on. 6837-11.   (REVISED COURSE)   MP-5524

(4 Hours)   [Total Marks : 100

N. B. : (1) Question No. 1 is **compulsory**.
  (2) Answer any **four** questions from the remaining **six** questions.
  (3) Use of standard data book is **permissible**.
  (4) Assume any data if **necessary**, giving **justification**.

Q.1. Answer any **four** of the followings: (4x5=20)
  a) What are the different types of gear tooth failures ?. State their causes and remedies.
  b) Explain how the following factors influence the life of rolling contact bearing:
    i) Load; ii) Speed; iii) Temperature; iv) Reliability
  c) Explain the desirable properties of the sliding contact bearing materials ?.
  d) What are the factors which limit the suction head of the centrifugal pump and what is the maximum value of height adopted in practice?.
  e) Explain the significance of the following terms in bearing:
    i) Sommerfeld number
    ii) Coefficient of friction variable
    iii) Flow variable
  f) State the assumptions made in the Lewis equation used for design of a gear and explain how these are taken into account during design.

Q.2.(a) A two stage reduction gear box is to be designed for following requirements: (10)
    i) Power to be transmitted   :   6 kW
    ii) Input speed to the gearbox   :   1440 rpm
    iii) Output speed of the gearbox   :   120 rpm
  For the second stage:
    i)   Select suitable materials stating clearly their stresses. Justify your selection.
    ii)   Design the gears based on beam strength.
    iii)   Check the gears for wear.

  (b) Design a worm gear drive to transmit 20 H.P from a worm at 1440 rpm to the worm wheel. The speed of the worm wheel should be $40 \pm 2\%$.   (10)

Q.3 A rotary disc cam with central translator roller follower has following motion:
    i) forward stroke of 30 mm in 100^0 of cam rotation with parabolic motion.
    ii) return stroke of 30mm in 80^0 of cam rotation with cycloidal motion.
    iii) dwell for 40^0 between forward and return stroke and after return stroke.

  The combined mass of follower system is 1.5 kg. Cam shaft speed is 600 rpm. Maximum pressure during forward stroke is 25^0. The external load during forward stroke is 500 N and return stroke is 100 N.

    Design a) Cam   (8)
      b) Follower stem, pin etc.   (5)
      c) Spring   (4)
  And find the maximum cam shaft torque hence find its diameter.   (3)

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Q.4.(a) Compare the rolling and sliding contact bearings in respect of the following foctors: (8)
   i) Magnitude of load   ii) Nature of load   iii) Speed   iv) Life   v) Frictional
   loss   vi) Space requirement vii) Positoinal accuracy   viii) Noise and ix) Cost.

(b) The following data is given for 360^0 hydrodynamic bearing: (12)
   journal diameter   :   100 mm
   bearing length   :   50 mm
   journal speed   :   1500 rpm
   min. oil film thickness   :   15 microns.
   viscosity of lubricant   :   30 cp
   specific gravity of oil   :   0.86
   specific heat of lubricant : 2.09 kJ / kg. ^{0}C

The fit between the journal and bearing is normal running fit $H_7 e_7$.
Calculate
   i)   The load carrying capacity of bearing
   ii)   The coefficient of friction
   iii)   The power lost in friction
   iv)   The total flow rate of the lubricant
   v)   The side leakage
   vi)   The temperature rise.

Q.5.(a) Design a pair of helical gears to transmit a power of 36,800 watts at 30 rps of the pinion.
   Gear ratio is 4. Helical angle is 15^0 . Teeth is 20^0 full depth. Material used is C50.
                                                                              (10)

(b) A single-row deep-groove ball bearing is subjected to the following work cycle: (10)

Sr.No	Fraction of cycle	Radial load(kN)	Thrust load(kN)	Radial factor	Thrust factor	Race rotating	Service factor	Speed r.p.m
1	1/10	1.5	0.25	1.0	0	Inner	1.2	400
2	1/5	1.0	0.75	0.56	2.0	Outer	1.8	500
3	3/5	5.0	1.1	0.56	2.0	Inner	1.5	600
4	Remaining	1.0	-	1.0	0	Outer	2.0	800

If the desired life of the bearing is 15000 hours, select the bearing from the following data.

Bearing No.	6011	6211	6311	6411
Dynamic capacity 'C' (kN)	28.1	43.6	71.5	99.5

Q.6. Design a Centrifugal Pump for the following data: (20)
   Static suction head   :   3.5 m
   Static delivery head   :   10 m
   Length of suction pipe   :   8 m
   Length of delivery pipe   :   60 m
   Pump discharge   :   900 lpm
   Working fluid   :   water at 30^0 C

Q.7. The following specifications refers to EOT crane:

Application	:	class II
Load to be lifted	:	100 kN
Hoisting speed	:	10 m/min
Maximum lift	:	8 m

a) Select suitable type and size of wire rope for an expected life of 12 months.   (6)

b) Select standard hook, material and design stresses. Check the induced stresses at the most critical sections.   (6)

c) Design the pulley axel.   (3)

d) Design the cross piece   (3)

e) Design the shackle plates.   (2)