, Geometric and Harmonic Progressions in case of design of gear box.	**03**
	(b)	A deep groove ball bearing has a rated static and dynamic load capacity of 4150 N and 4750 N respectively. The bearing has to take an axial load of 2075 N and a radial load of 4000 N. Find the expected life of the bearing.	**04**
	(c)	A worm and worm wheel gear drive is designated as 2 / 41 / 10 / 8. The drive is used to obtain a speed reduction of 20.5 from an input speed of 1450 rpm. Material of the worm wheel is Sand Cast and Chilled Phosphor Bronze, while the worm is made of Case-hardened alloy steel. Determine the power transmitting capacity of the drive based on beam strength.	**07**
Q.4	**(a)**	What are the two most usual causes of failures of the crank shafts?	**03**
	(b)	Explain the classification cranes using different standards.	**04**
	(c)	The cylinder of a four-stroke diesel engine has the following specifications: Break Power = 7.5 kW, Speed = 1400 rpm, Indicated mean effective pressure = 0.35 MPa, Mechanical efficiency = 80 %, Maximum gas pressure = 3.5 MPa. The cylinder liner and head are made of grey cast iron FG 260 having UTS 260 N/mm^2 and poisons ratio 0.25. The studs are made of plain-carbon steel having yield stress 380 N/mm^2. The factor of safety for all parts is 6. Calculate: (i) bore and length of the cylinder liner, (ii) thickness of the cylinder liner, (iii) thickness of cylinder head, (iv) size, number and pitch of studs.	**07**
		OR	
Q.4	**(a)**	Explain the aspect of heat generation in design of worm gears.	**03**
	(b)	A bearing is subjected to the following work cycle: radial load of 4450 N, 6675 N and 2225 N at 150 rpm, 600 rpm, and 300 rpm for 30 % of time, 10 % of time, and for remaining time of the cycle respectively. The inner ring rotates and the loads are steady. Find the expected life of this bearing in hours, by considering the static and dynamic load carrying capacities of the bearing as 10013 N and 14952 N respectively.	**04**
	(c)	Design a cast iron piston for a single acting four stroke engine for the following specifications. Cylinder bore = 100mm, stroke = 120 mm, maximum gas pressure = 0.65 MPa, Fuel consumption = 0.227 kg/kW/hr, speed = 2200 rpm. Assume the following data; Allowable stresses in CI = 37.5 N/mm^2, Allowable stresses for piston rings = 90 N/mm^2, Assume suitable data.	**07**
Q.5	**(a)**	Discuss the different types of piston rings and function of each one of it.	**03**
	(b)	How the rolling contact bearings are designed having probability of survival other than 90 percent?	**04**
	(c)	An elevator at the construction site is required to raise building materials weighing 5.5 KN. A maximum velocity of 1 m/s is attained in one second while raising the materials. The lift of material is 25 m. The drum diameter is 40 times the rope diameter. Find the number of 6 X 19 wire ropes required if 12 mm diameter ropes are used. Assume: diameter of wire d_w= 0.063 d, area of rope A_r= 0.38 d^2, mass of rope = 0.0036 d^2 kg/m, E_r = 84000 N/m^2, breaking strength = 385 d^2, factor of safety = 5. d is diameter of rope.	**07**

OR

Q.5 **(a)** What is material handling? What are the essentials of good material handling system? **04**

(b) A 360^0 full journal bearing operates under the following specifications: **10**

Journal Diameter = 70 mm, bearing length = 70 mm,
Journal speed = 960 rpm, steady radial load = 12 KN,
Viscosity of lubricant = 16 cP, Mass density of oil = 880 kg/m^3,
Specific heat = 1.76 kJ/kg ^{0}C, bearing clearance ratio (r/c) = 800,
Average heat transfer coefficient = 20 W/m^2-^{0}C.
Determine the required flow rate of oil. Also find the temperature of oil film and the bearing surface area for the desired heat transfer, if the ambient temperature is 30^0C. Assume that all heat generated in the bearing is carried away by the oil.

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