LUKHDHIRJI ENGINEERING COLLEGE-MORBI

Mechanical Engineering Department

(3171917)

DESIGN OF MACHINE ELEMENTS

A.Y.2022-23

LAB MANUAL

STUDENT NAME :______________________________

ENROLL NO. :______________________________

BRANCH :______________________________

BATCH :______________________________

LUKHDHIRJI ENGINEERING COLLEGE-MORBI

Vision of the Institute

To provide quality engineering education and transforming students into professionally competent and socially responsible human beings.

Mission of the Institute

- To provide a platform for basic and advanced engineering knowledge to meet global challenges
- To impart state-of-art know- how with managerial and technical skills
- To create a sustainable society through ethical and accountable engineering practices

Vision of the Department

To deliver quality engineering education for Mechanical Engineers with Professional competency, Human values and Acceptability in the society.

Mission of the Department

- To nurture engineers with basic and advance mechanical engineering concepts
- To impart Techno-Managerial skill in students to meet global engineering challenges
- To create ethical engineers who can contribute for sustainable development of society

Program Educational Objectives (PEOs)

Mechanical Engineering graduates will be able to,

1. Apply the knowledge of basic science and engineering to analyze and solve problems related to mechanical engineering.
2. Design and develop the new system/process using advanced tools and technologies.
3. Enhance professional practice to meet global challenges with ethical and social responsibility.

Program Specific Outcomes (PSOs)

1. Students will be able to apply the knowledge of computer aided tools for design and development of products based on engineering principles.
2. Students will be able to manage production of components/systems using conventional and advanced manufacturing methods.

LUKHADHIRJI ENGINEERING COLLEGE MORBI

MECHANICAL DEPARTMENT

CERTIFICATE

This to certify that Mr /Ms. ______________________________

Enrolment Number ____________________ from **Mechanical Engineering** course in semester **VII** has satisfactorily completed the term work satisfactorily in **Design of Machine Elements – (3171917)** for the Academic Year ___________as prescribed in the GTU curriculum.

Place:___________ Date:_____________

Subject Faculty

H.O.D.
Mechanical Department

List of Experiments

Sr. No.	Title	COs	POs PSOs	Date	Sign	Remark
1.	To specify the ‘size’ of the product within a given set of constraints.	CO1	PO1,PO3, PSO1			
2.	To design rigid and flexible couplings	CO2	PO1,PO2, PSO1			
3.	To design helical and leaf springs.	CO2	PO1,PO2, PSO1			
4.	To design pressure vessels.	CO2	PO1,PO2, PSO1			
5.	To select rolling contact bearing from manufacturer’s catalogue.	CO3	PO1,PO2, PSO1			
6.	To select parameters for journal bearing.	CO3	PO1,PO2, PSO1			
7.	To design a gear drives.	CO2	PO1,PO2, PSO1			
8.	To design a speed gear box.	CO4	PO1,PO2, PSO1			
9.	To design a valve gear mechanism for IC engine.	CO5	PO1,PO2, PO3,PSO1			

Experiment no -1
Design Considerations

AIM: To specify the ‘size’ of the product within a given set of constraints.

Instructions:

Select any **two real life products (examples are listed here**) dimensions from the manufacturers’ catalog database to specify the ‘size’ of the product and identify the preferred sizes for the particular products.

1) Shaft Diameters
2) Tractor Engine Power capacity
3) Refrigerator Capacity
4) Washing Machine Capacity etc

Experiment no -2
Design of Couplings

AIM: To design rigid and flexible couplings.

Design Problems:

A) Rigid Coupling

A rigid coupling is used to transmit 20 KW power at 720 rpm. There are four bolts and the pitch circle diameter of the bolts is 125 mm. The bolts are made of steel 45C8 (Syt = 380 N/mm2) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are finger tight in reamed and ground holes

B) **Flexible Coupling**

Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows:

a) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.
b) The allowable shear stress for cast iron is 15 MPa.
c) The allowable bearing pressure for rubber bush is 0.8 N/mm2.
d) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling.

Experiment no -3
Springs

AIM: To design helical and leaf springs.

Design Problems:

A) Helical Spring

Design a helical spring for a spring loaded safety valve (Ramsbottom safety valve) for the following conditions :

- Diameter of valve seat = 65 mm ; Operating pressure = 0.7 N/mm2;
- Maximum pressure when the valve blows off freely = 0.75 N/mm2;
- Maximum lift of the valve when the pressure rises = 3.5 mm ;
- Maximum allowable stress = 550 MPa ;
- Modulus of rigidity = 84 kN/mm2;
- Spring index = 6.

Draw a neat sketch of the free spring showing the main dimensions.

