



INTERNAL ASSESSMENT APPROVAL FORM (INCLUDING COLLABORATIVE PROVISION)

This form is used to ensure that assessment specifications have been through an internal review process prior to external examination/approval and release to students. It should be completed for each assessment for a particular module. The assessment tasks, criteria and marking scheme should accompany this form.

PARTNER (and taught location if relevant):	Coleg Sirgar				
EXTERNAL EXAMINER NAME:	TO BE ADVISED				
ASSESSMENT AUTHOR:	CHAS DAVIES				
MODULE TITLE:	THERMOFLUIDS AND MECHANICS				
MODULE CODE:	36DM6022		MODULE LEVEL:	6	
COMPONENT NO. (e.g. 1 of 2):	2 (MECHANICS COMP)		COMPONENT WEIGHTING (e.g. 50% of the module):	50%	
ASSESSMENT PERIOD	☐ Semester 1	☐ Semester 1 Re-sit	☒ Semester 2	☐ Semester 2 Re-sit	Other, please state
TYPE OF ASSESSMENT:	☐ Coursework		☒ Examination		☐ Practical
LANGUAGE OF ASSESSMENT:	ENGLISH		TRANSLATION REQUIRED (Y/N):	(N)	
FOR EXAMINATIONS ONLY. SPECIFY BELOW ANY ADDITIONAL MATERIAL(S) TO BE USED IN THE EXAMINATION					
This box will expand as you type					

INTERNAL MODERATOR PLEASE TICK TO INDICATE THAT THE ASSESSMENT INCLUDES:		Please ✓		Comments
		YES	NO	
1	Tasks that are specified clearly, accurately and comprehensibly, with appropriate use of language and neat presentation	✓		
2	Tasks which enable the module learning outcomes to be demonstrated (as per the module syllabus)	✓		
3	Tasks which conform to the assessment described in the module syllabus	✓		
4	Tasks which are written at the appropriate level of the Framework for Higher Education Qualifications (see http://www.qaa.ac.uk/docs/qaa/quality-code/qualifications-frameworks.pdf?sfvrsn=170af781_14).	✓		
5	Clear criteria for assessment and guidance about how marking/grading will be applied	✓		
6	Guidance about expected evidence for submission, e.g. essay or report, word count, bibliography and references	n/a		formal Examinations
7	Reference to good academic conduct, for example referencing, plagiarism and Turnitin	n/a		
8	Actions to complete n/a			
This box will expand as you type				
SIGNATURE OF APPROVAL:		SIGNATURE		DATE
INTERNAL MODERATOR: I confirm that this version of the assessment specification is ready		Adam Twell		07/10/19

to be sent to the Partnership Team Leader		
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ONLY TO BE COMPLETED IF THE ASSESSMENT IS LINKED TO A COLLABORATIVE PARTNER

PARTNERSHIP TEAM LEADER PLEASE TICK TO INDICATE THAT THE ASSESSMENT INCLUDES:		Please ✓		Comments
		YES	NO	
1	Tasks that are specified clearly, accurately and comprehensibly, with appropriate use of language and neat presentation			
2	Tasks which enable the module learning outcomes to be demonstrated (as per the module syllabus)			
3	Tasks which conform to the assessment described in the module syllabus			
4	Tasks which are written at the appropriate level of the Framework for Higher Education Qualifications (see http://www.qaa.ac.uk/docs/qaa/quality-code/qualifications-frameworks.pdf?sfvrsn=170af781_14).			
5	Clear criteria for assessment and guidance about how marking/grading will be applied			
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8	Actions to complete <i>This box will expand as you type</i>			
SIGNATURE OF APPROVAL:		SIGNATURE		DATE
PTL: I confirm that this version of the assessment specification is ready to be sent to the External Examiner				

UWTSO PROVISION: please submit the completed document to the appropriate Programme Director.

COLLABORATIVE PROVISION: please submit the completed document (or make available electronically) to the Partnership Team Leader. This must be in accord with specific arrangements for sharing electronic documents (e.g. via SharePoint or similar).

