KOLEJ YAYASAN PELAJARAN JOHOR

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PEPERIKSAAN AKHIR

NAMA KURSUS	:	**REKABENTUK KEJURUTERAAN**
KOD KURSUS	:	**DKM 2153**
PEPERIKSAAN	:	**MEI 2017**
MASA	:	**$2\frac{1}{2}$ JAM**

ARAHAN KEPADA CALON

1. **Kertas soalan ini mengandungi SATU (1) bahagian.**
2. Calon tidak dibenarkan membawa masuk sebarang peralatan ke dalam bilik peperiksaan kecuali dengan kebenaran pengawas peperiksaan.
3. Sila pastikan bahan-bahan berikut diperoleh untuk sesi peperiksaan ini:
   i. Kertas Soalan
   ii. Buku Jawapan

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU

KERTAS SOALAN INI MENGANDUNGI 13 HALAMAN BERCETAK TERMASUK MUKA HADAPAN

BAHAGIAN A

Bahagian ini mengandungi **LIMA (5)** soalan.

Jawab **EMPAT (4)** daripada **LIMA (5)** soalan di dalam Buku Jawapan.

Soalan 1/ Question 1

a. Terangkan definisi bagi momen dan prinsipnya.
Explain the definition of moment and its principle.

[5 markah]

b. Merujuk kepada **Rajah S1,** sebuah rasuk berdiameter 20 mm dan 100 mm panjang di sokong pada hujungnya. Kirakan maksima:

i. Tegasan tegangan dan tegasan ricih. **[10 markah]**

ii. Tegasan lentur. **[7 markah]**

iii. Jumlah tegasan normal dan jumlah tegasan ricih. **[3 markah]**

Yang berlaku pada rasuk tersebut.

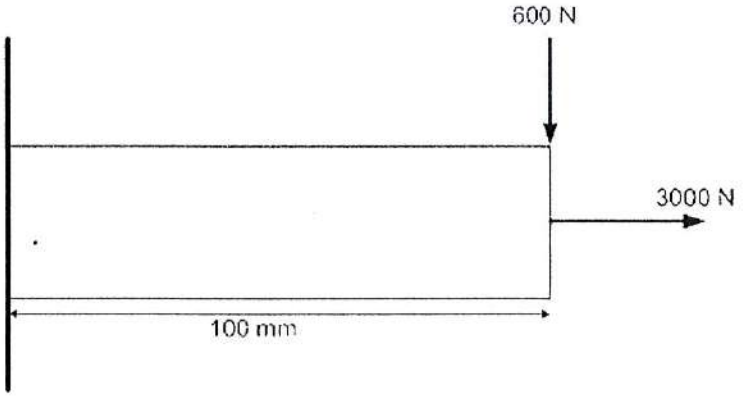
*Refererring to **Figure Q1** a member of 20 mm diameter by 100 mm long is supported at one end as cantilever. Calculate the maximum:*

i. Tensile and shear stress.

ii. Bending stress.

iii. Total normal and shear stress.

That occur on the member.



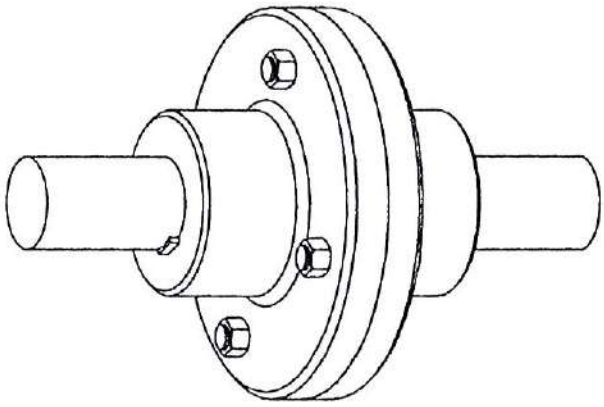
Rajah S1/ *Figure Q1*

Soalan 2/ Question 2

a. Huraikan **empat** (4) faktor mempengaruhi ketahanan lesu.
*Explain **four** (4) factor effecting fatigue on metal.*

[8 markah]

b. **Rajah S2** menunjukan dua aci bersambung dengan menggunakan teknik *flange coupling* untuk memindahkan 25 kN.m tork. *Flange coupling* diikat mengunakan 4 biji selak daripada bahan yang sama pada jejari 30 mm. Carikan saiz selak jika tegasan bukti minimum bahan yang dibenarkan adalah 310 MPa.
***Figure Q2** shows two shafts are connected by using flange coupling technique 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 mimimum proof strength for the bolt material is 310 MPa.*



Rajah S2/ Figure Q2

[12 markah]

Soalan 3/ Question 3

a. Apakah fungsi bagi galas?
What is the function of bearing?

