



KERALA AGRICULTURAL UNIVERSITY
B.Tech.(Agrl. Engg.) 2021 Admission
III Semester Final Examination – February 2023

Fpme.2104

Machine Design (2+0)

Marks: 50
Time: 2 hours
(10x1=10)

I Fill in the blanks

1. According to theory, failure occurs when the maximum principal stress is equal to the tensile yield strength.
2. is the ability of the material to resist scratching and indentation.
3. A localized compressive stress at the area of contact between two members is known as
4. The neutral axis of the beam is subjected to stress.
5. is the ability of the material to resist deformation under loading.

Answer the following

6. Define cast iron.
7. What is a Jackshaft?
8. Define self-locking of power screws.
9. What is spring index?
10. What is the purpose of using cotter joint?

II Write short notes on ANY FIVE of the following

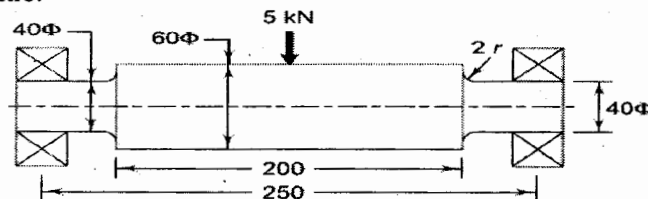
(5x2=10)

1. What are the various factors to be considered in deciding factor of safety?
2. Why Rankine's theory is not suitable for ductile materials?
3. Write a short note on notch of screw.
4. What are the methods used to improve the fatigue strength?
5. Write any two merits and demerits of welding process.
6. State the law of gearing.
7. What do you understand by single and double start threads?

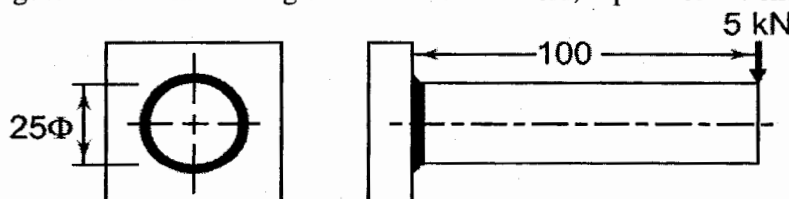
III Answer ANY FIVE of the following.

(5x4=20)

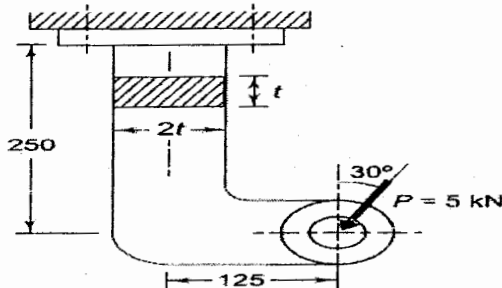
1. The principal stresses induced at a point in a machine component made of 50C4 (Yield strength, $S_{yt} = 460$ MPa) are as follows:
 $\sigma_1 = 200$ MPa, $\sigma_2 = 150$ MPa, $\sigma_3 = 0$.
Calculate the factor of safety by.
(i) Tresca theory and (ii) Distortion energy theory
2. A 40 mm diameter shaft is 50C4 steel (Ultimate strength, $S_{ut} = 660$ MPa) and has a machined surface. The expected reliability is 99% and the theoretical stress concentration factor is 1.6. The notch sensitivity factor is 0.9. Determine the endurance limit of the shaft.
3. Determine the maximum bending stress at the fillet section for the shaft shown in figure. Assume the shaft material to be brittle.



4. A solid circular beam, 25 mm in diameter, is welded to a support by means fillet weld as shown in figure. Determine the leg dimension of the weld, if permissible shear stress is 95 MPa.



5. In a pair of spur gears, the number of teeth on the pinion and the gear are 20 and 100 respectively. The module is 6 mm. Calculate
- the center distance
 - the pitch circle diameters of the pinion and the gear
 - addendum and dedendum
 - tooth thickness and bottom clearance
 - the gear ratio
6. A centrifugal pump is driven by 10 kW power 1440 rpm electric motor. There is a reduction gear box between the motor and the pump. The pump shaft rotates at 480 rpm. The design torque is 150% of the rated torque. The motor and pump shafts are made of plain carbon steel 40C8 (Yield strength, $S_{yt} = 380$ MPa) and the factor of safety is 4. Assume shear yield strength is half of tensile yield strength. Calculate
- diameter of the motor shaft and
 - diameter of the pump shaft
7. A bracket made of steel FeE200 (Yield strength, $S_{yt} = 200$ MPa) and subjected to a force of 5 kN acting at an angle of 30° to the vertical, is shown in figure below. The factor of safety is 4. Determine the dimensions of the cross section of the bracket.

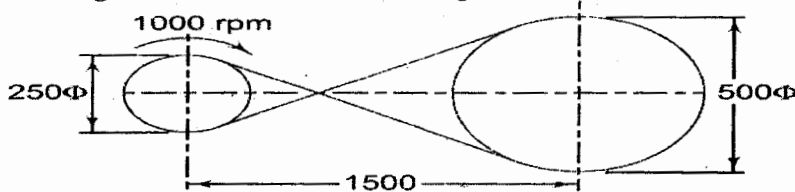


IV

Write an essay on ANY ONE of the following

(1x10=10)

- The layout of a crossed leather belt drive transmitting 7.5 kW is shown in figure. The mass of the belt is 0.55 kg per meter length and the coefficient of friction is 0.30. Calculate (i) the belt tensions on the tight and loose sides (ii) the length of the belt.



- It is required to design a helical compression spring subjected to a force of 500 N. The deflection of the spring corresponding to this force is 20 mm. The spring index should be 6. The spring is made of cold-drawn steel wire with ultimate tensile strength of 1000 MPa. The permissible shear stress of for the spring wire can be taken as 50% of the ultimate tensile strength. Take $G = 81370$ MPa.

Calculate:

- wire diameter
- mean coil diameter
- number of active coils
- total number of coils
- free length of the spring and
- pitch of the coils