The assessment tasks, criteria and marking scheme should accompany this form

THIS DOCUMENT IS ALSO AVAILABLE IN WELSH

LOCATION: COLEG SIR GAR (GRAIG)

LLEOLIAD: COLEG SIR GAR (GRAIG)

LEVEL 6

LEFEL 6

EXAMINATION PERIOD
MAY 2020

CYFNOD ARHOLIADAU
MAI 2020

MODULE CODE: SGDM6022
THERMOFLUIDS AND APPLIED MECHANICS

TIME: 2 HOURS

**STUDENTS MUST ATTEMPT AT LEAST ONE QUESTION
FROM EACH SECTION**

ANSWER A TOTAL OF THREE QUESTIONS OUT OF FIVE

Equipment or materials required

Calculators are permitted

Adnoddau neu ddefnyddiau sydd eu hangen

Caniateir cyfrifiannellau

SECTION A

QUESTION 1

a) Discuss the difference between static and dynamic balancing in a non coplanar system.

[6 Marks]

b) An experimental balancing rig consists of four discs A, B, C and D mounted on a rotating shaft, the linear distances between each of the discs being 0.5m. On each disc provision is made for the attachment of unbalanced masses at different radii and angular displacement. If a mass of 0.6kg at radius 120mm is attached to B at 0° and a mass of 0.3kg at radius 120mm is attached at C at 120° find the magnitude and angular position relative to B of masses placed at A and D at radii 100mm and 90mm respectively to give the system complete static and dynamic balance.

[14 Marks]

Total marks for Question 1 = 20 marks

QUESTION 2

a) Discuss the advantages of using epicyclic gear trains and provide some typical examples of their use in practice.

[5 Marks]

An epicyclic gear train shown in figure Q2 below has wheel A which has 30 teeth and rotates at 25rev/s, the fixed annular wheel C has 120 teeth and the other annular wheel E 100 teeth and wheel D has 40 teeth. What is the speed of rotation of the annular wheel E?

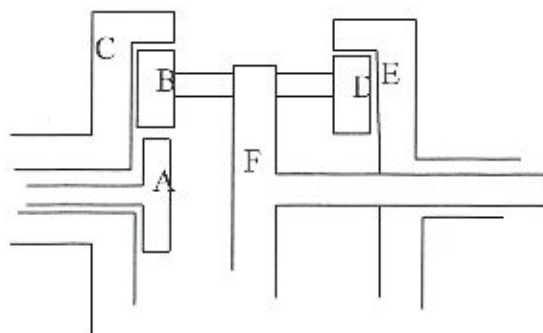


Figure Q2

[15 Marks]

Total marks for Question 2 = 20 Marks

QUESTION 3

The lifting device shown in figure Q3 consists of a motor M driving a drum D through a reduction gearbox. The load is lifted by a cable wrapped around the drum. Using the data provided calculate the vertical acceleration of the load neglecting the mass of the cable. Take the moment of inertia of the motor and gears on the motor shaft as 0.04 Kg m^2 and the moment of inertia of the drum and cables on the drum shaft as 25 Kg m^2 . The gear reduction is 30:1, the drum diameter is 800mm, the mass of the load is 500kg, the motor torque is 104Nm and the mechanical efficiency of the motor is 85%.

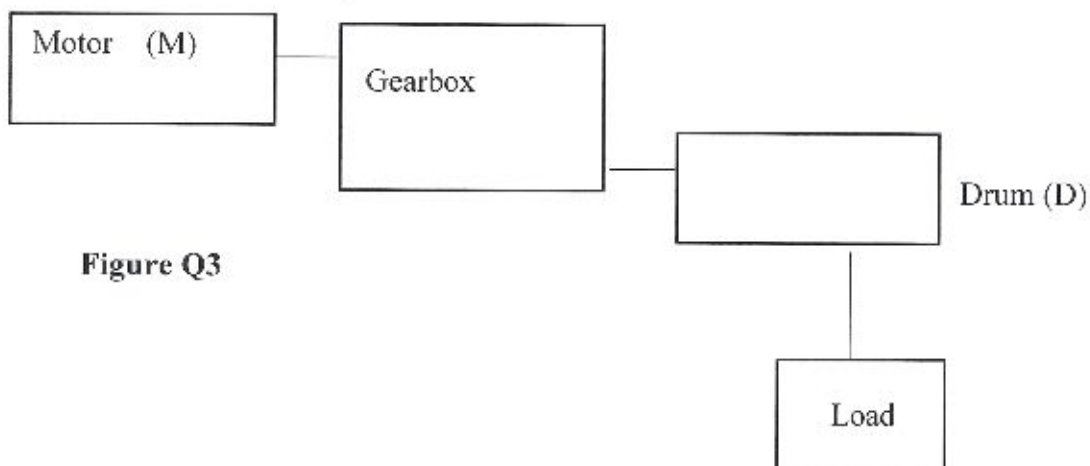


Figure Q3

Total marks for Question 3 = 20 marks

SECTION B

QUESTION 4

A steel pipe of internal diameter 30mm and external diameter 120mm is subject to an internal pressure of 12MPa and an external pressure of 5MPa.

