List of experiments and progressive assessment for term work (TW)
Academic Year: 2019-20

Course code: **ME 5 I** Sub & Code: **Elements of Machine Design(22564)**

Name of Candidate:_____ Enrl No:_____ Roll NO: _____

Marks: Max: Min: Name of Faculty: _____

Sr. No.	Title of Experiment	Date of Performance	Date of Submission	Assessment Marks	Dated Sign. Of Teacher with Remark
1	Study the various modes of failure and different International Standard codes for design of machine elements.				
2	Design and draw mechanical joints for given load.				
3	Design and draw mechanical levers for given load.				
4	Design and prepare the drawing on drawing sheet of transmission system by observing transmission on power through shaft, keys, coupling, pulley and belt drive etc.				
5	Design and prepare the CAD drawing of transmission system by observing transmission of power through Power Screw.				
6	Design of Fasteners.				
7	Design of Springs.				
				Total Marks out of (25*7=175)	
				Marks out of _____	

EXPERIMENT NO. 01

(To be performed by group of 4-5 students)

1.0 Title: Study the various modes of failure and different International Standard codes for design of machine elements.

2.0 Prior Concepts:

Types of Forces applied.
Types of stresses induced.
Fasteners (Threaded joints and key joints).
Coupling used for joining of shafts.

3.0 New concepts:

Proposition 1: Crushing stress

It is a localized compressive stress at the surface of contact between two members of a machine part that are relatively at rest.

Proposition 2: Bearing Pressure.

It is localized compression which exists at the surface of contact between two members of a machine part that are in relatively motion.

(Note: It is not the Bearing stress.)

Proposition 3: Standardization

Obligatory norms to which various characteristics of a product should confirm. Characteristics include material , dimensions and shape of the components, method of testing and storing of the product.

Proposition 4: Standard and code

A standard is a set of specification for parts, material or processes.

Standard ensure that products and services are safe, reliable and of good quality.

Standard reduce costs of minimizing waste and errors and increasing productivity.

4.0 Student Activity:

1. Observe equipment available in different laboratories used for practical of mechanical engineering and find the stresses developed in different components of equipment. Draw and determine the area under failure for each component.

2. Observe the mechanism of bicycle and identify the stresses developed in each component. Draw and determine the area under failure for each component.

3. Using table 1 of IS 4218 Annexure for standards find the dimensions of the metric thread profile when pitch of thread P is (Teacher shall provide the different values of pitch)

$$H = \sqrt{3}\,P / 2 = 0.866025404\,P$$
$$5/8\,H = 0.541265877\,P$$
$$3/8\,H = 0.324759526\,P$$
$$H/4 = 0.216506351\,P$$
$$H/8 = 0.108253175\,P$$

Pitch				
H				
5/8 H				
3/8 H				
H/4				
H/8				

4. Using table 2 of IS 4218 Annexure for standards determine the pitch of the metric thread profile when nominal diameter of thread D or d is (Teacher shall provide the different values)

Nominal Diameter D , d			coarse	Pitch P		
1st choice	2nd choice	3rd choice		Fine		

5.0 Questions for confirmation of learning:

1. Distinguish between screw and bolt.

_____
_____
_____
_____
_____
_____
_____
_____

2. Distinguish between standard and code.

_____
_____
_____
_____
_____
_____
_____
_____

3. State the meaning of the following material designation
    1. 40C10_____
    2. SG700/5_____
    3. 35Ni15Cr4_____
    4. FeE250_____
    5. 15Cr20Ni10_____
    6. X15Cr20Ni10_____

6.0 Conclusion :

1. Static force multiplied by perpendicular distance is called_____ of force.
2. Stress developed in paper when it is cut by scissor is_____.
3. IS 4218-(part 4) can be used for selection of dimensions and tolerances of metric threads for major/ minor diameter upto_____mm.(64/100/200/300)

Marks Obtained			Dated sign of Teacher
Process Related(10)	Product Related(15)	Total(25)	

EXPERIMENT NO. 02

(To be performed by group of 4-5 students)

Title: Design and draw mechanical joints for given load.

1.0 Prior Concepts:

Types of mechanical joints used in machines.

Types of stresses induced.

Knowledge of engineering materials.

2.0 New concepts:

Proposition 1: Factor of safety

It is ratio of maximum stress to working stress.

In case of ductile materials like mild steel, where the yield point is clearly defined, the factor of safety is based upon the yield point stress.

In case of brittle material like cast iron, where the yield point is not clearly defined, the factor of safety is based upon the ultimate point stress.

Proposition 2: Cotter Joint(Socket and spigot joint).

