BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2024)

CLASS: BTECH   SEMESTER : V
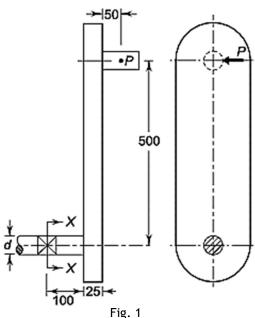BRANCH: PIE   SESSION : MO/2024

SUBJECT: PE328 DESIGN OF MACHINE ELEMENTS

TIME: 02 Hours   FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions, each of 5 marks and a total of 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates
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Q.1 Evaluate the significance of each mode of failure: elastic deflection, general yielding, and   [5]   1   4
fracture, in the design of machine elements. Provide examples where each mode is
critical to the functionality of mechanical components under different operating
conditions.

Q.2 The dimensions of an overhang crank are given in Figure 1. The force P acting at the   [5]   1   3
crankpin is 1 kN. The crank is made of steel 30C8 (S_{yt} = 400 N/mm^2) and the factor of
safety is 2. Using the maximum shear stress theory of failure, determine the diameter d
at section - XX.

Fig. 1

Q.3 Two rods are to be joined using a knuckle joint subjected to an axial tensile force of 50   [5]   2   3
kN. Each rod has a diameter of 30 mm, and the knuckle pin has a diameter of 40 mm.
Determine the dimensions of the fork and eye ends made from plain carbon steel 30C8
(S_{yt} = 400 N/mm^2), considering only bearing and tensile failure criteria. The yield strength
in compression is equal to the yield strength in tension. A factor of safety of 5 is to be
applied.

Q.4 A solid circular bar of 100 mm diameter is welded to a structural member, as shown in   [5]   2   3
Figure 2, by a fillet weld all around the bar. Determine the leg dimension of the fillet
weld, if P= 16 kN and permissible shear stress in weld is 90 N/mm^2. [I_{xx} of weld section =
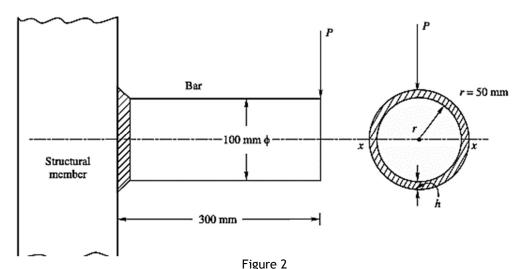$\pi r^3 t$ mm^4]

PTO

Figure 2

Q.5 Prove that when the height of the nut is approximately 0.4 times the nominal diameter [5] 3 4
of the bolt, the threads of the bolt in a standard nut will not experience shear failure.
Apply relevant mechanical principles and equations to substantiate the claim.

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