- What are the radial and circumferential stresses at the inner and outer surfaces.
- Sketch the variation of hoop stress across the material, clearly showing the maximum and minimum positions of hoop stress.

[20 marks]

Total marks for Question 4 = 20 marks

QUESTION 5

The shaft shown in Figure Q5 consists of a 30mm diameter solid section CD and a tube AC that has an outside diameter of 45mm and an inside diameter of 35mm. The shaft is subjected to concentrated torques at B, C, and D. The shear modulus of elasticity is $G = 75 \text{ GPa}$. Calculate

- The maximum shear stress in the shaft.

[12 Marks]

- The angle of rotation of each section.

[4 Marks]

- The angle of rotation of D relative to A.

[4 Marks]

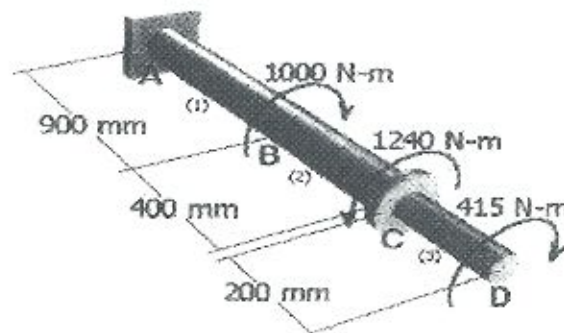


Figure Q5

Total marks for Question 5 = 20 marks

END OF PAPER



EXAMINATION SOLUTIONS

(to accompany the examination paper sent to the external examiner
but NOT to be seen by students)

X MAIN APPLIED MECHANICS PAPER

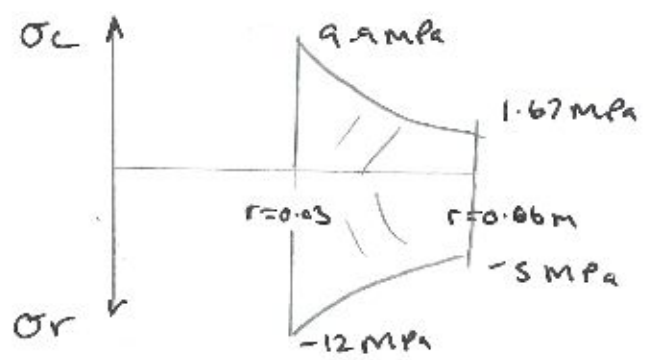
Programme:	BSc(ONS) MECHANICAL ENG	Level:	6
Module:	SGDM6020 THERMOFLUIDS AND APPLIED MECHANICS		
Author:	CHRIS DAVIES	Page:	1 /

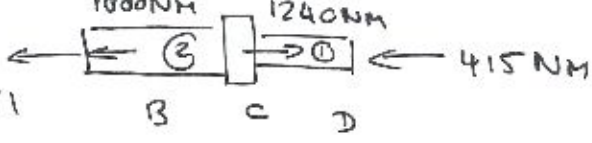
Q 1	Question	Marks																														
(a)	STATIC BALANCING IS ACHIEVED WHEN $\sum Mr = 0$ AND ALL MASSES ARE BALANCED AROUND THE CENTRE OF ROTATION. DYNAMIC BALANCING IS ACHIEVED WHEN $\sum Mr = 0$ & $\sum Mr l = 0$ AND MASSES ARE BALANCED AROUND THE CENTRE OF ROTATION AND MOMENTS ARE BALANCED ALONG THE LENGTH OF THE SHAFT.	(6)																														
(b)	CONSTRUCTS $Mr l$ TABLE <table border="1"> <thead> <tr> <th>MASS</th><th>RAD(M)</th><th>MR(KGM)</th><th>l(M)</th><th>Mr.l(KGM²)</th><th>θ</th></tr> </thead> <tbody> <tr> <td>MA</td><td>0.1</td><td>0.1MA</td><td>0</td><td>0</td><td>0A</td></tr> <tr> <td>0.6KG</td><td>0.12</td><td>0.072B</td><td>0.5</td><td>0.036</td><td>0</td></tr> <tr> <td>0.3</td><td>0.12</td><td>0.036</td><td>1.0</td><td>0.036</td><td>120</td></tr> <tr> <td>MB</td><td>0.09</td><td>0.09MD</td><td>1.5</td><td>0.136 MD</td><td>0D</td></tr> </tbody> </table> FIRSTLY DRAWS $Mr l$ polygon (SCALE 1CM = 0.01KGM²) SECONDLY DRAWS Mr polygon (SCALE 1CM = 0.02KGM) $Mr l D = 0.041 KGM^2$ $\therefore MD = 0.041 / 0.136$ $MD = 0.3KG$ $0D = 48^\circ 22'$ $Mr A = 0.036 KGM$ $MA = 0.74 KG$ $0A = 196^\circ$	MASS	RAD(M)	MR(KGM)	l(M)	Mr.l(KGM ²)	θ	MA	0.1	0.1MA	0	0	0A	0.6KG	0.12	0.072B	0.5	0.036	0	0.3	0.12	0.036	1.0	0.036	120	MB	0.09	0.09MD	1.5	0.136 MD	0D	(4) (5) (5)
MASS	RAD(M)	MR(KGM)	l(M)	Mr.l(KGM ²)	θ																											
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MB	0.09	0.09MD	1.5	0.136 MD	0D																											
		20																														