It is a type of joint that is used to connect two co-axial rods, subjected to either axial tensile or compressive force.

Proposition 3: Knuckle Joint.

It is type of joint that is used to connect two rods subjected to only tensile forces whose axes either coincide or intersect or lie in one plane.

Proposition 4: Turnbuckle.

It connects two threaded rods which are in tension and which require slight adjustment in length during the assembly.

3.0 Observations.

1. It is required to design the cotter joint to connect two steel rods of equal diameter. Each rod subjected to axial tensile force of 100kN. Design the joint and specify the main dimensions. Assume suitable data.

2. It is required to design Knuckle joint to connect two circular rods subjected to an axial force of 35kN. The rods are coaxial. Design the joint and specify the dimensions of its components. Assume suitable data.

3. It is required to design the turnbuckle for connecting the tie rods in the roof truss. The maximum pull in the tie rods is 10kN. Assume suitable data.

4.0 Questions for confirmation of learning

1. List four applications of knuckle joint.

1.
2.
3.
4.

2. Why taper is provided on cotter in case of cotter joint

_____
_____
_____
_____
_____
_____

5.0 Conclusion:

1. In case of cotter joint for cotter_____ material is used.

2. List two application of turnbuckle.

   1._____

   2._____

3. Mechanical joints are used to transmit _____ (axial force/ Torque) between two rods.

Marks Obtained			Dated sign of Teacher
Process Related(10)	Product Related(15)	Total(25)	

EXPERIMENT NO. 03

(To be performed by group of 4-5 students)

1.0 Title: Design and draw mechanical levers for given load.

2.0 Prior Concepts:

Types of mechanical levers used in machines.

Types of stresses induced.

Knowledge of engineering mechanics.

3.0 New concepts:

Proposition 1: Lever

It is rigid rod or bar capable of turning about a fixed point called fulcrum to multiply or transfer the force.

Proposition 2: Types of Levers.

Type 1: Those where the fulcrum is placed between the effort and the load.
Application:- Pliers, Bell Crank Lever in railway signal mechanism.

Type 2: Those where the load is placed between the fulcrum and the effort.
Application:- Lever operated safety valve used in boilers.

Type 3: Those where the effort is [placed between the fulcrum and the load.
Application:- Paper punching machine, weighing machine.

4.0 Observations:

A hand lever of a lever is 800mm long from the Centre of Gravity of the spindle to the point of pull of 400N. The effective overhang from nearest bearing is 100mm. If the permissible stress in tension, shear and crushing is not to exceed 6N/mm^2. Design the spindle, key, lever and boss. Assume the arm of lever to be rectangular having width as twice of thickness.

5.0 Questions for confirmation of learning:

1. List four applications of hand lever & Foot Lever

Hand lever	Foot Lever
1.	**1.**
2.	**2.**
3.	**3.**
4.	**4.**

2. Write the formula for failure of key under crushing and shear stress failure.

   _____
   _____
   _____
   _____
   _____

3. Write the formula for failure of shaft under pure torsion.

   _____
   _____
   _____
   _____

6.0 Conclusion:

1. In case of hand lever diameter of boss (d2) is _____ times diameter of shaft (d).
2. Diameter of shaft at the center of bearing (d1) is calculated by considering _____ moment.
3. Write the relation for width and height of key for square and rectangular key in terms of diameter of shaft.
   For square key_____
   For rectangular key_____

Marks Obtained			Dated sign of Teacher
Process Related(10)	Product Related(15)	Total(25)	

EXPERIMENT NO. 04

(To be performed by group of 4-5 students)

1.0 Title: Design and prepare the drawing on drawing sheet of transmission system by observing Transmission on power through shaft, keys, coupling, pulley and belt drive etc.

2.0 Prior Concepts:

Transmission system

Mechanical properties of materials

Theories of failure

3.0 New concepts:

Proposition 1: Transmission shaft

It is rotating machine element circular in cross section, which supports transmission elements like gears, pulleys and sprockets.

Proposition 2: Design of shaft.

It is a determination of shaft dimensions to sustain and to transmit the given power.

Shaft is may be solid or hollow.

Design of shaft is done using following theories of failure

Ductile material	Maximum shear stress theory
Brittle material	Maximum normal stress theory(Rankine Theory)

4.0 Observations

A line shaft is driven by means of a motor placed vertically below it. The pulley on the line shaft is 1.5m in diameter and has belt tensions of 5.4kN and 1.8kN on the tight side and slack side of the belt respectively. Both these tensions may be assumed to be vertical. The pulley is overhang from the shaft; the distance from center line of pulley to the center of bearing is 400mm. assume maximum allowable shear stress of 42MPa. Determine the diameter if the shaft

5.0 Questions for confirmation of learning:

1. State the reason for using hollow shaft rather than solid shaft for larger power transmission.

_____
_____
_____
_____
_____
_____

2. Distinguish between rigid and flexible coupling on the basis of

1. Alignment 2. Vibration 3. Deflection 4. Cost

_____
_____
_____
_____
_____
_____
_____

6.0 Conclusion:

1. For a square key, the permissible crushing stress is _____ the permissible shear stress.

2. When a small misalignment between two shafts is to be permitted while transmitting the torque, then _____coupling is used.

