SUMMER-2024	
Exam Seat No.:	
Academic Year:2023-2024	Semester:IV
Class:SY	Program:B.Tech
Branch Code:ROB	Pattern:2022
Name of Course:Design of Machine Elements	Course Code:ROB222012
Max. Marks:60	Duration:2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper
and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 2 pages.
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Question No. 1 Attempt following Question

1a)   What is volumetric strain?   (6)   CO1,
A steel beam with a length of 7 m is subjected to an eccentric load of 8500 N. The distance between   CO2
the applied force and the center of the beam is 0.9 m. The beam has a rectangular cross-section with
a width of 0.15 m and a height of 0.30 m. Calculate the moment applied to the beam and find the
maximum bending stress in the beam in MPa.

Question No. 2 Attempt following Question

2a)   What is power ratings of belt, and give any two factors affecting it.   (6)   CO3,
The centre to centre distance between the two sprockets of a chain drive is 700 mm. The chain drive   CO4
is used to reduce the speed from 200 rpm to 100 rpm on the driving sprocket having 20 teeth and a
pitch circle diameter of 520 mm. Determine:
i) Number of teeth on the driven sprocket
ii) Pitch and length of the chain

Question No. 3 Attempt following Question

3a)   What are gear trains, and what are their different types? Explain in detail.   (8)   CO1,
  CO5

OR

3b)   i) The following data relate to a pair of 20° involute gears in mesh: (8)   CO1,
Module = 6 mm, Number of teeth on pinion = 19, Number of teeth on gear = 51; Addendum on   CO5
pinion and gear wheel = 1 module. Find the number of pairs of teeth in contact. [4 marks]

ii) Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1.
The teeth are of involute form; module = 6 mm, addendum = one module, pressure angle = 20°. The
pinion rotates at 110 r.p.m. Determine: The number of teeth on the pinion to avoid interference on it
and the corresponding number of teeth on the wheel. [4 marks]

3c) In an epicyclic gear train, an arm carries two gears A and B having 38 and 47 teeth respectively. If the arm rotates at 200 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 350 r.p.m. in the clockwise direction, what will be the speed of gear B? (8) CO1, CO5

OR

3d) Define length of path of contact, length of arc of contact and contact ratio for gears. (8) CO1, CO5
A pinion having 32 teeth drives a gear having 84 teeth. The profile of the gears is involute with 20° pressure angle, 15 mm module and 12 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.

Question No. 4 Attempt following Question

4a) What are transmission shafts? What are the design considerations required in transmission shafts? (8) CO1
A shaft with a diameter of 65 mm is rotating at 1500 rpm. If the shaft transmits a power of 0.04 MW, determine the torque transmitted by the shaft.

OR

4b) Explain in detail about the designing of shafts on the basis of strength. (8) CO1

4c) What is Stribeck's equation for roller contact bearing? Explain the concept of equivalent load and, (8) CO1
load life relationship for bearings.

OR

4d) i) A solid circular shaft is subjected to a bending moment of 2500 N-m and a torque of 8000 Nm. (8) CO1
The shaft is having ultimate tensile stress of 650 MPa and an ultimate shear stress of 450 MPa.
Assuming a factor of safety of 5, determine the diameter of the shaft. [4 marks]

ii) A solid steel spindle transmits 5 kW at 1000 r.p.m. The angular deflection should not exceed
0.25° per metre of the spindle. If the modulus of rigidity for the material of the spindle is 84 GPa,
find the diameter of the spindle and the shear stress induced in the spindle. [4 marks] [8]

Question No. 5 Attempt following Question

5a) Write the expression for the efficiency of the self-locking screw, and explain the concept of over- (8) CO1
hauling and self-locking screws. Also explain the concept of Acme threads.

OR

5b) The lead screw of a lathe has Acme threads of 80 mm outside diameter and 10 mm pitch. The screw (8) CO1
must exert an axial pressure of 3000 N in order to drive the tool carriage. The thrust is carried on a
collar 130 mm outside diameter and 65 mm inside diameter and the lead screw rotates at 60 r.p.m.
Determine (a) the power required to drive the screw; and (b) the efficiency of the lead screw.
Assume a coefficient of friction of 0.15 for the screw and 0.12 for the collar.

5c) Elaborate the types of screw thread used for power screws in detail. (8) CO1

OR

5d) A vertical screw with single start square threads of 70 mm mean diameter and 14 mm pitch is raised (8) CO1
against a load of 15 kN by means of a hand wheel, the boss of which is threaded to act as a nut. The
axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of
60 mm. The coefficient of friction is 0.15 for the screw and 0.18 for the collar. If the tangential
force applied by each hand to the wheel is 175 N, find suitable diameter of the hand wheel.

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