Q2	Question	Marks																								
(a)	COMMONS ON HIGH GEAR RATES, SMALL SIZE, HIGH PRECISION, LOW NOISE, HIGH TORQUE RATIO, ABILITY TO LINK COMPLEXES ETC. PROVIDES EXAMPLES IN USE	(5)																								
(b)	$T_A = 30$ $N_A = 25 \text{ Rev/s}$ $T_C = 120$ $T_B = 120 - 2(30)$ $T_E = 100$ $T_B = 60$ $T_D = 40$ CONSTRUCTS TABLE <table border="1"> <thead> <tr> <th></th> <th>A</th> <th>B/D</th> <th>C</th> <th>E</th> <th>F</th> </tr> </thead> <tbody> <tr> <td>ROTATE GEAR TRAIN +1 REV</td> <td>+1</td> <td>+1</td> <td>+1</td> <td>+1</td> <td>+1</td> </tr> <tr> <td>FIX FIRM & ROTATE C = 1 REV</td> <td>$1 \cdot \left(\frac{120}{30}\right)$</td> <td>$-1 \left(\frac{120}{60}\right)$</td> <td>-1</td> <td>$-1 \left(\frac{120 \times 40}{60 \times 100}\right)$</td> <td>0</td> </tr> <tr> <td>ADD LINES 1 + 2</td> <td>5</td> <td>-1</td> <td>0</td> <td>0.2</td> <td>1</td> </tr> </tbody> </table> $N_A = 25 \text{ Rev/s}$ $\therefore N_E = \frac{0.2}{5} \times 25$ $N_E = 1 \text{ Rev/sec}$		A	B/D	C	E	F	ROTATE GEAR TRAIN +1 REV	+1	+1	+1	+1	+1	FIX FIRM & ROTATE C = 1 REV	$1 \cdot \left(\frac{120}{30}\right)$	$-1 \left(\frac{120}{60}\right)$	-1	$-1 \left(\frac{120 \times 40}{60 \times 100}\right)$	0	ADD LINES 1 + 2	5	-1	0	0.2	1	
	A	B/D	C	E	F																					
ROTATE GEAR TRAIN +1 REV	+1	+1	+1	+1	+1																					
FIX FIRM & ROTATE C = 1 REV	$1 \cdot \left(\frac{120}{30}\right)$	$-1 \left(\frac{120}{60}\right)$	-1	$-1 \left(\frac{120 \times 40}{60 \times 100}\right)$	0																					
ADD LINES 1 + 2	5	-1	0	0.2	1																					

Q 3	Question	Marks
	MAA013 B11181 ~~MAA013 B11181~~ ~~MAA013 B11181~~ $T_{\text{tot}} = I_M \alpha_M \omega_M + I_d \alpha_d \omega_d + [M(g+r) r] \omega_d \quad (5)$ where $T_M = 104 \text{ Nm}$ $I_d = 25 \text{ kgm}^2$ $M = 500 \text{ kg}$ $I_M = 0.04 \text{ kgm}^2$ $\omega_M = 30 \omega_d$ $\alpha_M = 30 \alpha_d = \frac{30 a}{0.4} \quad \alpha_d = \frac{a}{0.4} \quad (2)$ $\therefore T_{\text{tot}} = 0.04 \times \frac{30 a}{0.4} \omega_M + 25 \times \frac{a}{0.4} \omega_M + 500(9.81 + a) 0.4 \omega_M / 30 \quad (3)$ $+ = 3a + 2.08a + 65.2 + 6.65a \quad (5)$ $+ = 11.73a + 65.2$ $Z_T = 0.85$ $\therefore 0.85 \times 104 = 11.73a + 65.2$ From which <u>$a = 1.47 \text{ m/s}^2$</u> (5)	
		<u>20</u>

