Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B. TECH (INDUSTRIAL & PRODUCTION ENGG.) END SEMESTER ONLINE EXAMINATIONS, JANUARY-FEBRUARY 2021

SUBJECT: DESIGN OF MACHINE ELEMENTS [MME 3155]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. A flat plate subjected to a tensile force of 5 kN is shown in figure-1. The plate material is grey cast iron FG 200 and the factor of safety is 2.5. Determine the thickness of the plate. 5

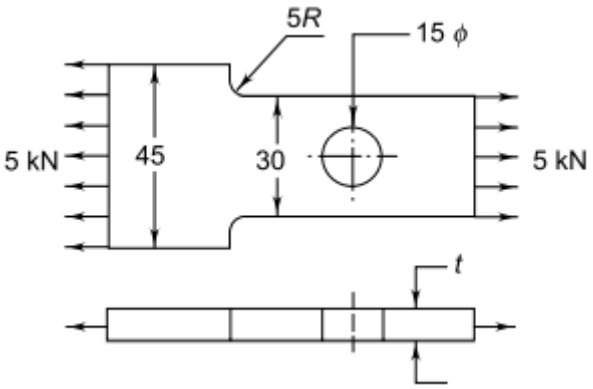
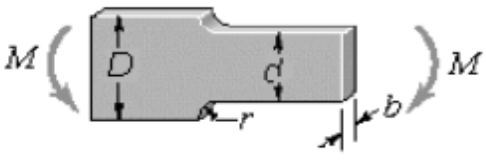


Figure 1

1B. A rectangular stepped steel bar is loaded as shown in figure-2. Determine the fatigue stress-concentration factor if ultimate stress of the materials is 689 MPa. Assume notch sensitivity factor =0.88. 3



r = 5mm
D = 50 mm
d = 40 mm
b = 1 mm

Figure 2

1C. Draw the S-N curve for steel and mention the important points. 2

2A. A transmission shaft is supported between two bearings, which are 750 mm apart. Power is supplied to the shaft through a coupling, which is located to the left of the left-hand bearing. Power is transmitted from the shaft by means of a belt pulley, 450 mm in diameter, which is located at a distance of 200 mm to the right of the left-hand bearing. The weight of the pulley is 300 N and the ratio of the belt tension of tight and slack sides is 2:1. The belt tensions act in vertically downward direction. The shaft is made of steel FeE 300 (σ_y = 300 N/mm^2) and the factor of safety is 3. Determine the shaft diameter, if it transmits 12.5 kW power at 300 rpm from the coupling to the pulley. Assume ($\tau_y = 0.5\ \sigma_y$) and suddenly applied load with minor shocks. 5

2B. A hollow shaft inner diameter to outer diameter ratio 3/5 is required to transmit 45kW at 1200 rpm. The shearing stress in the shaft must not exceed 60N/mm^2 and the twist in a length of 2.5 m is not to exceed 1°. Calculate the minimum external diameter of the shaft based on both strength and rigidity. Take, G=8.0kN/mm^2. 3

2C. What is the permissible shear stress as per the ASME Code? 2

3A. A helical compression spring is to be designed for an operating load range of 1kN to 1.3kN. The initial compression of the spring is 60 mm for a load of 1kN. Assume that the spring index is 10. The shear stress in the spring material is 500 MPa and modulus of rigidity is 82.7 GPa. 5

3B. Briefly explain the stress distribution at cross section of circular wire in a compression spring with a sketch. 3

3C. What is nested spring? Mention its advantages. 2

4A. A helical gear is required to transmit power of 12 kW at 10000 rpm of pinion. The teeth are of 20° full depth involute with at a helix angle of 45°. The pinion diameter is 80 mm and gear diameter 320 mm. The drive is safe for continuous operation. Find out the normal module and details of the drive. Assume that the material for gear and pinion is case hardened alloy steel and gear system is subjected to medium shock, and subjected to 10×10^6 repetitions of stress. 5

4B. Check wear and dynamic loads for the above gear system whether the design is safe ? 3

4C. What is the main disadvantage of a single helical gear? What is the remedy? 2

5A. Select a suitable deep groove ball bearing for a shaft of axial flow compressor with the following details; Radial load= 2000 N, Axial load = 4225 N and bore diameter required is70 mm. The required bearing life is of 50 hours per week to run 21 months continuously without change of bearing. 3

5B. Design a journal bearing to a machine tool with the following specific data; diameter of journal is 75mm, speed is 1440 rpm, load on the journal is 11500 N, working temperature of oil is 70°C and atmospheric temperature is 25°C. Select a suitable lubricant. 5

5C. Calculate the heat generated and heat dissipation for the above mentioned bearing and state whether artificial cooling is required? 2