KOLEJ YAYASAN PELAJARAN JOHOR
PEPERIKSAAN AKHIR

NAMA KURSUS	:	REKABENTUK KEJURUTERAAN
KOD KURSUS	:	DKM 2153
PEPERIKSAAN	:	OKTOBER 2018
MASA	:	2½ JAM

ARAHAN KEPADA CALON

1. Kertas soalan ini mengandungi **LIMA (5)** soalan. Jawab **EMPAT (4)** daripada **LIMA (5)** soalan tersebut pada Buku Jawapan.

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 10 HALAMAN BERCETAK TERMASUK MUKA HADAPAN

Arahan: Jawab **EMPAT (4)** daripada **LIMA (5)** soalan tersebut pada Buku Jawapan.

SOALAN 1 / *QUESTION 1* (25 MARKAH)

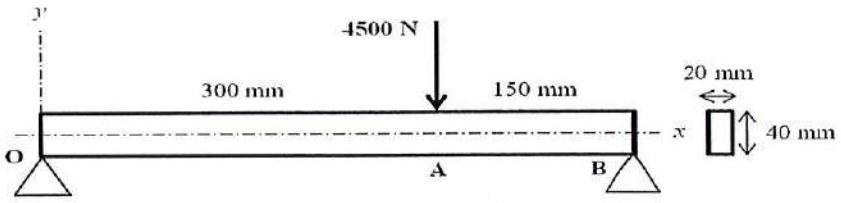
a. Bagaimanakah proses rekabentuk bermula?
How does design process begin?

(2 Markah)

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

(3 Markah)

c. **Rajah S1** menunjukkan satu rasuk yang disokong pada O dan B beserta satu daya yang dikenakan pada titik A.
Figure Q1 *shows a beam supported at point O and B with a force acting at point A.*



Rajah S1 / *Figure Q1*

Daripada Rajah S1, cari daya yang bertindak pada titik O dan B, seterusnya:
From Figure Q1, find the force acting at point O and B, next:

i. Kira momen luas kedua pada paksi x, I_x
Calculate second moment area about x axis, I_x (7 Markah)

ii. Lakarkan gambar rajah daya ricih dan momen lentur
Draw shear force and bending moment diagram (3 Markah)

iii. Cari titik lokasi dan magnitud tegasan lenturan maksimum, σ_{maks}
Find locations and magnitudes of the max bending stress, σ_{max}

(4 Markah)

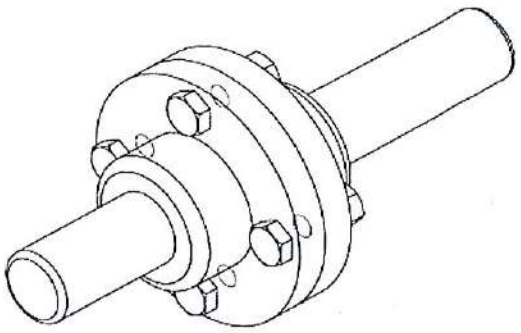
iv. Kira tegasan ricih maksimum, T_{maks}
Calculate the maximum shear stress, T_{max} (6 Markah)

SOALAN 2 / *QUESTION 2* (25 MARKAH)

a. Terangkan **empat (4)** "*The American National (Unified, UN) standard thread*". *Explain* ***four (4)*** *"The American National (Unified, UN) standard thread".*

(8 Markah)

b. **Rajah S2** menunjukkan dua aci bersambung dengan menggunakan teknik *flange coupling* untuk memindahkan 25 kN.m tork. *Flange coupling* tersebut diikat menggunakan 4 biji *bolt* daripada bahan yang sama pada jejari 30 mm. ***Figure Q2*** *shows two shafts are connected by using flange coupling technique to transmit torque of 25 kN.m. The flanges of the coupling are fastened by four bolts of the same material at a radius of 30 mm.*



Rajah S2 / *Figure Q2*

Jika tegasan bukti minimum bahan adalah 310 MPa, tentukan:
If the minimum proof strength for the bolt is 310 MPa, determine:

i. Luas *bolt*, A
Bolt area, A (11 Markah)

ii. Diameter utama, d dan *pitch bolt*, p
Major diamteter, d and pitch of the bolt, p (5 Markah)

iii. Saiz *bolt* yang sesuai
Suitable bolt size (1 Markah)

SOALAN 3 / *QUESTION 3* (25 MARKAH)