Q 4	Question	Marks
(i)	when $r = 30\text{mm}$ $\sigma_r = -12\text{MPa}$ when $r = 60\text{mm}$ $\sigma_r = -5\text{MPa}$. $\therefore \sigma_r = -12 \times 10^6 = a + \frac{b}{0.03^2}$ — (1) & $\sigma_r = -5 \times 10^6 = a + \frac{b}{0.06^2}$ — (2) from (1) $a = -12 \times 10^6 - \frac{b}{0.03^2}$ sub into (2) $\therefore \underline{b = -9844} \quad \underline{a = -1.06 \times 10^6}$ $\sigma_c = a - \frac{b}{r^2}$ when $r = 60\text{mm}$ $\sigma_c = -1.06 \times 10^6 - \frac{(-9844)}{0.06^2}$ $\underline{\sigma_c = 1.67\text{MPa}}$ when $r = 30\text{mm}$ $\sigma_c = -1.01 \times 10^6 - \frac{(-9844)}{0.03^2}$ $\underline{\sigma_c = 9.9\text{MPa}}$	(5) (5) (5)
(ii)	SKETCHED PROFILE & LABELS CORRECTLY. 	(5)

Q 5	Question	Marks
	 $\text{dia}_1 = 30 \text{ mm}$ $\text{dia}_2 \text{ o.d} = 45 \text{ mm}$ $\text{dia}_2 \text{ i.d} = 35 \text{ mm}$ $-415 + 1240 - 1000 - T_1 = 0 \quad T_1 = -175 \text{ Nm}$ $J_1 = \frac{\pi D^4}{32} = \frac{\pi \times 0.03^4}{32} = 7.95 \times 10^{-8} \text{ m}^4$ $J_2 = \frac{\pi \times 0.045^4}{32} - \frac{\pi \times 0.035^4}{32} = 4.025 \times 10^{-7} - 1.47 \times 10^{-7}$ $J_2 = 2.55 \times 10^{-7} \text{ m}^4$ $\tau = \frac{T r}{J} \quad \tau_1 = \frac{T_1 r_1}{J_1} = \frac{175 \times 0.0225}{2.55 \times 10^{-7}} = 15.44 \text{ MPa}$ $\tau_2 = \frac{825 \times 0.0225}{2.55 \times 10^{-7}} = 72.7 \text{ MPa}$ $\tau_3 = \frac{415 \times 0.015}{7.95 \times 10^{-8}} \quad \tau = 78.3 \text{ MPa}$ $\text{Max } \tau = 78.3 \text{ MPa}$ $\phi = \frac{TL}{JG}$ For section ① $\phi_1 = \frac{-175 \times 0.9}{2.55 \times 10^{-7} \times 75 \times 10^9} \quad \phi_1 = -0.00823 \text{ Rads}$ $\phi_2 = \frac{825 \times 0.4}{2.55 \times 10^{-7} \times 75 \times 10^9} \quad \phi_2 = 0.01724 \text{ Rads}$ $\phi_3 = \frac{-415 \times 0.2}{7.95 \times 10^{-8} \times 75 \times 10^9} \quad \phi_3 = -0.01392 \text{ Rads}$ $\phi_D \text{ Relative to A} = -0.0049 \text{ Rads}$	(2) (2) (2) (2) (2) (2) (4) (4)

LOCATION: COLEG SIR GAR (GRAIG)

LLEOLIAD: COLEG SIR GAR (GRAIG)

LEVEL 6

LEFEL 6

EXAMINATION PERIOD
AUGUST 2020

CYFNOD ARHOLIADAU
AWST 2020

MODULE CODE: SGDM6022
APPLIED MECHANICS PAPER

TIME: 2 HOURS

**STUDENTS MUST ATTEMPT AT LEAST ONE QUESTION
FROM EACH SECTION**

ANSWER A TOTAL OF THREE QUESTIONS OUT OF FIVE

Equipment or materials required

Calculators are permitted

Adnoddau neu ddefnyddiau sydd eu hangen

Calculators are permitted

SECTION A

QUESTION 1

A simple sun-planet-annulus epicyclic gear train as shown in Figure Q1 has 40 teeth on the sun wheel and 90 teeth on the annulus. If the speed of the sun is 900rev/min at what speed must the annulus be driven to cause the planet carrier (arm) rotate at 18 rev/min.