[2 markah]

b. Nyatakan dan lukiskan dua (2) jenis galas.
List and sketch two (2) type of bearing.

[4 markah]

c. Berikan **dua (2)** kelebihan dan kekurangan galas *rolling-contact* berbanding galas *sliding-contact.*
*Give **two (2)** advantages and disadvantages of rolling-contact bearing compare to sliding-contact bearing.*

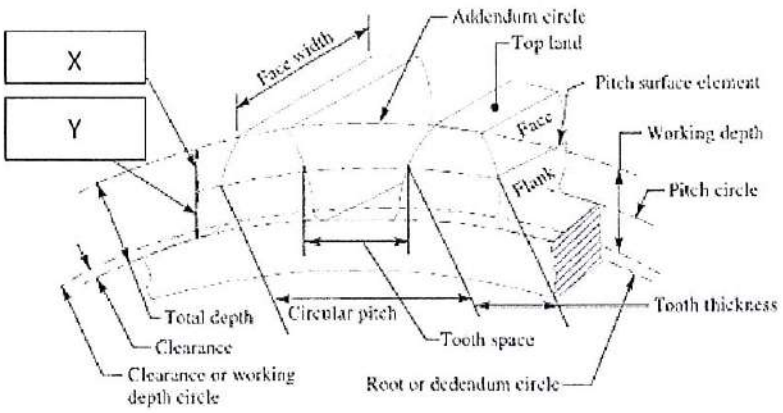
[4 markah]

d. Sebuah galas akan dipilih untuk menampung 6.5 kN beban secara radial. Jangka hayat rekabentuk mestilah 5000 jam dengan kadar putaran 900 rpm. Bagi sebuah galas yang mempunyai realibiliti 0.9 dan pada kadar satu juta putaran, tentukan galas yang bersesuaian yang terdapat di dalam katalog.
A ball bearing to be select to carry a radial load of 6.5 kN. The designed life is 5000 hr with a rotation rate of 900 rpm. For a bearing reliability of 0.90 and one million revolutions, find the suitable bearing in the available catalog.

[15 markah]

Soalan 4/ Question 4

a. **Rajah S4** menunjukan skematik gear. Nyata dan terangkan bahagian X dan Y.
__Figure Q4__ show a gear schematic. State and briefly part X and Y.



Rajah S4/ Figure Q4

[8 markah]

b. Pemacu keluli *BHN hobbed spur gear* mempunyai 19-gigi dan menjana 15 kW pada kelajuan 360 rpm kepada 77-gigi dengan bahan gear yang sama. Kelebaran muka gear adalah 75 mm pada 20° dan m = 6mm. Dengan menggunakan formula Lewis, kirakan tegasan lenturan.
A 19-tooth 300 BHN Hobbed steel spur gear pinion transmits 15 kW at a pinion speed of 360 rpm to a 77-tooth of the same material gear. The face width is 75 mm at 20° and m = 6mm. By using Lewis formula calculate the bending stress.

[17 markah]

Soalan 5/ Question 5

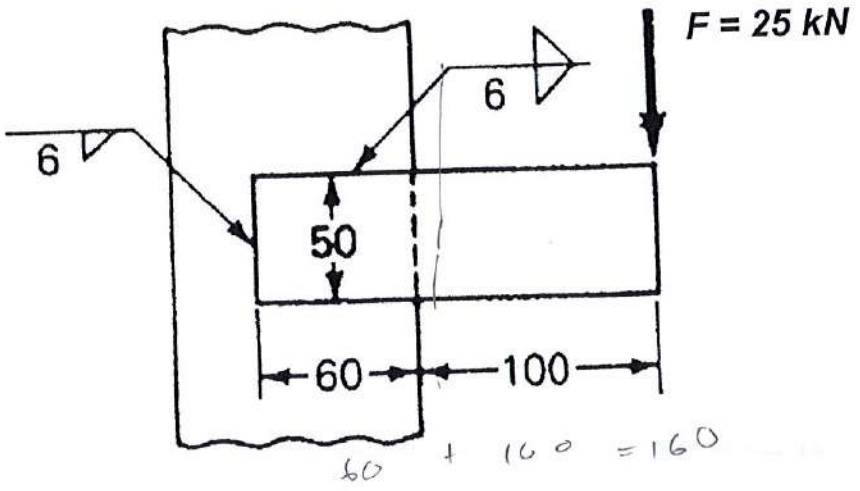
a. Terangkan definasi kimpalan.
Define definition of welding.

