Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: IDD (B.Tech and M.Tech)
Sub_Code: MEPC2005

4th Semester Regular Examination: 2024-25
SUBJECT: Design of Machine Elements-I
BRANCH(S): MANUTECH, MECH
Time: 3 Hours
Max Marks: 100
Q.Code: S501

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.
(Use of relevant data book is permissible)

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What are fits and tolerances?
b) What is standardization?
c) What do you understand by the term riveted joint?
d) Where do you use a cotter joint? Give practical examples.
e) What are the various types of stresses developed in the key?
f) Distinguish clearly, giving examples between axle and shaft.
g) In a close coiled helical spring, the spring index is given by 'D/d', where, 'D' and 'd' are the mean coil diameter and wire diameter, respectively. For considering the effect of curvature, write the expression for Wahl's stress factor 'K'.
h) What is nipping in a leaf spring?
i) Name the commonly used materials for sliding contact bearings.
j) Define rating life of bearing.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Briefly discuss about the factors to be considered for the selection of materials for the design of machine elements.
b) What do you understand by preferred numbers? Explain.
c) A steel plate, 100 mm wide and 10 mm thick, is welded to another steel plate by means of double parallel fillet welds as shown in Fig. 1. The plates are subjected to a static tensile force of 50 kN. Determine the required length of the welds if the permissible shear stress in the weld is 94 N/mm^2.

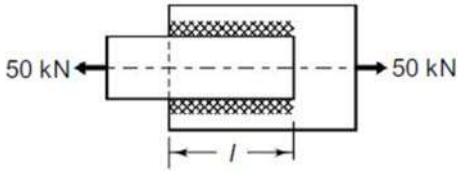

Fig. 1

d) Define the following terms use in screw threads:
(I) Major diameter, (II) Minor diameter, (III) Pitch, and (IV) Lead.

e) Sketch two views of a knuckle joint and write the equations showing the strength of joint for the most probable modes of failure.

f) How are the keys classified? Draw neat sketches of different types of keys and state their applications.

g) A hollow steel shaft transmits 600 kW at 500 r.p.m. The maximum shear stress is 62.4 MPa. Find the outside and inside diameter of the shaft, if the outer diameter is twice of inside diameter, assuming that the maximum torque is 20% greater than the mean torque.

h) A solid circular shaft is subjected to a bending moment of 3000 N-m and a torque of 10000 N-m. The shaft is made of 45C8 steel having ultimate tensile stress of 700 MPa and an ultimate shear stress of 500 MPa. Assuming a factor of safety as 6, determine the diameter of the shaft.

i) Describe, with the help of neat sketches, the types of various shaft couplings mentioning the uses of each type.

j) State and explain the importance of A.M. Wahl's factor in the design of helical springs.

k) What are the various terms used in journal bearings analysis and design? Give their definitions in brief.

l) Select appropriate type of rolling contact bearing under the following condition of loading giving reasons for your choice.
1. Light radial load with high rotational speed.
2. Heavy axial and radial load with shock.
3. Light load where radial space is very limited.
4. Axial thrust only with medium speed.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(16 x 2)**

Q3 What are the steps involved in design of a machine element? Explain. **(16)**

Q4 A double riveted lap joint with chain riveting is to be made for joining two plates 10 mm thick. The allowable stresses are: σ_t = 60 MPa; τ = 50 MPa and σ_c = 80 MPa. Find the rivet diameter, pitch of rivets, and distance between rows of rivets. Also, find the efficiency of the joint. **(16)**

Q5 Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an electric motor to a compressor. The service factor may be assumed as 1.35. The following permissible stresses may be used: **(16)**
Shear stress for shaft, bolt and key material = 40 MPa
Crushing stress for bolt and key = 80 MPa
Shear stress for cast iron = 8 MPa
Draw a neat sketch of the coupling.

Q6 Design a journal bearing for a centrifugal pump from the following data: **(16)**
Load on the journal = 20000 N; Speed of the journal = 900 r.p.m.; Type of oil is SAE 10, for which the absolute viscosity at 55 °C = 0.017 kg / m-s; Ambient temperature of oil = 15.5 °C; Maximum bearing pressure for the pump = 1.5 N / mm^2. Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m^2/°C.