No. of Printed Pages : 8 **BME-024**

BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)

00544

Term-End Examination
June, 2010

BME-024 : MECHANICAL ENGINEERING DESIGN

Time : 3 hours *Maximum Marks : 70*

Note : *All questions are **compulsory**. Use of calculator is allowed. Required Tables from Machine Design Data Book are given in the paper for your help. Assume suitable data if data is missing.*

1. *Attempt **any eight** questions :* **8x5=40**

(a) Define modulus of resilience and modulus of toughness. Discuss the importance of modulus of resilience in Mechanical Engineering Design.

(b) For bevel gear, define the following :

(i) Cone distance

(ii) Pitch angle

(iii) Face angle

(iv) Root angle

(v) Back cone distance

(c) What are the various forces acting on worm and worm gear ?

(d) Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures.

(e) List the important physical characteristics of a good bearing material. What are the commonly used materials for sliding contact bearings ?

(f) What are the materials used for brake lining ? Discuss the different types of brakes giving at least one practical application for each.

(g) Write procedure for designing a centrifugal clutch.

(h) What do you understand by the term riveted joint ? Show by neat sketches the various ways in which a riveted joint may fail.

(i) What are the applications of springs ? Define the terms pitch, and solid length used in connection with compression springs.

(j) Define fits and tolerances. Distinguish between allowance and tolerance.

2. Attempt *any three* questions : **3x10=30**

(a) A solid circular shaft is subjected to a bending moment of 3.5 kNm and a torque of 1 kNm. The shaft is to be made in carbon steel for which $\sigma_r = 480$ MPa and $\tau_r = 265$ MPa. If the beginning of plastic deformation is to be avoided calculate the shaft diameter using :

(i) Maximum Principal stress theory,

(ii) Maximum shearing stress theory, and

(iii) Distortion Energy theory.

(b) For a transition fit H7/n6, calculate the extreme diameters of shaft and hole if the nominal diameter is 15 mm. Calculate the largest clearance.

(c) A solid shaft is transmitting 1 MW at 240 rpm. Determine the diameter of the shaft if the maximum torque transmitted exceeds the mean torque by 20%. Take the maximum allowable shear stress as 60 MPa.

(d) Two shafts are connected by means of a flanged coupling to transmit torque of 25 N-m. The flanges of the coupling are fastened by four bolts of the same material at a radius of 30 mm. Find the size of the bolts if the allowable shear stress for the bolt material is 30 MPa.

(e) A plate 100 mm wide and 12.5 mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of the weld so that the maximum stress does not exceed 56 MPa. consider the joint first under static loading and then under fatigue loading.

(stress concentration factor for parallel fillet welding is 2.7).

Table 0·3
International Tolerance Grades
(All values in mm)

Basic Sizes	*Tolerance grade*					
	I T 6	*I T 7*	*I T 8*	*I T 9*	*I T 10*	*I T 11*
0–3	0·006	0·010	0·014	0·025	0·040	0·060
3–6	0·008	0·012	0·016	0·030	0·048	0·075
6–10	0·009	0·015	0·018	0·036	0·058	0·090
10–18	0·011	0·018	0·027	0·043	0·070	0·110
18–30	0·013	0·021	0·033	0·052	0·084	0·130
30–50	0·016	0·025	0·039	0·062	0·100	0·160
50–80	0·019	0·030	0·046	0·074	0·120	0·190
80–120	0·022	0·035	0·054	0·087	0·140	0·220
120–180	0·025	0·040	0·063	0·100	0·160	0·250
180–250	0·029	0·046	0·072	0·115	0·185	0·290
250–315	0·032	0·052	0·081	0·130	0·210	0·320
315–400	0·036	0·057	0·089	0·140	0·230	0·360