[2 markah]

b. Nyatakan jenis-jenis gabungan kimpalan.
State types of welding joint.

[4 markah]

c. **Rajah S5** menunjukkan dua keping plat yang disambung bertindih menggunakan kaedah kimpalan. Sekiranya nilai *F* adalah 25 kN, kirakan maksimum stress yang ditampung oleh logam kimpalan.
***Figure Q5** shows two plates are stack joined by using weld method. If value F given 25 kN, calculate the maximum stress welded metal can be supporting.*



Rajah S5/ Figure Q5

[19 markah]

KERTAS SOALAN TAMAT

Formula:

Tensile stress , $\sigma_t = \frac{F}{A}$

Shear Stress, $\tau = \frac{F}{A}$

Bending Stress, $\sigma_B = \frac{My}{I}$

Torsional Stress, $\tau_t = \frac{Tr}{J}$

; *where* $J = \frac{\pi D^4}{32}$

Total normal stress, $\sigma_T = \sigma_t + \sigma_B$

Total shear stress, $\tau_T = \tau + \tau_t$

$F.S = \frac{1}{\frac{\tau}{S_{yt}} - \frac{\tau}{S_{yc}}}$

Bolt and screw analysis

$\tau' = \frac{V\prime}{A} = \frac{V\prime}{nA}$

$\tau'' = \frac{V''}{A} = \frac{U_s r_n}{A}$

; $U_s = \frac{T}{\sum r_i^2}$

$\sigma' = \frac{F\prime}{A}$

$\sigma'' = \frac{F''}{A} = \frac{U_b l_n}{A}$

; $U_b = \frac{M}{\sum l_i^2}$

$\sigma_{equi} = \sqrt{\sigma_T^2 + 3\tau_R}$

$F.S = \frac{S_p}{\sigma_{equi}}$ *or* $F.S = \frac{S_{sy}}{\sigma_{equi}}$

; *where* $S_{sy} = \frac{S_y}{2}$

Bearing analysis

$$C_{10} = Fr \left[\frac{L_D \times N_D \times 60}{10^6}\right]^{1/a}$$

Gear analysis

$\frac{n_p}{n_G} = \frac{N_p}{N_G}$

$e = \frac{number\ of\ teeth\ driving}{number\ of\ teeth\ driven}$

$V = \frac{\pi dn}{60}$

$W_t = \frac{H}{V}$

$K_v = \frac{3.05+V}{3.05}$ *(cast profile)*

$K_v = \frac{6.1+V}{6.1}$ *(cut or milled profile)*

$K_v = \frac{3.56+\sqrt{V}}{3.56}$ *(hobbed and shaped profile)*

$K_v = \frac{\sqrt{5.56+\sqrt{V}}}{5.56}$ *(shaved or grooved profile)*

$$\sigma = \frac{k_v W_t}{FYm}$$

Welding analysis

$\tau' = \frac{V}{A}$

$\tau'' = \frac{Tr}{J}$

$\sigma' = \frac{F}{A}$

$\sigma'' = \frac{My}{I}$

$\tau_{max} = \sqrt{\sigma''^2 + \tau'^2}$ *(for cases secondary bending and primary shear stresses)*

$\tau_{max} = \sqrt{\tau'^2 + \tau''^2 - 2\tau'\tau''cos\theta}$ *(for cases primary shear and secondary torsional)*

Part 1 Properties of Sections

A = area

G = location of centroid

$I_x = \int y^2\, dA$ = second moment of area about x axis

$I_y = \int x^2\, dA$ = second moment of area about y axis

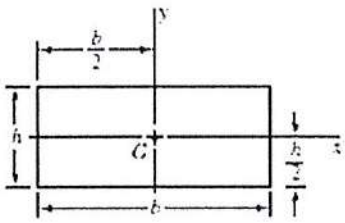
$I_{xy} = \int xy\, dA$ = mixed moment of area about x and y axes

$J_G = \int r^2\, dA = \int (x^2 + y^2)\, dA = I_x + I_y$

= second polar moment of area about axis through G

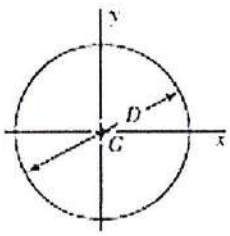
$k_x^2 = I_x / A$ = squared radius of gyration about x axis

Rectangle



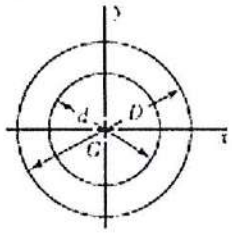
$A = bh \qquad I_x = \dfrac{bh^3}{12} \qquad I_y = \dfrac{b^3 h}{12} \qquad I_{xy} = 0$