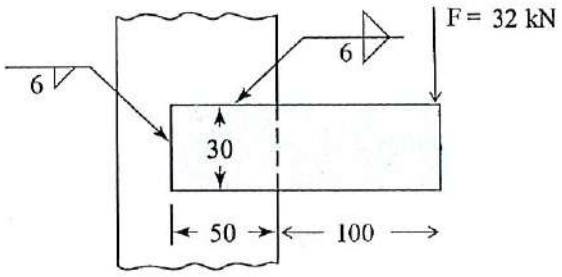
a. Berikan **empat (4)** jenis sambungan kekal yang digunakan dalam pembuatan pada hari ini.
*Give **four (4)** type of permanent joint used in manufacturing today.*

(2 Markah)

b. Nyatakan **empat (4)** jenis sambungan kimpalan.
*State **four (4)** types of welding joint.*

(4 Markah)

c. **Rajah S3** menunjukkan dua keping plat yang disambung bertindih menggunakan kaedah kimpalan. Sekiranya nilai F adalah 32 kN, kirakan:
***Figure Q3** shows two plates are stack joined by using weld method. If value F given 32 kN, calculate:*



Rajah S3 / *Figure Q3*

i. Dengan merujuk Jadual 9-2, cari; keluasan logam kimpalan, A dan tegasan ricih utama logam kimpalan, T.
By referring Table 9-2, find; welded metal area, A and primary shear stress of the welded metal. (5 Markah)

ii. Berpandukan Jadual 9-2, tentukan nilai y dan I seterusnya kirakan tegasan tegangan kedua logam kimpalan.
Based on Table 9-2, determine the value of y and I, next find secondary tensile stress of the welded metal. (10 Markah)

iii. Kirakan tegasan maksimum yang ditampung oleh logam kimpalan.
Calculate the maximum stress welded metal can be supporting.

(4 Markah)

SOALAN 4 / *QUESTION 4* (25 MARKAH)

a. Apakah maksud *Catalog Load Rating*?
What is mean by Catalog Load Rating?

(2 Markah)

b. Terangkan **dua (2)** kaedah berbeza digunakan untuk memastikan jangka hayat sesetengah galas.
*Explain **two (2)** different steps bearing common life measures.*

(4 Markah)

c. Berikan **tiga (3)** kelebihan dan **tiga (3)** kekurangan *rolling-contact bearing* berbanding *sliding-contact bearing*.
*Give **three (3)** advantages and **three (3)** disadvantages of rolling-contact bearing compare to sliding-contact bearing.*

(6 Markah)

d. Galas A mempunyai *catalog rating* 2.0kN berdasarkan sistem *catalog rating* 3000 jam pada 500rev/min.
Bearing A has a catalog rating of 2.0kN based on a catalog rating system of 3000 hours at 500rev/min

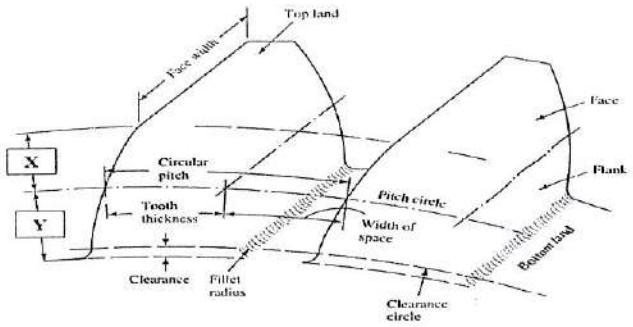
i. Cari *catalog rating* bagi Galas A berdasarkan *catalog* yang menilai pada 10^6 kitaran.
Find catalog rating of Bearing A based on catalog rating at 10^6 cycles. (10 Markah)

ii. Galas B mempunyai catalog rating 7.0 kN berdasarkan catalog yang menilai pada 10^6 kitaran. Jika kedua-dua galas tersebut digunapakai, tentukan galas yang mana boleh membawa beban yang lebih besar.
Bearing B has a catalog rating of 7.0 kN based on a catalog that rates at 10^6 cycles. For a given application, determine which bearing can carry the larger load. (3 Markah)

SOALAN 5 / *QUESTION 5* (25 MARKAH)

a. **Rajah S5** menunjukkan skematik gear. Nyatakan bahagian X dan Y beserta penerangannya.

