QUESTION BANK
GUJRAT UNIVERSITY
MECHANICAL ENGG. SEM III IDMD

Q.1. Explain hole-based and shaft based limit system with neat sketch

Q.2. Design a knuckle joint to connect two mild steel bars under a tensile load of

25KN. The allowable stresses are 65MPa in tension 50MPa, in shear and 83MPa in crushing

Q.3. What is factor of safety? Which are the factors to be considered while selecting the same?

Q.4. A rectangular bar of 40mmX60mm size is subjected to tensile load of 100KN. The factor of safety is 2. Select the suitable material from below given materials.
Mild Steel : Permissible tensile stress = 90MPa
Cast Iron: Permissible tensile stress = 20MPa

Q.5

The armature shaft of a 40 kW, 720 r.p.m. electric motor mounted on two bearings are as shown in Fig.no.1.the total magnetic pull on the armature is 7 kN and it is assumed to be uniformly distributed over a length of 700 mm midway between the bearings. The shaft is made-up of steel with an ultimate tensile strength of 770 MPa and yield strength of 580 MPa.Determine the shaft diameter using ASME code if, k_b = 1.5 and k_t = 1.0 Assumed that the pulley is keyed to the shaft. Fig 1

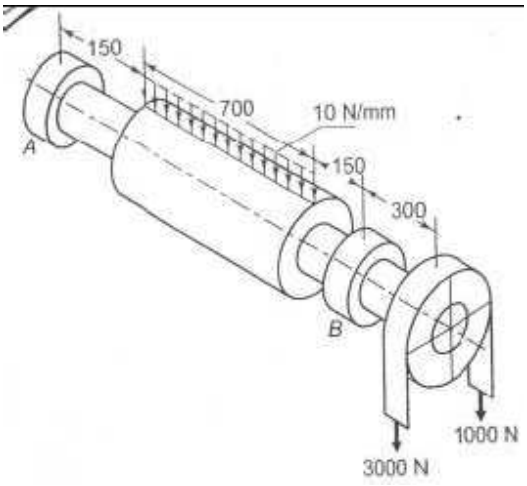

Fig 1.

Q.6.

A bracket is supported by means of four rivets of same size as shown in Fig-2. Determine the diameter of rivet if the maximum shear stress is 140MPa.

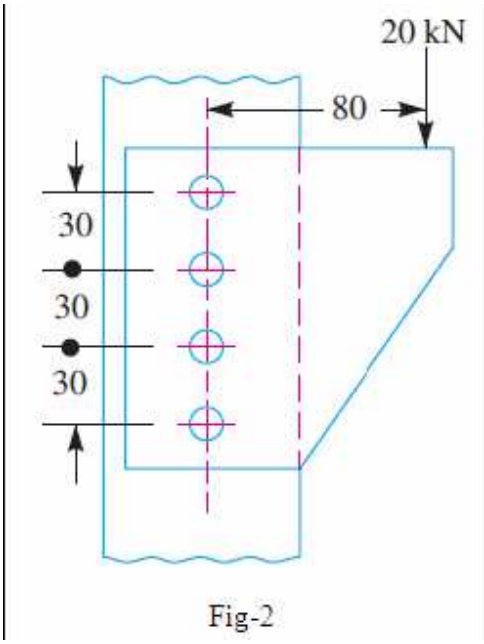

Fig-2

Q.7.
A lever loaded safety valve is 70mm in diameter and is to be designed for a boiler to blow off at pressure of 1N/mm2 gauge. Design a suitable mild steel lever of rectangular cross section. For mild steel: Permissible tensile stress = 70MPa, Shear stress = 50MPa, Bearing pressure intensity = 25N/mm2
The pin is also made of mild steel. The distance from the fulcrum to the weight of the lever is 880mm and the distance between the fulcrum and pin connecting the valve spindle links to the lever is 80mm.

Q.8.
A machine vice as shown in Fig-3 has single start square threads with 22mm nominal diameter and 5mm pitch. The outer and inner diameters of the friction collar are 55mm and 45mm respectively. The coefficient of friction for thread and collar are 0.15 and 0.17 respectively. The machinist can comfortably exert a force of 125N on the handle at a mean radius of 150mm. Assuming uniform wear for the collar calculate
1. Clamping force developed between the jaws
2. The overall efficiency of the clamp

Q.9
A right angle bell crank lever is shown in Fig-4. The load W = 4.5KN. The lever consists of forged steel material and a pin at the fulcrum. Take the

following permissible stress for the pin and lever material. Safe stress in tension = 75MPa, Safe stress in shear = 60MPa, Safe bearing pressure on pin = 10N/mm2. The length of fulcrum pin is 1.25 times the diameter of fulcrum pin. Calculate the following.
1. Reaction at fulcrum pin
2. Fulcrum pin dimensions
3. Lever dimensions

Q.10.
Explain the design procedure for lever loaded safety valve.

Q.11
Design a bush pin type protected flexible flange coupling to connect the output shaft of an electric motor to the shaft of a centrifugal pump. The motor delivers 20 kW power at 720 r.p.m. The starting torque of motor can be assumed to be 150 % of the rated torque. The permissible stresses are as under :
95MPa in shear for shaft, 100MPa in shear and 300MPa in crushing for key, 200MPa in tension and 35MPa in shear for pin and 17MPa in shear for flanges.
Consider the No. of pins = 6

Q.12

Design a cast iron flange coupling for a mild steel shaft transmitting 90KW at 250RPM. The allowable shear stress in the shaft is 40MPa and the angle of twist is not to exceed 1 degree in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30MPa. Take width of key = Shaft diameter/4 and thickness of key = Shaft diameter/6. Assume number of bolts = 4

Q.13

Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200N and is located at 300mm from the centre of the bearing. The diameter of the pulley is 200mm and the maximum power transmitted is 1KW at 120RPM. The angle of lap of the belt is 180 degree and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35MPa.