B) **Leaf Spring**

A locomotive semi-elliptical laminated spring has an overall length of 1 m and sustains a load of 70 kN at its centre. The spring has 3 full length leaves and 15 graduated leaves with a central band of 100 mm width. All the leaves are to be stressed to 400 MPa, when fully loaded.
The ratio of the total spring depth to that of width is 2. E = 210 kN/mm2.

Determine:

1. The thickness and width of the leaves.
2. The initial gap that should be provided between the full length and graduated leaves before the band load is applied.
3. The load exerted on the band after the spring is assembled.

Experiment no -4
Design of Pressure Vessels

AIM: To design pressure vessels.

Design Problem:

A high-pressure cylinder consists of a steel tube with inner and outer diameters of 20 and 40 mm respectively. It is jacketed by an outer steel tube, having an outer diameter of 60 mm. The tubes are assembled by a shrinking process in such a way that maximum principal stress induced in any tube is limited to 100 N/mm2. Calculate the shrinkage pressure and original dimensions of the tubes (E = 207 kN/mm2) and plot the distribution of stresses due to shrink fit. In service, the cylinder is further subjected to an internal pressure of 300 MPa. Plot the resultant stress distribution.

Experiment no -5
Rolling Contact Bearing

AIM: To select rolling contact bearing from manufacturer's catalogue.

Design Problem:

A) Write the basic procedure steps for the selection of a rolling contact bearing from the manufacturer's catalogue.

B) A single-row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life L10h of the bearing is 20 000 h. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball bearing for this application.

Experiment no -6

Sliding Contact Bearing

AIM: To select parameters for journal bearing.

Design Problem:

The following data is given for a 360° hydrodynamic bearing:
radial load = 3.2 kN
journal speed = 1490 rpm
journal diameter = 50 mm
bearing length = 50 mm
radial clearance = 0.05 mm
viscosity of lubricant = 25 cP
Assuming that the total heat generated in the bearing is carried by the total oil flow in the bearing, calculate
(i) coefficient of friction;
(ii) power lost in friction;
(iii) minimum oil fi lm thickness;
(iv) flow requirement in 1itres/min; and
(v) temperature rise.

Experiment no -7

Design of Gear Drives

AIM: To design a gear drives.

Design Problem:

A) Helical Gear

Design a pair of helical gears for transmitting 22 kW. The speed of the driver gear is 1800 r.p.m. and that of driven gear is 600 r.p.m. The helix angle is 30° and profile is corresponding to 20° full depth system. The driver gear has 24 teeth. Both the gears are made of cast steel with allowable static stress as 50 MPa. Assume the face width parallel to axis as 4 times the circular pitch and the overhang for each gear as 150 mm. The allowable shear stress for the shaft material may be taken as 50 MPa. The form factor may be taken as 0.154 – 0.912 / T_E, where T_E is the equivalent number of teeth. The velocity factor may be taken as, 350 / 350 + v, where v is pitch line velocity in m / min. The gears are required to be designed only against bending failure of the teeth under dynamic condition.

B) Worm Gear

A worm drive transmits 15 kW at 2000 r.p.m. to a machine carriage at 75 r.p.m. The worm is triple threaded and has 65 mm pitch diameter. The worm gear has 90 teeth of 6 mm module. The tooth form is to be 20° full depth involute. The coefficient of friction between the mating teeth may be taken as 0.10.

Calculate:

1. tangential force acting on the worm ;
2. axial thrust and separating force on worm; and
3. efficiency of the worm drive.

Experiment no -8

Design of Speed Gear Box

AIM: To design a speed gear box.

Design Problems:

A) Design a nine speed gear box to connect to a motor running at 720 rpm through a belt drive.

B) The gear box is to have a minimum speed of 31.5 rpm and a maximum speed of 500 rpm. Using standard spindle speeds,

- Draw the structure and speed diagram for the arrangement.
- Draw the gear box layout
- Select suitable standard pulley diameters for connecting the motor to the gear box shaft.

The standard pulley diameters are based on R20 series with a diameter starting from 80 mm.

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Experiment no -9

Design of Mechanisms

AIM: To design a valve gear mechanism for IC engine.

Design Problem:

Design a rocker arm, and its bearings, tappet, roller and valve spring for the exhaust valve of a four stroke I.C. engine from the following data:

Diameter of the valve head = 80 mm;
Lift of the valve = 25 mm
Mass of associated parts with the valve = 0.4 kg
Angle of action of camshaft = 110°
R. P. M. of the crankshaft = 1500.
From the probable indicator diagram, it has been observed that the greatest back pressure when the exhaust valve opens is 0.4 N/mm2 and the greatest suction pressure is 0.02 N/mm2 below atmosphere.

The rocker arm is to be of I-section and the effective length of each arm may be taken as 180 mm ; the angle between the two arms being 135°. The motion of the valve may be assumed S.H.M., without dwell in fully open position.

Choose your own materials and suitable values for the stresses.

Draw fully dimensioned sketches of the valve gear.