- (a) in the same direction as the sun.
- (b) in the opposite direction as the sun.

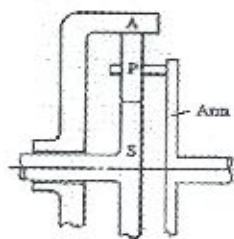


Figure Q1

[20 Marks]

Total marks for Question 1 = 20 marks

QUESTION 2

For the hoist system shown in Figure Q2 a motor rotates a wheel A which is geared to wheel B and hence lifts the load by wrapping around a drum attached to wheel B. What motor torque is required to lift a load of 350kg with an acceleration of 1.5m/s^2 .

The drum has a radius of 250mm, a moment of inertia of 22kgm^2 and a frictional torque of 75Nm. Gear B has 120 teeth and gear A has 45 teeth. The moment of inertia of the motor shaft is 1.5kgm^2 and has a frictional torque of 30Nm.

[20 marks]

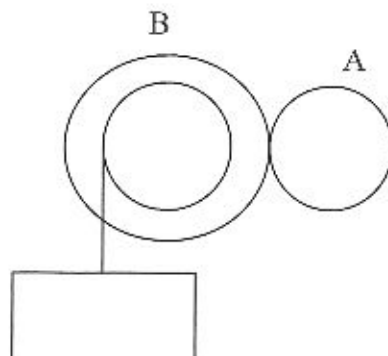


Figure Q2

Total marks for Question 2 = 20 marks

QUESTION 3

Discuss why can a Vee section belt transmit more power before belt slippage compare to a flat section belt drive.

[6 Marks]

A belt is 200mm wide and laps a 600mm diameter pulley by 170° . If the maximum permissible tension is 12N/mm width of belt and the coefficient of friction is 0.25, calculate the power transmitted when the pulley rotates at 240rpm.

[14 marks]

Total marks for Question 3 = 20 marks

SECTION B

QUESTION 4

The maximum stress permitted in a thick cylinder of internal and external radii 200mm and 300mm respectively is 20N/mm^2 . If the external pressure is 5N/mm^2 find the internal pressure that can be applied. Plot a curve showing the variation of circumferential and radial stress through the material.

Total marks for Question 4= 20 marks

QUESTION 5

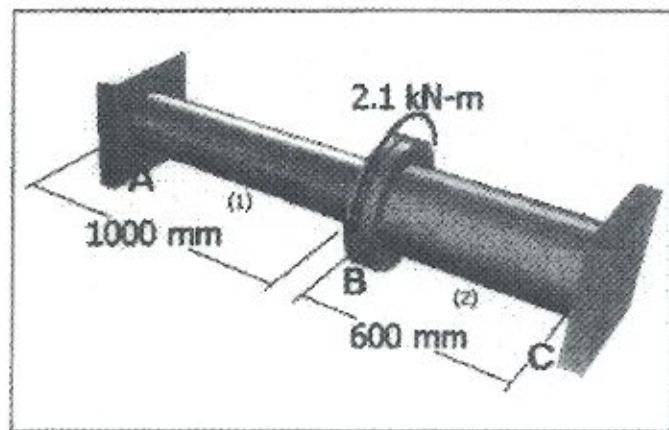
A 40 mm solid titanium-alloy shaft ($G = 42\text{ GPa}$) is connected at B to an aluminum-alloy tube ($G = 28\text{ GPa}$) that has an outside diameter of 65 mm and an inside diameter of 50 mm. The shaft is subjected to a concentrated torque at B of 2.1 kN m. Calculate:

(a) The maximum shear stress in the shaft

[15 Marks]

(b) The angle of rotation of B relative to A

[5 Marks]



