



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:	CHWYD DAVIES				
MODULE TITLE:	MECHANICAL SCIENCE 1				
MODULE CODE:	SEM4002		MODULE LEVEL:	4	
COMPONENT NO. (e.g. 1 of 2):	2 (MAINT REIT EXAM 1)		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
7	Reference to good academic conduct, for example referencing, plagiarism and Turnitin			N/A
8	Actions to complete			
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		Arenas		03/10/19.

to be sent to the Partnership Team Leader

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			
6	Guidance about expected evidence for submission, e.g. essay or report, word count, bibliography and references			
7	Reference to good academic conduct, for example referencing, plagiarism and Turnitin			
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				

UWTSD 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

**UNIVERSITY OF WALES:
TRINITY SAINT DAVID**



**PRIFYSGOL CYMRU:
Y DRINDOD DEWI SANT**

LOCATION: COLEG SIR GAR (GRAIG)

LLEOLIAD: COLEG SIR GAR (GRAIG)

LEVEL 4

LEFEL 4

**EXAMINATION PERIOD
MAY 2020**

**CYFNOD ARHOLIADAU
MAI 2020**

**MODULE CODE: SGDM4002
MECHANICAL SCIENCE 1**

TIME: 2 HOURS

**STUDENTS MUST ATTEMPT ALL QUESTIONS IN SECTION "A" AND ANY
THREE QUESTIONS FROM SECTION "B".**

Equipment or materials required

- *Calculators are permitted.*

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- *Caniateir cyfrifiwmellau*

QUESTION A

QUESTION ONE

a. State Newton's second law of motion.

[5 marks]

b. Define acceleration and state the units.

[5 marks]

c. State and explain the conditions of equilibrium.

[5 marks]

d. With the aid of a diagram define frequency and state the unit.

[5 marks]

e. A crate that is 2m x 2m square and 3m high contains foam that has a density of 200kg/m^3 . If the crate has a mass of 3kg calculate the total mass and weight of the crate if it is half-full of foam.

[5 marks]

Total marks for Question 1 = 25 Marks

SECTION B

QUESTION TWO

a) Define Poisson's ratio.

[4 marks]

b) A duralumin tie 300 mm long and 40mm in diameter, has an axial hole drilled out along its length. The hole is 25mm dia and 100mm long. Calculate the maximum stress and total extension of the tie due to a load of 180kN. Take $E = 82.5 \text{ GN/m}^2$.

[12 marks]

c) A punch presses out washers from material, which has a thickness of 4mm. If the outside diameter of the washer is 60mm and the inside diameter is 25mm, calculate the force required to punch out the washers if the stress in the material is not to exceed 460 MN/m^2 .

[9 marks]

Total marks for Question 2 = 25 marks

QUESTION THREE

For the beam shown in figure Q3, determine the shear force and bending moment equations and draw the shear force and bending moment diagrams.

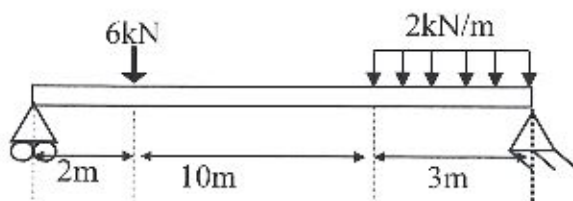


Figure Q3

Total marks for Question 3 = 25 marks

QUESTION FOUR

a) A flywheel rotating about its axle accelerates at a constant value of 6rad/s^2 . If the initial angular velocity is 8rad/s , calculate its angular velocity after 4 complete revolutions. Also, determine the time taken during these four revolutions.

[8 marks]

b) What constant force will increase the velocity of a mass of 50kg from 54km/h to 83km/h in 10 seconds? Also, determine the distance the mass would travel in this time. Neglect the effect of friction.

[8 marks]

c) A car with wheels 700mm diameter accelerates uniformly from rest to a velocity of 15km/h in 10 seconds. Determine the acceleration of the car and the angular acceleration of the wheels in this time.

[9 marks]

Total marks for Question 4 = 25 marks

QUESTION FIVE

a) Define Simple Harmonic Motion

[5 marks]

b) A 20kg load is hung from a spring and gives an extension of 30mm . The load is pulled down a further distance of 200mm and released. Determine:

- i) The frequency of the vibration
- ii) The periodic time
- iii) The maximum force acting
- iv) The velocity at 10mm from the midpoint.

