B.E. MECHANICAL ENGINEERING (PART TIME) SECOND YEAR SECOND SEMESTER EXAM 2018

Machine Design I

Time: 3hrs Full marks: 100

(Answer Group A and B from the following)

Missing data if any are to be reasonably assumed.

Group A 6×8=48

Answer any eight (8) for following in this group

1. Explain about BIS designations of plain carbon steel and alloy steel.
2. What is the distortion energy theory and explain with and prove that $S_{sy}=0.577\times S_{yt}$.
3. Draw the distribution of bending stress diagram for eccentric loaded beam and shear stress due to tensional moment of circular bar.
4. Explain with neat sketch the different types of keys and key failure.
5. Design for finite life and infinite life for reversed stress in fatigue design.
6. A hollow circular shaft of outer and inner diameters of d_0 and d_1 respectively is subjected to a tensional moment of M_t over a length l. The permissible angle of twist is θ degrees. Determine the outer diameter of the shaft.
7. Explain the different mechanical properties of engineering materials.
8. Determine the maximum normal stress and maximum shear stress for combined loading.
9. Explain the classification of engineering materials and describe.
10. Explain improvement of properties through heat treatment of steel.
11. Explain the effect of stress concentration and show with neat sketch the different method of 'Reduction of stress concentration'.

Group B 13×4=52

Answer any four (4) from following in this group

1. A manufacturer is interested in starting a business with five different models of tractors ranging from 7.5 to 75 kW capacities. Specify power capacities of the models. There is an expansion plan to further increase the number of models from five to nine to fulfill the requirement of farmers. Specify the power capacities of the additional models.

2. A rotating bar made of steel 45C8 (Sut = 630 N/mm2) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mm2. Calculate the fatigue strength of the bar for a life of 90,000 cycles.

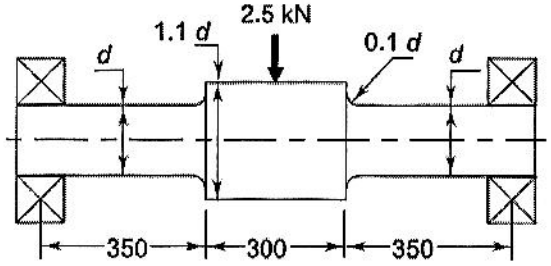
3. (a) A solid circular shaft of diameter 150 mm is subjected to an axial stress of 80 Mpa. It is further subjected to a torque of 15 kN-m. Determine the maximum principal stress experienced on the shaft. 7

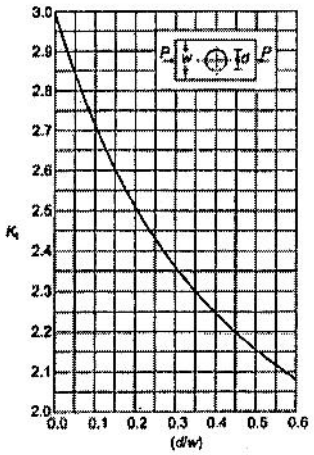
(b) A small element at the critical section of a component is in a bi-axial state of stress with the two principal stresses being 380 Mpa and 240 Mpa. Determine the maximum working stress according to the distorsion energy theory. 6

4. (a) A propeller shaft is required to transmit 45 kW power at 500 rpm. It is a hollow shaft, having an inside diameter 0.6 times of outside diameter. It is made of plain carbon steel and the permissible shear stress is 84 N/mm2. Calculate the inside and outside diameters of the shaft. 6
   (b) A Steel flat key (σ_{yt}=380 N/mm^2, factor of safety 2.5, cross section 20×15 mm^2) is fitted into the shaft having diameter 52 mm. The power transmitted by the shaft to the hub is 25 kW at 300 rpm. Determine the length of the key. 7

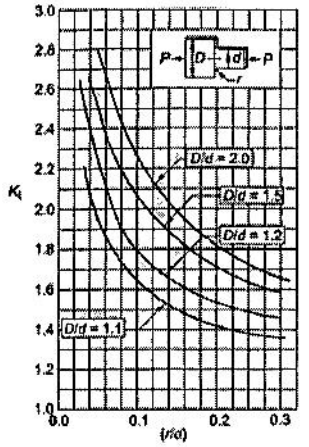
5. A rotating shaft, 40 mm in diameter, is made of steel FeE 580 (Syt = 580 N/mm2). It is subjected to a steady torsional moment of 250 N-m and bending moment of 1250 N-m. Calculate the factor of safety based on, (i) maximum principal stress theory; and (ii) maximum shear stress theory.

6. A non-rotating shaft supporting a load of 2.5 kN is shown in Figure below. The shaft is made of brittle material, with an ultimate tensile strength of 300 N/mm2. The factor of safety is 3. Determine the dimensions of the shaft.

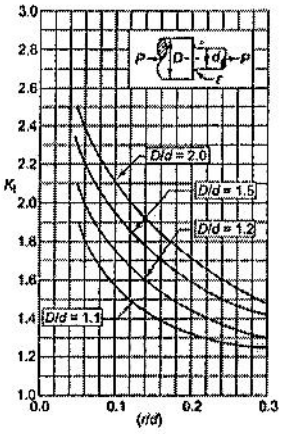




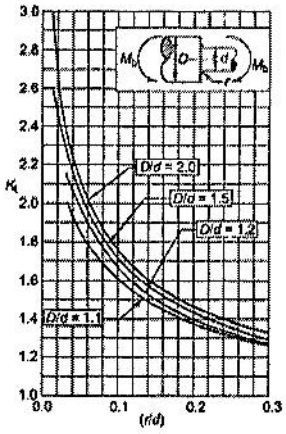
Stress Concentration Factor (Rectangular Plate with Transverse Hole in Tension or Compression)



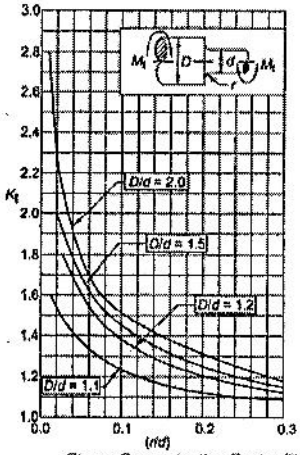
Stress Concentration Factor (Flat Plate with Shoulder Fillet in Tension or Compression)



Stress Concentration Factor (Round Shaft with Shoulder Fillet in Tension)



Stress Concentration Factor (Round Shaft with Shoulder Fillet in Bending)



Stress Concentration Factor (Round Shaft with Fillet in Torsion)