Total marks for Question 5= 20 marks

END OF PAPER

EXAMINATION SOLUTIONS

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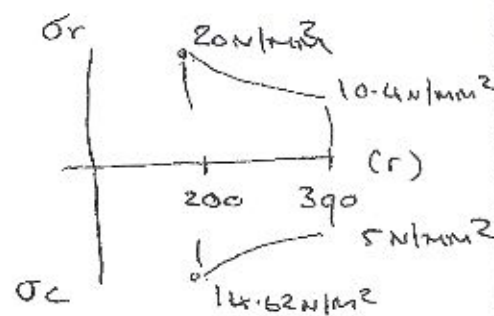
Programme:	Bsc (Hons) Mechanical Eng	Level:	L
Module:	Pedimole (REST)		
Author:	Dr Chris Davies	Page:	2 /

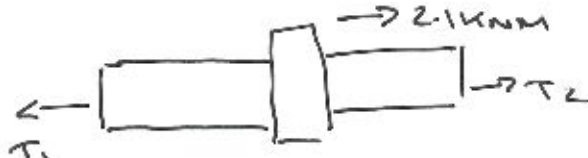
Q1	Question	Marks																				
	$\omega_s = 40 \quad \omega_3 = 900 \text{ rpm} \quad \omega_p = \frac{\omega_A - \omega_s}{2}$ $\omega_A = 90 \quad \omega_A = ? \quad \omega_p = \frac{90 - 40}{2} = 25$ $\omega_2 = 18 \text{ rpm}$ <table border="1"> <thead> <tr> <th></th><th>P</th><th>S</th><th>A</th><th>L</th></tr> </thead> <tbody> <tr> <td>① Rotate all +M</td><td>+M</td><td>+M</td><td>+M</td><td>+M</td></tr> <tr> <td>② Lock gear & rotate sun +M</td><td>$-\frac{40N}{25}$</td><td>+N</td><td>$-\frac{90N}{90}$</td><td>C</td></tr> <tr> <td>ADD ① + ②</td><td>$M - \frac{40N}{25}$</td><td>M+N</td><td>$M - \frac{4N}{9}$</td><td>M</td></tr> </tbody> </table> $\frac{\omega_s}{\omega_p} = -\frac{\omega_p}{\omega_s} \quad \omega_p = \frac{40}{25} \times -N$ $\frac{\omega_A}{\omega_p} = \frac{\omega_p}{\omega_A} \quad \omega_A = -\frac{40N}{25} \times \frac{25}{90} \quad \omega_A = -\frac{40}{90}N$		P	S	A	L	① Rotate all +M	+M	+M	+M	+M	② Lock gear & rotate sun +M	$-\frac{40N}{25}$	+N	$-\frac{90N}{90}$	C	ADD ① + ②	$M - \frac{40N}{25}$	M+N	$M - \frac{4N}{9}$	M	(4)
	P	S	A	L																		
① Rotate all +M	+M	+M	+M	+M																		
② Lock gear & rotate sun +M	$-\frac{40N}{25}$	+N	$-\frac{90N}{90}$	C																		
ADD ① + ②	$M - \frac{40N}{25}$	M+N	$M - \frac{4N}{9}$	M																		
	$\omega_s = 1.6N$ $M+N = 900$ $M = 18$ $N = 882$ $\therefore \omega_A = 18 - \frac{40 \times 882}{90} = -374 \text{ rpm}$	(8)																				
	$M+N = 900$ $M = -18$ $N = 918$ $\omega_A = -18 \times -\frac{4}{9} \times 918$ $\omega_A = -426 \text{ rpm}$	(4)																				

Q2	Question	Marks
	$P = T\omega = I_A \omega_A \alpha_A + F_A \omega_A + I_B \omega_B \alpha_B + F_B \omega_B + m(g+a)r\omega_B$	(5)
	$P = T\omega_A \quad m = 350 \text{ kg} \quad a = 1.5 \text{ m/s}^2$ $r = 0.25 \text{ m} \quad I_B = 22 \text{ kgm}^2 \quad F_B = 75 \text{ N}$ $t_B = 120 \quad t_A = 45$ $I_A = 1.5 \text{ kgm}^2 \quad F_A = 30 \text{ N}$	
	$T\omega_A = 1.5 \omega_A \alpha_A + 30 \omega_A + 22 \omega_B \alpha_B + 75 \omega_B + 350(9.81 + 1.5)0.25 \omega_B$	(2)
	$\frac{\omega_B}{\omega_A} = \frac{t_A}{t_B} \quad \omega_A = \omega_B \frac{t_B}{t_A} = \frac{120}{45} \omega_B$	(2)
	$\alpha_B = \frac{a}{r} = \frac{1.5}{0.25} = 6 \text{ rad/s}^2$	(2)
	$\alpha_A = \frac{t_B}{t_A} \times \alpha_B = 6 \times \frac{120}{45} = 16 \text{ rad/s}^2$	(2)
	$T_{\text{up}} = 1.5 \omega_A 16 + 30 \omega_A + 22 \times \frac{45}{120} \omega_A \times 6 + 75 \times \frac{45}{120} \omega_A + 350(9.81 + 1.5)0.25 \times \frac{45}{120} \omega_A$	(2)
	$T = 24 + 30 + 49.5 + 28.1 + 371.1$	
	$T = 502.7 \text{ Nm}$	(5)