Q.14.

Explain different types of keys with its applications

Q.15
Explain purpose and requirement of shaft coupling

Q.16
1. compare the strengths of square key and rectangular key.
2. What is splined shaft? Explain the design of splined shaft.

Q.17
Explain purpose and requirement of shaft coupling

Q.18

Explain different types of keys with its applications

Q.19

Explain the following terms with neat sketches.
1) Tensile stress 2) Compressive stress
3) Principle Stress 4) Bearing pressure

Classify the different types of load & Explain each In brief.

Explain surface roughness symbols & importance of it.
Differentiate between assembly drawing & detail drawing.

Q.20

Enlist different types of cotter joint & explain design procedure of any one.

Q.21

A Knuckle joint is required to sustain a tensile load of 30 kN. Design the joint, if the permissible stresses are σ_t = 55 Mpa , τ = 42 Mpa , σ_c = 70 Mpa.

Q.22
A cotter joint is required to sustain a tensile load of 40 kN. Design the joint, if the permissible stresses are σ_t = 55 Mpa , τ = 42 Mpa , σ_c = 70 Mpa.

Q.23
Explain stress concentration & methods of reducing it by sketches.

Q.24
State & Explain the various criteria on which shaft are designed?

Q.25

Answer the following.
(i)Differentiate in between rigid and flexible coupling.
(ii)What is critical speed of shaft?
(iii)Write types of failure in riveted joint.

Q.26

(A)What is self-locking and over-hauling of power screw? Why the efficiency of self-locking square threaded screw is less than 50%?

(B) What is factor of safety? List the factors to be considered for deciding the magnitude of factor of safety?

Q.27

A bell crank lever is to be designed to raise a load of 5KN at the short arm end. The arm lengths are 150 mm and 500 mm. The permissible stresses for lever and pin materials in shear and tension are 60 MPa and 90 MPa respectively. The bearing pressure on the pin is to be limited to 12 MPa. Assume the lever cross section as t x 4t and fulcrum pin length as 1.25 times pin diameter

Q.28

A triple threaded power screw, used in a screw jack, has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square and the length of nut is 48 mm. The screw jack is used to lift a load of 7.5 KN. The coefficient of friction at the threads is 0.12 and collar friction is negligible. Calculate: (i) the principal shear stress in the screw body, (ii) the transverse shear stresses in the screw and the nut, (iii) the unit bearing pressure. State whether the screw is self-locking or not.

Q.29

Design a rocker arm lever having equal arms of 160 mm length inclined at 135^0 for an exhaust valve of a gas engine subjected to a maximum force of 2500 N at roller end. Consider – I cross section 6t x 2.5t x t size (where t = thickness of web and flange) for lever. The permissible stresses for the lever material are 80MPa in tension and design bearing pressure is pin 6 MPa for pin.

Q.30
A. State and explain the different functions of levers.
B Explain the different failures of riveted joints.

Q.31

Explain various failures of rivetted joints.

Q.32

Explain the following terms related to rivetted joints.
1) Pitch 3) Margin
2) Diagonal pitch

Q.33
Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm2. Assume joint efficiency as 75%, allowable tensile stress in the plate 90 Mpa, Compressive stress 140 Mpa & shear stress in the rivet 56 Mpa.

Q.34
Design a right angled bell crank lever having one arm 500 mm & the other 150 mm long. The load of 5 kN is to be raised acting on a pin at the end of 500 mm arm & the effort is applied at the end of 150 mm arm. The lever consists of steel forgings, turning on a point at the fulcrum. The permissible stresses for the pin & lever are 84 Mpa in tension & compression & 70 Mpa in shear, the bearing pressure on the pin is not to exceed 10 N/mm

Q.35
A. Determine the minimum size of a circular hole that can be punched in a M.S. plate, 5 mm thick and having ultimate shear strength of 300 MPa. Take compressive strength of punch as 360 MPa.
B. Define machine design. Explain different types of design problems stating suitable examples.

Q.36

Answer the following (Any THREE) **:**
(i) Define factor of safety. List and explain the factors affecting selection of it.
(ii) Explain the various steps of machine design process.
(iii) Explain the following materials giving their applications:
FG200, 16Ni3Cr2, 40C8.
(iv) Distinguish clearly between bending and bearing stress.
(v) List and explain the factors affecting selection of suitable materials.

Q.37
A. Differentiate between (with neat sketch):
1) crushing and compressive stresses
2) torsional and transverse shear stress
BDefine the following :
1) proof resilience 2) Preferred Number 3)Factor of Safety
4)Residual stress 5) principle stress

Q.38

Determine the diameter below which the angle of twist of a shaft and not the maximum stress, is the controlling factor in design of solid shaft in torsion. The allowable shear stress is 56 MPa and the maximum allowable twist is ¼ degree per meter. Take G = 84 MPa.

Q.39

Compare the weight, strength and rigidity of a hollow shaft of same external diameter as that of solid shafts, both the shafts are made of same material. Assume that diameter ratio for the hollow shaft is $d_i/d_o = 0.6$

Q.40

1. Determine the minimum size of a circular hole that can be punched in a M.S. plate, 5 mm thick and having ultimate shear strength of 300 MPa. Take compressive strength of punch as 360 MPa.
2. Define machine design. Explain different types of design problems stating suitable examples.