Mechanical

College of Engineering Pune

Department of Mechanical Engineering

Year (Final B. Tech.) 2012-13

(Subject: Advanced Machine Design) (ME 401)

Endsem Exam

Day & Date: 3rd Dec 2012 Max Marks: 50

Timing: Duration: 3 hr.

Instructions: 1. Attempt any five questions.
2. Write to the point and irrelevant writing will lead to deduction of marks.
3. Write only two reasons, if you are asked to do so. Examiner will not select correct answers from among the mix of right and wrong answers.
4. Sub questions should be written at one place.
5. Do not redraw any of the figures in the question paper.

Que. 1 (a) Identify the principle used while dimensioning the component shown in Fig. 1 . State its advantages and disadvantages. (4)
(b) As a designer give two solutions to avoid the effect of tolerance stack up (2)
(c) Identify manufacturing process of parts shown in Fig. 2, giving reason. (4)

Que. 2 (a) Justify the following statement giving two reasons. 'The high factor of safety does not ensure 100% reliability.' (2)
(b) Observe the graphs in Fig. 3. In which case reliability is high? Why? (2)
(c) The yield point strength of a shaft denoted by 'Y', is normally distributed with mean value of 550 MPa and variance 400. Similarly the load, denoted by 'L', is distributed normally with mean of 300MPa and variance of 1600. Calculate the factor of safety and reliability of the shaft. (3)
(d) The internal diameter on a lot of spacers, drilled on a drilling machine, is normally distributed and has variance of 0.0001. The rejection on the basis of design diameter is 25%. The design diameter is $30 \pm 0.06\ mm$ What is the mean value of the internal diameter of spacer produced on the drilling machine? (3)

Que. 3 (a) When does the variability arise? What do you understand by variability in mechanical properties of a material? (2)
(b) Write two uses of statistical considerations in Design. (2)
(c) A group of shafts is inspected for their diameters in mm which is distributed normally with mean and variance to be (30, 0.0016). What is the natural tolerance on the shaft diameter and what is the diameter of the shaft at '-2σ' away from the mean? (3)
(d) The breaking strength in 'N' of a synthetic fibre is normally distributed with mean of 800N and variance of 144. The purchaser of fabric requires the fabric to have strength atleast 772N. A fabric sample is randomly selected and tested. What is the probability that the strength of fabric is at least 772N. (3)

Que. 4 (a) How 'temperature' and 'size of the component' affect its yielding? (2)
(b) Differentiate between (4)
I. EPFM & LEFM,
II. Brittle failure, ductile failure
(c) Determine G_I for a strip of width B, thickness h, modulus E with a center crack of length 2a as shown in the figure 4. Given $u = \frac{Pl^3}{48EI}$ where u is the deflection of the center of the beam of length 'l' loaded with center load. If h= 1.5mm, B= 25mm, P= 1000N, a= 25mm, E= 70GPa, G_{IC} = 25kJ/m^2 determine whether the crack is safe. (2+2)

OR

(c) For a strip with edge crack under bending shown in the figure 5, determine the SIF. If K_{IC} = 40 MPa√m, is the crack likely to grow. (M = 1000Nm, W = 40 mm, a = 20mm, B = 20mm)

Given: $K_I = \frac{6M}{BW^2}\sqrt{\pi a} f(\propto)$ where f(α) = a/W, B= plate thickness.

$f(\propto) = 1.12 - 1.40 \propto +7.33 \propto^2 - 13.083 \propto^3 + 14 \propto^4$ (4)

Que. 5 (a) Why the results obtained by of S-N Curve are unreliable? Give three reasons (3)

(b) Why it is difficult to mathematically model environmental assisted corrosion? (3)

(c) Determine the critical crack length in a centered cracked plate, loaded in mode I, if critical stress intensity factor K_{IC} = 60MPa√m and far field stress is 120MPa (2)

(d) Stress field is same for plane stress and plane strain problems. Why is it not so for displacement fields? (2)

Que. 6 (a) A CT specimen has been made by estimating K_{IC} of the material and meeting all the geometrical constraints. The experimentally obtained Load-CMOD curve is shown on the graph below (Figure 6). Determine K_Q. Is it a valid test? Justify your answer.