Circle



$A = \dfrac{\pi D^2}{4} \qquad I_x = I_y = \dfrac{\pi D^4}{64} \qquad I_{xy} = 0 \qquad J_G = \dfrac{\pi D^4}{32}$

Hollow circle



$A = \dfrac{\pi}{4}(D^2 - d^2) \qquad I_x = I_y = \dfrac{\pi}{64}(D^4 - d^4) \qquad I_{xy} = 0 \qquad J_G = \dfrac{\pi}{32}(D^4 - d^4)$

Diameters and Areas for Metric Threads

Table 8–1

Diameters and Areas of Coarse-Pitch and Fine-Pitch Metric Threads.*

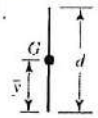
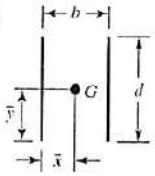
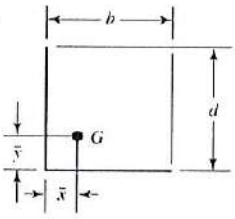
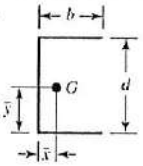
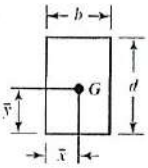
Nominal Major Diameter d mm	Coarse-Pitch Series			Fine-Pitch Series		
	Pitch p mm	Tensile-Stress Area A_t mm²	Minor-Diameter Area A_r mm²	Pitch p mm	Tensile-Stress Area A_t mm²	Minor-Diameter Area A_r mm²
1.6	0.35	1.27	1.07			
2	0.40	2.07	1.79			
2.5	0.45	3.39	2.98			
3	0.5	5.03	4.47			
3.5	0.6	6.78	6.00			
4	0.7	8.78	7.75			
5	0.8	14.2	12.7			
6	1	20.1	17.9			
8	1.25	36.6	32.8	1	39.2	36.0
10	1.5	58.0	52.3	1.25	61.2	56.3
12	1.75	84.3	76.3	1.25	92.1	86.0
14	2	115	104	1.5	125	116
16	2	157	144	1.5	167	157
20	2.5	245	225	1.5	272	259
24	3	353	324	2	384	365
30	3.5	561	519	2	621	596
36	4	817	759	2	915	884
42	4.5	1120	1050	2	1260	1230
48	5	1470	1380	2	1670	1630
56	5.5	2030	1910	2	2300	2250
64	6	2680	2520	2	3030	2980

Metric Mechanical-Property Classes for Steel Bolts

Property Class	Size Range, Inclusive	Minimum Proof Strength,† MPa	Minimum Tensile Strength,† MPa	Minimum Yield Strength,† MPa	Material	Head Marking
4.6	M5–M36	225	400	240	Low or medium carbon	
4.8	M1.6–M16	310	420	340	Low or medium carbon	
5.8	M5–M24	380	520	420	Low or medium carbon	
8.8	M16–M36	600	830	660	Medium carbon, Q&T	
9.8	M1.6–M16	650	900	720	Medium carbon, Q&T	
10.9	M5–M36	830	1040	940	Low-carbon martensite, Q&T	
12.9	M1.6–M36	970	1220	1100	Alloy, Q&T	

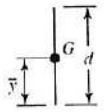
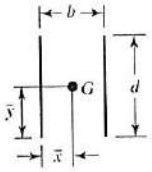
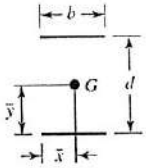
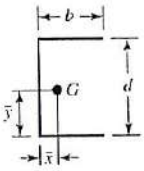
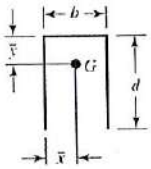
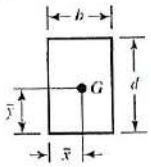
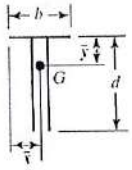
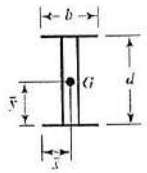
Table 8–11

Common Torsional Properties of Fillet Welds (Table 9–1)