[20 marks]

Total marks for Question 5 = 25 marks

DATA SHEET

Motion

$$v = u + at$$

$$s = ut + \frac{1}{2} at^2$$

$$v^2 = u^2 + 2as$$

$$s = \left(\frac{u+v}{2} \right) t$$

$$\omega_2 = \omega_1 + \alpha t$$

$$\theta = \omega_1 t + \frac{1}{2} \alpha t^2$$

$$\omega_2^2 = \omega_1^2 + 2\alpha\theta$$

$$\theta = \left(\frac{\omega_1 + \omega_2}{2} \right) t$$

$$v = \omega r, \quad a = \alpha r$$

$$s = \theta r$$

Elasticity

$$\sigma = \frac{P}{A}, \quad \varepsilon = \frac{\delta L}{L}$$

$$E = \frac{\sigma}{\varepsilon}$$

$$\nu = -\frac{\varepsilon_{\text{lat}}}{\varepsilon_{\text{long}}}$$

$$\tau = \frac{V}{A_R}, \quad G = \frac{\tau}{\gamma}$$

$$FOS = \frac{P_{\text{allow}}}{P_{\text{ultimate}}} = \frac{\sigma_{\text{allow}}}{\sigma_{\text{ultimate}}}$$

Bending and Torsion

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

$$Z = \frac{I}{y_{\text{max}}}$$

$$\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{l}$$

Gear Ratio

$$\frac{\text{Speed of A}}{\text{Speed of B}} = \frac{\text{Teeth on B}}{\text{Teeth on A}}$$

Forces

$$F = \mu N$$

$$F = -kx$$

$$F = ma$$

SHM

$$T = \frac{2\pi}{\omega}, \quad f = \frac{1}{T}$$

$$\omega = 2\pi f$$

$$T = 2\pi \sqrt{\frac{l}{g}}$$

$$\frac{k}{m} = \frac{g}{\delta}$$

$$\omega_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{g}{l}} = \sqrt{\frac{g}{\delta}}$$

$$v = -\omega \sqrt{r^2 - x^2}$$

$$v = -\omega r \sin \theta$$

$$a = -\omega^2 r \cos \theta$$

$$a = -\omega^2 r$$

Work, Energy and Power

$$WD = F \times s$$

$$P = \frac{WD}{t} = F \times v$$

$$PE = mgh$$

$$KE = \frac{1}{2} mv^2$$

Impulse and Momentum

$$F = \frac{m(v-u)}{t}$$

$$H_u = mu, \quad H_v = mv$$

$$J = F \times t$$

$$H_v = H_u + J$$

$$m_A u_A + m_B u_B = m_A v_A + m_B v_B$$

$$e = \frac{v_B - v_A}{u_A - u_B}$$

Thermodynamic Process

$$\text{Polytropic Process - } PV^n = C$$

$$\text{Work Transfer - } W = \frac{P_1 V_1 - P_2 V_2}{n-1}$$

$$\text{Isothermal Process - } W = P_1 V_1 \ln \frac{v_2}{v_1}$$

Perfect Gases

$$\text{Characteristic Gas Equation}$$

$$PV = mRT$$

$$\text{Other useful relationships -}$$

$$\frac{T_1}{T_2} = \left(\frac{P_1}{P_2} \right)^{\frac{n-1}{n}}, \quad \frac{T_1}{T_2} = \left(\frac{v_2}{v_1} \right)^{n-1}$$

$$C_v = \left(\frac{du}{dT} \right)_p, \quad c_p = \left(\frac{dh}{dT} \right)_p$$