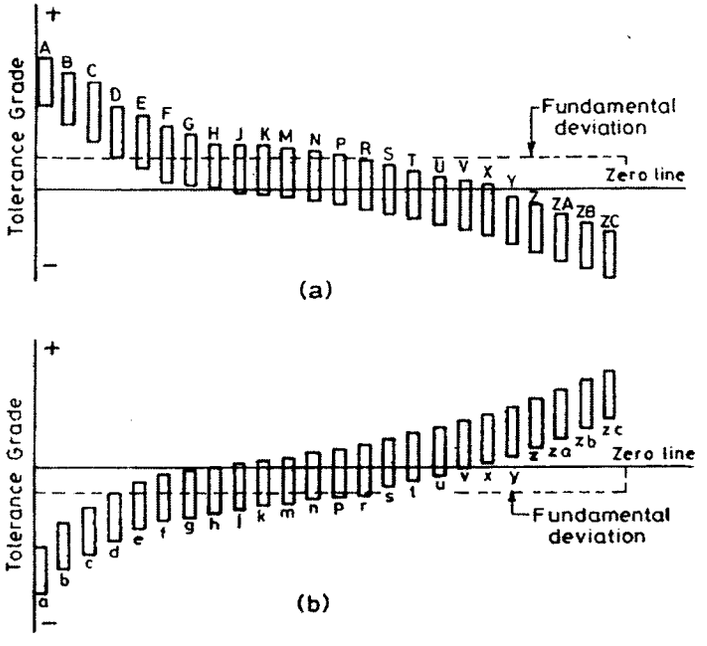

Fig. . Schematic presentation of deviations for (*a*) hole, (*b*) shaft.

Table 0-4

Preferred Fits Using Basic Hole System

Fit	*Description of Fit*	*Symbol*
Clearance	Loose running fit–wide commercial tolerance	H 11/*c* 11
	Free running fit–large temp. variation, high speeds, heavy pressure	H 9/*d* 9
	Close running fit for running on accurate at moderate speeds and pressure	H 8/*f* 7
	Slide fit to move and turn freely and to locate accurately	H 7/*g* 6
	Locational clearance fit–snug fit for location of stationary part, freely assembled and disassembled.	H 7/*h* 6
Transition	Locational transition fit for accurate location–a compromise between clearance and interference	H 7/*k* 6
	Locational transition fit for more accurate location where greater interference is permissible	H 7/*n* 6
Interference	Locational interference fit for parts requiring rigidity and alignment with prime accuracy of location with no special requirement of bore pressure	H 7/*p* 6
	Medium drive fit for steel parts, the tightest fit to be used with C.I. parts or light sections	H 7/*s* 6
	Force fit–for parts which can be shrunk	H 7/*u* 6

Table 0-5
Fundamental Deviation for Shaft (All values in mm)

Nominal size	*Upper deviation*				*h*	*Lower deviation*				
	c	*d*	*f*	*g*		*k*	*n*	*p*	*s*	*u*
0–3	–0·060	–0·020	–0·006	–0·002	0	0	0·004	0·006	0·014	0·018
3–6	–0·070	–0·030	–0·010	–0·004	0	0·001	0·008	0·012	0·019	0·023
6–10	–0·080	–0·040	–0·013	–0·005	0	–	0·010	0·015	0·023	0·028
10–14	–0·095	–0·050	–0·016	–0·006	0	–	0·012	0·018	0·028	0·033
14–18	–	–	–	–	–	–	–	–	–	–
18–24	–0·110	–0·065	–0·020	–0·007	0	0·002	0·015	0·022	0·035	0·041
24–30	–	–	–	–	–	–	–	–	–	0·048
30–40	–0·120	–0·080	–0·025	–0·009	0	–	0·017	0·026	0·043	0·060
40–50	–0·130	–	–	–	–	–	–	–	–	0·070
50–65	–0·140	–0·100	–0·030	–0·010	0	–	0·020	0·032	0·053	0·087
65–80	–0·150	–	–	–	–	–	–	–	0·059	0·102
80–100	–0·170	–0·120	–0·036	–0·012	0	0·003	0·023	0·037	0·071	0·124
100–120	–0·180	–	–	–	–	–	–	–	0·077	0·144
120–140	–0·200	–0·145	–0·043	0·014	0	–	0·027	0·043	0·092	0·170
140–160	–0·210	–	–	–	–	–	–	–	0·100	0·190
160–180	–0·230	–	–	–	0	–	–	–	0·108	0·210
180–200	–0·240	–0·170	–0·050	–0·015	0	0·004	0·031	0·050	0·122	0·236
200–225	–0·260	–	–	–	–	–	–	–	0·130	0·258
225–250	–0·280	–	–	–	–	–	–	–	0·140	0·284
250–280	–0·300	–0·190	–0·056	–0·017	0	–	0·034	0·056	0·158	0·315
280–315	–0·330	–	–	–	–	–	–	–	0·170	0·350
315–355	–0·360	–0·210	–0·062	–0·081	0	–	0·037	0·062	0·190	0·390
355–400	–0·400	–	–	–	–	–	–	–	0·208	0·435

Note : In blank positions marked by–read value immediately above. The nominal size range excludes the first and includes the second.