Q3	Question	Marks
	VEE BELTS HAVE AN INCLUDED ANGLE 2β. VEE BELTS CREEP ON THE SIDE AND NOT ON THE BASE OF THE PULLEY. THE WEDGING EFFECT INCREASES THE FORCE BETWEEN THE PULLEY AND THE BELT FROM R TO R'. SINCE THE FRICTIONAL FORCE IS INCREASED, GREATER POWER CAN BE TRANSMITTED BEFORE THE BELT SLIPS BELT WIDTH = 200 MM $r = 0.3 \text{ m}$ $\theta = 170^\circ = 2.97 \text{ RADS}$ $\mu = 0.25$ $T_{\text{MAX}} = 12 \times 0.2 = 2.4 \times 10^3 \text{ N}$ $\omega = 240 \times 2\pi/60 = 25.13 \text{ RADS/S}$ $V = \omega r$ $V = 25.13 \times 0.3 = 7.54 \text{ M/S}$ $P = T_1 (1 - e^{-\mu\theta}) V$ $P = 2.4 \times 10^3 (1 - e^{-0.25 \times 2.97}) \times 7.54$ $P = 9.41 \text{ KW}$	(6) (2) (1) (1) (2) (8)
		20

Q 4	Question	Marks
	LAMES EQUATION $\sigma_c = a + \frac{b}{r^2} \quad \sigma_r = a - \frac{b}{r^2}$ $\sigma_r = -p$ $\therefore -5 = a - \frac{b}{300^2} \quad \text{--- (1)}$ MAXIMUM STRESS IS CIRCUMFERENTIAL AT INNER SURFACE $\therefore 20 = a + \frac{b}{200^2} \quad \text{--- (2)}$ $-5 \times 300^2 = a \cdot 300^2 - b$ $20 \times 200^2 = a \cdot 200^2 + b$ $(800 - 450) \times 10^3 = (300^2 + 200^2) a$ $a = 2.69 \quad b = 692.4 \times 10^3$ $\sigma_r = a - \frac{b}{200^2} = 2.69 - \frac{692.4 \times 10^3}{200^2}$ $\sigma_r = -14.62 \text{ N/mm}^2$ $\sigma_c = a + \frac{b}{r^2} = 2.69 + \frac{692.4 \times 10^3}{300^2}$ $\sigma_c = 10.38 \text{ N/mm}^2$ 	(4) (4) (4) (4)

Q 5	Question	Marks
	 $\sum T = 0 \quad \rightarrow -T_1 + T_2 + 2.1 = 0 \quad \text{--- (1)}$ $I_1 = \frac{\pi D^4}{32} = \frac{\pi \times 40^4}{32} = 251327.4 \text{ mm}^4$ $I_2 = \frac{\pi(D^4 - d^4)}{32} = \frac{\pi \times (65^4 - 50^4)}{32} = 1138888.7 \text{ mm}^4$ $\phi_1 = \phi_2$ $\frac{T_1 L_1}{J_1 G_1} = \frac{T_2 L_2}{J_2 G_2}$ $T_1 = \frac{T_2 L_2}{L_1} \times \frac{J_1}{J_2} \quad T_1 = -0.1986 T_2 \quad \text{--- (2)}$ Sub (2) INTO (1) $T_2 = -1.752 \text{ kNm}$ $T_1 = 0.347 \text{ kNm}$ $\tau_1 = \frac{347 \times 1000 \times 20}{251327.4} = 27.7 \text{ MPa}$ $\tau_2 = \frac{-1752 \times 1000 \times 32.5}{1138888.7} = -50 \text{ MPa}$ $\theta = \frac{T_1 L_1}{J_1 G_1} = \frac{347 \times 1000 \times 1000}{42000 \times 281327.4} = 0.0329 \text{ Rads}$	(5) (5) (10) (5)