Figure Q5 *show a gear schematic. State part X and Y with the explanation.*



Rajah S5 / *Figure Q5*

(8 Markah)

b. Satu pinion spur keluli mempunyai modul 1.25 mm, 18 gigi dipotong pada 20° sistem kedalaman penuh, dan 12 mm lebar permukaan. Pada kelajuan 1800 rev/min, pinion ini dijangka membawa beban tetap sebanyak 0.5 kW. Tentukan nilai:

A steel spur pinion has a module of 1.25 mm, 18 teeth cut on the 20° full-depth system, and a face width of 12 mm. At a speed of 1800 rev/min, this pinion is expected to carry a steady load of 0.5 kW. Determine:

i. Pitch diameter bulatan, d serta halaju, V dan faktor halaju, Kv
Pitch circle diameter, d, velocity, V and velocity factor, Kv
(9 Markah)

ii. Daya tangen, Wt
Tangential force, Wt (3 Markah)

iii. Tegasan lenturan, σ
Bending stress, σ (5 Markah)

[100 MARKAH]

KERTAS SOALAN TAMAT

Formula:

Stress analysis

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

$L_T = 2d + 6$

$l_d = L - L_T$

$l_t = l - l_d$

$A_d = \frac{\pi d^2}{4}$

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

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

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

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

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

$k_b = \frac{A_d A_t E}{A_d l_t + A_t l_d}$

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)*

Bearing analysis

$C_{10} = Fr\left[\frac{L_D \times N_D \times 60}{10^6}\right]^{1/3}$

Gear analysis

$d = Nm$

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

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

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

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

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

Bending Stress. $\sigma = \frac{K_v W_t}{FYm}$

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

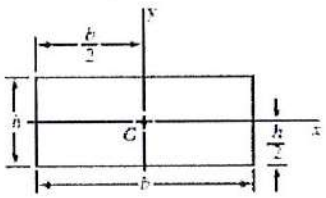
$I_{xy} = \int xy\, dA$ = mixed moment of area about x and y axes

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

= second polar moment of area about axis through G

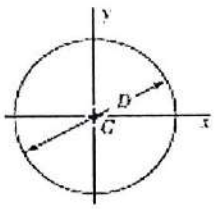
$k_x^2 = I_x / A$ = squared radius of gyration about x axis

Rectangle



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

Circle



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

Table A-31

Nominal Size, mm				
M5	8	4.7	5.1	2.7
M6	10	5.2	5.7	3.2
M8	13	6.8	7.5	4.0
M10	16	8.4	9.3	5.0
M12	18	10.8	12.0	6.0
M14	21	12.8	14.1	7.0
M16	24	14.8	16.4	8.0
M20	30	18.0	20.3	10.0
M24	36	21.5	23.9	12.0
M30	46	25.6	28.6	15.0
M36	55	31.0	34.7	18.0

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 mm^2	Minor-Diameter Area A_r mm^2	Pitch p mm	Tensile-Stress Area A_t mm^2	Minor-Diameter Area A_r mm^2
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

Table 9–2

Bending Properties of Fillet Welds*

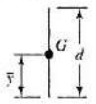
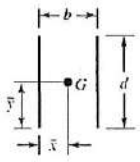
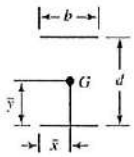
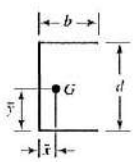
Weld	Throat Area	Location of G	Unit Second Moment of Area
	$A = 0.707hd$	$\bar{x} = 0$ $\bar{y} = d/2$	$I_u = \frac{d^3}{12}$
	$A = 1.414hd$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \frac{d^3}{6}$
	$A = 1.414hd$	$\bar{x} = b/2$ $\bar{y} = d/2$	$I_u = \frac{bd^2}{2}$
	$A = 0.707h(2b + d)$	$\bar{x} = \frac{b^2}{2b+d}$ $\bar{y} = d/2$	$I_u = \frac{d^2}{12}(6b + d)$

Table 11–3

Dimensions and Basic Load Ratings for Cylindrical Roller Bearings

	02-Series				03-Series			
Bore, mm	OD, mm	Width, mm	Load Rating, kN C_{10}	C_0	OD, mm	Width, mm	Load Rating, kN 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 14–2

Values of the Lewis Form Factor Y (These Values Are for a Normal Pressure Angle of 20°, Full-Depth Teeth, and a Diametral Pitch of Unity in the Plane of Rotation)

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