Marks Obtained			Dated sign of Teacher
Process Related(10)	Product Related(15)	Total(25)	

EXPERIMENT NO. 05

(To be performed by group of 4-5 students)

Title: Design and prepare the CAD drawing of transmission system by observing transmission of power through Power Screw.

2.0 Prior Concepts:

Types of thread profiles used in power screw.

Types of stresses induced in power screw.

3.0 New concepts:

Proposition 1: Power Screw

It is used for converting rotary motion into linear motion and transmitting power.

Proposition 2: Application of power screw.

1. To raise or lower load e.g. Screw jack, Toggle jack.
2. To obtain accurate motion in machining operations

4.0 Observations

Design of Screw jack

It is required to design a screw jack for supporting the machine parts during their repair and maintenance on the shop floor. It should be a general purpose jack with a load carrying capacity of 100kN and maximum lifting height of 500mm.

5.0 Questions for confirmation of learning

1. Give two reasons why we select square thread profile for screw jack

_____
_____
_____
_____

2. Write down four applications of power screw.

_____
_____
_____
_____
_____

6.0 Conclusion

1. The screw is subjected to _____(Torsional moment/Bending Moment/Compressive force/Torsional,Bending and Compressive Force)

2.Total hand force exerted on handle by two workers is_____(0.9*2*400 or 1.5*4*400 or 0.8*3*350)N

Marks Obtained			Dated sign of Teacher
Process Related(10)	Product Related(15)	Total(25)	

EXPERIMENT NO. 06

(To be performed by group of 4-5 students)

1.0 Title: Design of Fasteners.

2.0 Prior Concepts:

Types of thread profiles used in screwed joints.

Types of welded joints.

3.0 New concepts:

Proposition 1: Fasteners

A fastener is a hardware device that mechanically joints or affixes two or more objects together.

Proposition 2: Types of fasteners.

Fasteners are basically classified in two categories.

1. Screwed joint
2. Welded joint

4.0 Observations

1. (Teacher shall provide the question on screwed joint and welded joint)

5.0 Questions for confirmation of learning

1. Give two examples where screwed joints are preferred over welded joints.

_____
_____
_____
_____

2. Write down 2 advantages and 2 disadvantages of screwed joints

_____
_____
_____
_____
_____

3. Write down 2 advantages and 2 disadvantages of welded joints

_____
_____
_____
_____
_____

6.0 Conclusion

1. In case of screw joint major diameter of bolt is _____times core diameter of bolt.

2.In order to allow starting and stopping of the weld _____mm should be added to the length of each weld obtained

Marks Obtained			Dated sign of Teacher
Process Related(10)	Product Related(15)	Total(25)	

EXPERIMENT NO. 07

(To be performed by group of 4-5 students)

1.0 Title: Design of springs.

2.0 Prior Concepts:

Torsional strength.

Theories of columns.

Mechanical properties of materials.

3.0 New concepts:

Proposition 1: Mechanical springs

It is a resilient member capable of providing large elastic deformation.

Proposition 2: Design of Helical Springs.

It is a process of determining the dimensions of spring involving the following considerations

- Selection of appropriate spring material for the required application
- Space into which the spring must fit and operate
- Accuracy and reliability needed.

4.0 Observations

Design a closed coil helical spring used for an automobile suspension system.

Assume, Material – Cold drawn steel wire

$S_{ultimate}$ = 1090 MPa , Shear stress = 545MPa,

G = 81370MPa W = 1250 N

C = 6 Deflection = 30 mm

Determine the following

1. Diameter of wire
2. Number of turns
3. Length of spring

5.0 Questions for confirmation of learning

1. Define stiffness of the spring.

_____
_____
_____
_____

2. State two essential properties of material required for manufacturing of springs.

_____
_____
_____
_____
_____
_____

6.0 Conclusion

1. Buffer springs used for railway wagons are subjected to _____load.

2. Wahl's correction factor considers the effect of stress concentration due to_____ effect (curvature/shearing/bending) of the coil.

Marks Obtained			Dated sign of Teacher
Process Related(10)	Product Related(15)	Total(25)	