(Yield stress =400MPa, crack length a= 24mm, plate thickness B= 25mm, W= 50mm. For these values of a and W f (a/W)= 9.093, $K_I = \frac{P}{B\sqrt{W}} f\left(a/W\right)$

The graph sheet attached to this can be attached to your answer sheet. (5)

(b) What is refinement of design space? (3)

(c)What is analogy? Explain with examples not discussed in the class or text book (2)

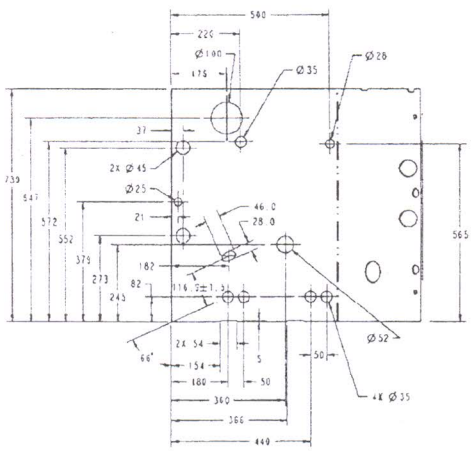


Figure 1

(A) (B)

Figure 2

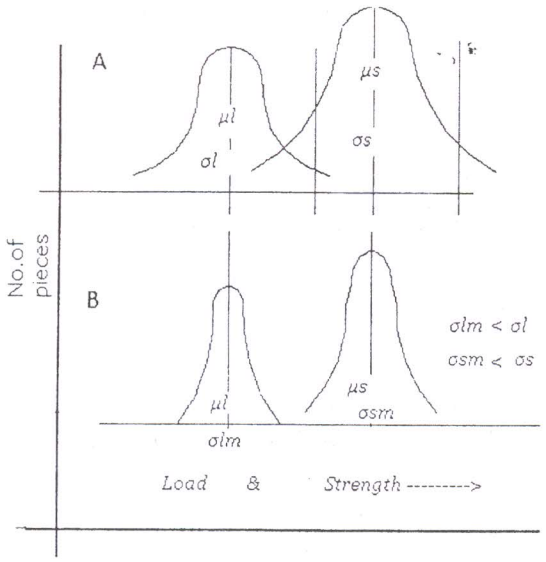


Figure 3

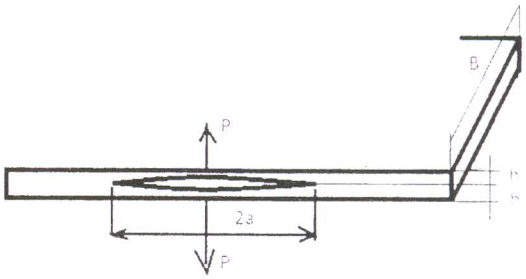


Figure 4

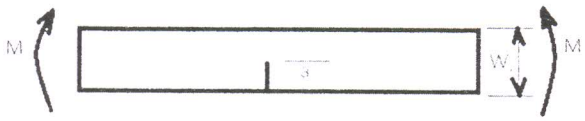


Figure 5

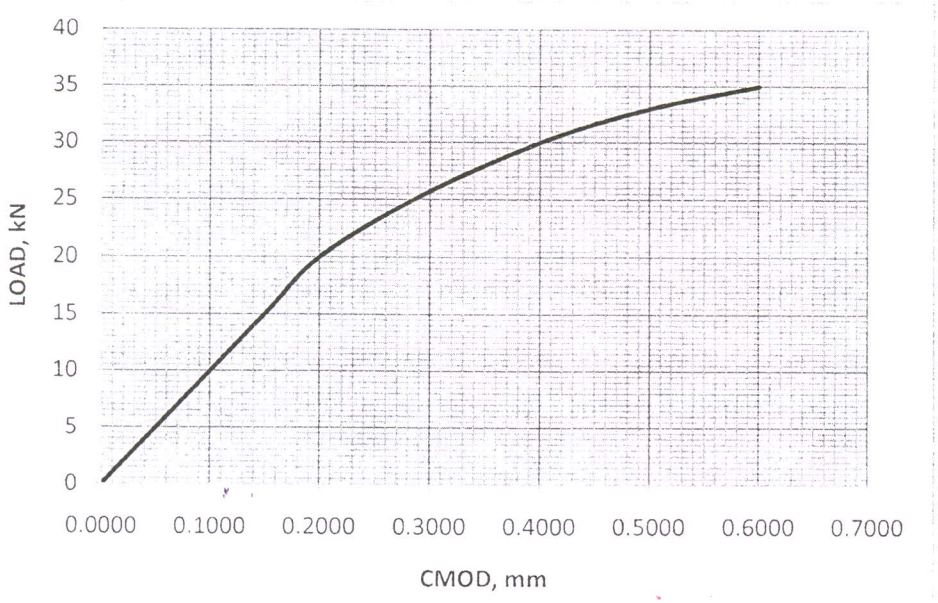
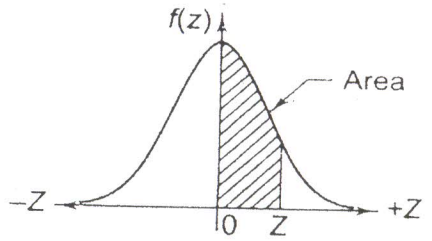


Figure 6

Z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999



Area below normal curve