Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2024

Course: Design of Machine Elements **Semester: V**

Program: B.Tech Mechanical, ADE and Mechatronics **Time : 03 hrs.**

Course Code: MECH3024 **Max. Marks: 100**

Instructions: 1. All the questions are compulsory.

2. Use of Design Data Handbook is allowed.

SECTION A (5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Identify the process involved for the approximate estimation of endurance limit.	**4**	**CO2**
Q 2	Define and classify the fluctuating load.	**4**	**CO2**
Q 3	Explain the procedure to minimize the stress concentration in stepped shaft.	**4**	**CO1**
Q 4	Develop R5 and R10 series.	**4**	**CO1**
Q 5	Designate the steel i. Carbon = 0.12–0.20%, silicon = 0.15–0.35%, manganese = 0.60–1.00%, nickel = 0.60–1.00%, chromium = 0.40–0.80%. ii. Carbon = 0.15–0.25%, silicon = 0.10–0.50%, manganese = 0.30–0.50%, nickel = 1.5–2.5%, chromium = 16–20%	**4**	**CO1**

SECTION B (4Qx10M= 40 Marks)

Q 6	The section of a steel shaft is shown in Fig. The shaft is machined by a turning process. The section at XX is subjected to a constant bending moment of 500 kN-m. The shaft material has ultimate tensile strength of 500 MN/m^2, yield point of 350 MN/m^2 and endurance limit in bending for a 7.5 mm diameter specimen of 210 MN/m^2. The notch sensitivity factor can be taken as 0.8. The theoretical stress concentration factor may be interpolated from the following tabulated values. where r_f is the fillet radius and d is the shaft diameter. The reliability is 90%. Determine the life of the shaft.	**10**	**CO2**

$\left(\frac{r_f}{d}\right)$	0.025	0.05	0.1
K_t	2.6	2.05	1.66

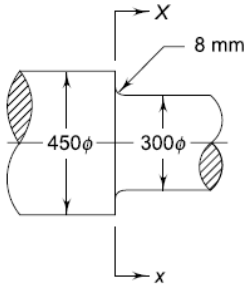


Table : Values of coefficients a and b in surface finish factor

Surface finish	*a*	*b*
Ground	1.58	–0.085
Machined or cold-drawn	4.51	–0.265
Hot-rolled	57.7	–0.718
As forged	272	–0.995

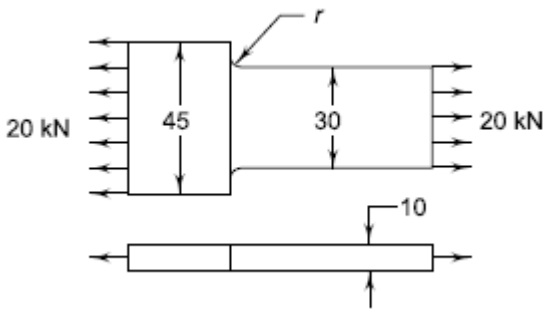
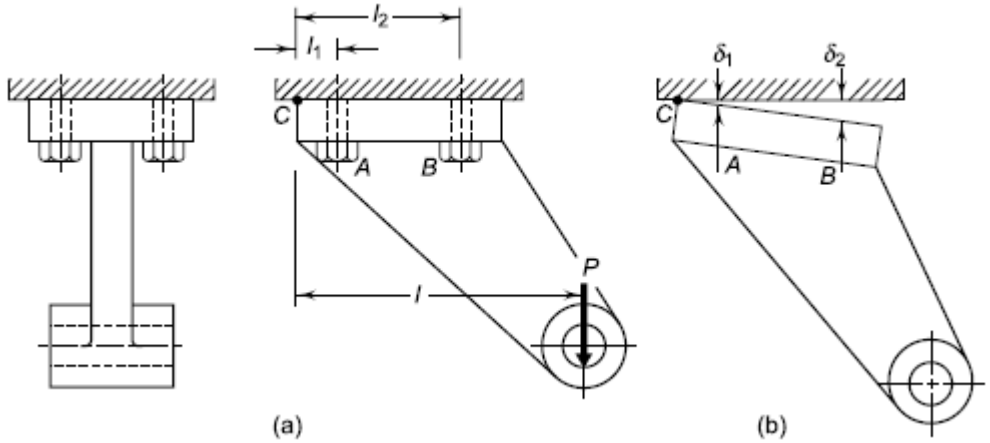
Table : Values of size factor

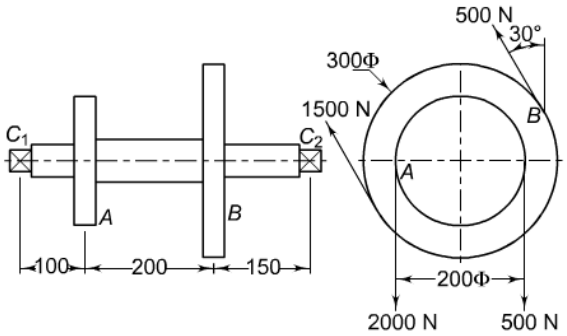
Diameter (d) (mm)	K_b
$d \leq 7.5$	1.00
$7.5 < d \leq 50$	0.85
$d > 50$	0.75

Table: Reliability factor

Reliability R (%)	K_c
50	1.000
90	0.897
95	0.868
99	0.814
99.9	0.753
99.99	0.702
99.999	0.659

Q 7	A plate, 10 mm thick, subjected to a tensile load of 20 kN is shown in Fig. The plate is made of cast iron (Sut = 350 N/mm2) and the factor of safety is 2.5. Determine the fillet radius.	**10**	**CO2**

			
Q 8	It is required to design a cottor joint to connect two rods of 25 mm dia subjected under 10 kN load.	**10**	**CO3**
Q 9	A cast iron bracket fixed to the steel structure is shown in Fig. It supports a load P of 25 kN. There are two bolts at A and two bolts at B. The distances are as follows, l_1 = 50 mm l_2 = 200 mm l = 400 mm. Determine the size of the bolts, if maximum permissible tensile stress in the bolt is 50 N/mm^2. 	**10**	**CO3**
SECTION-C (2Qx20M=40 Marks)			
Q 10	It is required to design a pair of spur gears. The pinion shaft is connected to a 10 kW, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4 : 1. Design the gears, specify their dimensions and suggest suitable surface hardness for the gears.	**20**	**CO4**
Q 11	A transmission shaft, supporting two pulleys A and B and mounted between two bearings C1 and C2 is shown in Fig. Power is transmitted from the pulley A to B. The shaft is made of plain carbon steel 45C8 (Sut = 600 and Syt = 380 N/mm2). The pulleys are keyed to the shaft. Determine the shaft diameter using the ASME code.	**20**	**CO4**



OR

The armature shaft of a 40 kW, 720 rpm electric motor, mounted on two bearings A and B, is shown in Fig. The total magnetic pull on the armature is 7 kN and it can be assumed to be uniformly distributed over a length of 700 mm midway between the bearings. The shaft is made of steel with an ultimate tensile strength of 770 N/mm2

and yield strength of 580 N/mm2. Determine the shaft diameter using the ASME code if, C_m = 1.5 and C_t = 1.0 Assume that the pulley is keyed to the shaft.