Weld	Throat Area	Location of G	Unit Second Polar Moment of Area
1. 	$A = 0.707\,hd$	$\bar{x} = 0$ $\bar{y} = d/2$	$J_u = d^3/12$
2. 	$A = 1.414\,hd$	$\bar{x} = b/2$ $\bar{y} = d/2$	$J_u = \dfrac{d(3b^2 + d^2)}{6}$
3. 	$A = 0.707h(b + d)$	$\bar{x} = \dfrac{b^2}{2(b + d)}$ $\bar{y} = \dfrac{d^2}{2(b + d)}$	$J_u = \dfrac{(b + d)^4 - 6b^2d^2}{12(b + d)}$
4. 	$A = 0.707h(2b + d)$	$\bar{x} = \dfrac{b^2}{2b + d}$ $\bar{y} = d/2$	$J_u = \dfrac{8b^3 + 6bd^2 + d^3}{12} - \dfrac{b^4}{2b + d}$
5. 	$A = 1.414h(b + d)$	$\bar{x} = b/2$ $\bar{y} = d/2$	$J_u = \dfrac{(b + d)^3}{6}$
6. 	$A = 1.414\,\pi hr$		$J_u = 2\pi r^3$

*G is centroid of weld group; h is weld size; plane of torque couple is in the plane of the paper; all welds are of unit width.

Bending Properties of Fillet Welds (Table 9–2)

Weld	Throat Area	Location of G	Unit Second Moment of Area
1. 	$A = 0.707hd$	$\bar{x} = 0$ $\bar{y} = d/2$	$I_u = \frac{d^3}{12}$
2. 	$A = 1.414hd$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \frac{d^3}{6}$
3. 	$A = 1.414hb$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \frac{bd^2}{2}$
4. 	$A = 0.707h(2b + d)$	$\bar{x} = \frac{b^2}{2b + d}$ $\bar{y} = d/2$	$I_u = \frac{d^2}{12}(6b + d)$
5. 	$A = 0.707h(b + 2d)$	$\bar{x} = b/2$ $\bar{y} = \frac{d^2}{b + 2d}$	$I_u = \frac{2d^3}{3} - 2d^2\bar{y} + (b + 2d)\bar{y}^2$
6. 	$A = 1.414h(b + d)$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \frac{d^2}{6}(3b + d)$
7. 	$A = 0.707h(b + 2d)$	$\bar{x} = b/2$ $\bar{y} = \frac{d^2}{b + 2d}$	$I_u = \frac{2d^3}{3} - 2d^2\bar{y} + (b + 2d)\bar{y}^2$
8. 	$A = 1.414h(b + d)$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \frac{d^2}{6}(3b + d)$
9. 	$A = 1.414\pi hr$		$I_u = \pi r^3$

Bore, mm	02- Series				03 - Series			
	OD, mm	Width, mm	Load Rating, kN		OD, mm	Width, mm	Load Rating, kN	
			C_{10}	C_0			C_{10}	C_0
25	52	15	16.8	8.8	62	17	28.6	15.0
30	62	16	22.4	12.0	72	19	36.9	20.0
35	72	17	31.9	17.6	80	21	44.6	27.1
40	80	18	41.8	24.0	90	23	56.1	32.5
45	85	19	44.0	25.5	100	25	72.1	45.4
50	90	20	45.7	27.5	110	27	88.0	52.0
55	100	21	56.1	34.0	120	29	102	67.2
60	110	22	64.4	43.1	130	31	123	76.5
65	120	23	76.5	51.2	140	33	138	85.0
70	125	24	79.2	51.2	150	35	151	102
75	130	25	93.1	63.2	160	37	183	125
80	140	26	106	69.4	170	39	190	125
85	150	28	119	78.3	180	41	212	149
90	160	30	142	100	190	43	242	160
95	170	32	165	112	200	45	264	189
100	180	34	183	125	215	47	303	220
110	200	38	229	167	240	50	391	304
120	215	40	260	183	260	55	457	340
130	230	40	270	193	280	58	539	408
140	250	42	319	240	300	62	682	454
150	270	45	446	260	320	65	781	502

Table 11-3

Values of Lewis Form Factor Y

Number of Teeth	Y	Number of Teeth	Y
12	0.245	28	0.353
13	0.261	30	0.359
14	0.277	34	0.371
15	0.290	38	0.384
16	0.296	43	0.397
17	0.303	50	0.409
18	0.309	60	0.422
19	0.314	75	0.435
20	0.322	100	0.447
21	0.328	150	0.460
22	0.331	300	0.472
24	0.337	400	0.480
26	0.346	Rack	0.485

DKM2153 (Ralat)

Bolt and screw analysis

$\sigma_{equi} = \sqrt{\sigma_T^2 + 3\tau_R^2}$ *(m/s 7, pembetulan)*

Bearing analysis

$C_{10} = F_D \left[\frac{L_D}{L_R}\right]^{1/a} = F_D \left[\frac{f_D \times n_D \times 60}{f_R \times n_R \times 60}\right]^{1/a}$ *(m/s 7 , pembetulan)*

Gear analysis

d =Nm *(m/s 8, tambahan)*