Table 0.6

DESIGN Dimensions of SCREW THREADS

(*Coarse*)

Designation	*p(mm)*	*d or D (mm)*	d_p *(mm)*	d_c *(mm)*		*Thread depth (mm)*	*Stress area* (mm^2)
				nut	*bolt*		
M 0·4	0·1	0·400	0·335	0·292	0·277	0·061	0·074
M0·8	0·2	0·800	0·670	0·584	0·555	0·123	0·295
M 1	0·25	1·000	0·838	0·729	0·693	0·153	0·460
M 1·4	0·3	1·400	1·205	1·075	1·032	0·184	0·983
M 1·8	0·35	1·800	1·573	1·421	1·371	0·215	1·70
M 2	0·4	2·000	1·740	1·567	1·509	0·245	2·07
M 2·5	0·45	2·500	2·208	2·013	1·948	0·276	2·48
M 3	0·5	3·000	2·675	2·459	2·387	0·307	5·03
M 3·5	0·6	3·500	3·110	2·850	2·764	0·368	6·78
M 4	0·7	4·000	3·545	3·242	3·141	0·429	8·78
M 5	0·8	5·000	4·480	4·134	4·019	0·491	14·20
M 6	1	6·000	5·350	4·918	4·773	0·613	20·10
M 8	1·25	8·000	7·188	6·647	6·466	0·767	36·60
M 10	1·5	10·000	9·026	8·876	8·160	0·920	58·30
M 12	1·75	12·000	10·863	10·106	9·858	1·074	84·00
M 14	2	14·000	12·701	11·835	11·564	1·227	115·00
M 16	2	16·000	14·701	13·895	13·545	1·227	157·00
M 18	2·5	18·000	16·376	15·294	14·933	1·534	192
M 20	2·5	20·000	18·376	17·294	16·933	1·534	245
M 24	3	24·000	22·051	20·752	20·320	1·840	353
M 30	3·5	30·000	27·727	26·211	25·706	2·147	561
M 36	4	36·000	33·402	31·670	31·093	2·454	976
M 45	4·5	45·000	42·077	40·129	39·416	2·760	1300
M 52	5	52·000	48·752	46·587	45·795	3·067	1755
M 60	5·5	60·000	56·428	54·046	53·177	3·374	2360

Table 0.7

DESIGN **Dimensions of** SCREW THREADS

(Fine)

Designation	*p(mm)*	*d or D (mm)*	d_p *(mm)*	d_c *(mm)*		*Thread depth (mm)*	*Stress area* (mm^2)
				nut	*screw*		
M 8 × 1	1	8·000	7·350	6·918	6·773	0·613	39·2
M 10 × 1·25	1·25	10·000	9·188	8·647	8·466	0·767	61·6
M 12 × 1·25	1·25	12·000	11·184	10·647	10·466	0·767	92·1
M 14 × 1·5	1·5	14·000	13·026	12·376	12·166	0·920	125
M 16 × 1·5	1·5	16·000	15·026	14·376	14·160	0·920	167
M 18 × 1·5	1·5	18·000	17·026	16·376	16·160	0·920	216
M 20 × 1·5	1·5	20·000	19·026	18·376	18·160	0·920	272
M 22 × 1·5	1·5	22·000	21·026	20·376	20·160	0·920	333
M 24 × 2	2	24·000	22·701	21·835	24·546	1·227	384
M 27 × 2	2	27·000	25·701	24·835	24·546	1·227	496
M 30 × 2	2	30·000	28·701	27·835	27·546	1·227	621
M 33 × 2	2	33·000	31·701	30·335	30·546	1·227	761
M 36 × 3	3	36·000	34·051	32·752	32·391	1·840	865
M 39 × 3	3	39·000	37·051	35·752	35·391	1·840	1028