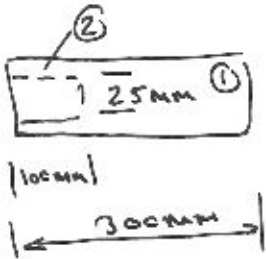
Steam and Properties of Vapours

$$\text{Enthalpy of wet steam} = hf + xhfg$$

$$\text{Specific volume of wet steam} = xv_g$$

$$\text{Mass of vapour } m = \frac{V}{v}$$



Q2	Question	Marks
(a)	$\nu = \epsilon_t / \epsilon_l$	(4)
(b)	 $O.D = 40\text{mm}$ $F = 180\text{ kN}$ $E = 205\text{ GPa}$ $\text{STRESS ①} = \frac{F}{A} = \frac{180 \times 10^3}{(\pi \times 0.02^2)} = 143.2\text{ MN/m}^2$ $\text{STRESS ②} = \frac{F}{A} = \frac{180 \times 10^3}{[(\pi \times 0.02^2) - (\pi \times 0.0125^2)]} = 235\text{ MN/m}^2$ $\text{MAX STRESS IS IN THE HOLLOW SECTION} = 235\text{ MN/m}^2$ $\Delta L = \Delta L_1 + \Delta L_2$ $\Delta L_1 = \epsilon_1 \times L_1$ $\epsilon_1 = \frac{\sigma_1}{E} = \frac{143.2 \times 10^6}{205 \times 10^9} = 6.98 \times 10^{-4}$ $\therefore \Delta L_1 = 6.98 \times 10^{-4} \times 0.2$ $\Delta L_1 = 1.39 \times 10^{-4}\text{m}$ $\Delta L_2 = \epsilon_2 \times L_2$ $\epsilon_2 = \frac{\sigma_2}{E} = \frac{235 \times 10^6}{205 \times 10^9} = 1.146 \times 10^{-3}$ $\therefore \Delta L_2 = 1.146 \times 10^{-3} \times 0.1$ $\Delta L_2 = 1.146 \times 10^{-4}\text{m}$ $\therefore \Delta L = 2.536 \times 10^{-4}\text{m}$	(2)
(c)	 $ID = 0.025\text{m}$ $O.D = 0.08\text{m}$ $t = 3.5\text{mm}$ $\text{USS} = 460\text{ MN/m}^2$ $\text{Area} = \pi D t + \pi d t$ $= (\pi \times 0.08 \times 0.0035) + (\pi \times 0.025 \times 0.0035)$ $= 8.79 \times 10^{-4} + 2.748 \times 10^{-4}$ $= 1.153 \times 10^{-3}\text{ m}^2$ $I = F/A$ $F = \sigma \times A$ $F = 460 \times 10^6 \times 1.153 \times 10^{-3}$ $F = 530.78\text{ kN}$	(2)
		(4)
		(3)



Q 3	Question	Marks
	Diagram of a beam structure with a pin support at A and a roller support at B. A point load of 6kN is applied at C, 2m from A. A uniformly distributed load (UDL) of 2kN/m is applied from D to E, where D is 10m from A and E is 12m from A. The distance between C and D is 8m. Shear Force (S.F.) diagram shows a constant shear of 5.8kN from A to C, a jump to -0.2kN at C, a constant shear of -0.2kN from C to D, and a linear increase from -0.2kN to -6.2kN from D to E. Bending Moment (B.M.) diagram shows a linear increase from 0 at A to 11.6kNm at C, a constant moment of 11.6kNm from C to D, and a parabolic curve from 11.6kNm at D to 9.6kNm at E. <u>DETERMINE REACTION</u> TAKE MOMENTS ABOUT RA CW = POSITIVE MOMENT $(6 \times 2) + (2 \times 3 \times 13.5) = R_B \times 15$ $12 + 81 = 15 R_B$ $93/15 = R_B$ $R_B = 6.2 \text{ kN}$ $\therefore R_A = 12 - 6.2$ $R_A = 5.8 \text{ kN}$ <u>MAX S.F. = 6.2 kN</u> B.M. at A = 0 kNm B.M. at B = 0 kNm B.M. at C = 5.8×2 $= 11.6 \text{ kNm}$ B.M. at D = $(5.8 \times 12) - (6 \times 10)$ 9.6 kNm <u>MAX B.M. = 11.6 kNm</u>	(5) (10) (10)



Q5	Question	Marks
(a)	SIMPLE HARMONIC MOTION OCCURS WHEN THE FORCE (F) ON AN OBJECT IS DIRECTLY PROPORTIONAL TO THE DISPLACEMENT (x) OF THE OBJECT, BUT IN THE OPPOSITE DIRECTION MATHEMATICALLY OBEYS HOOKE'S LAW $F = -Kx \quad F = F_{\text{spring}}$ K = SPRING CONSTANT x = DISPLACEMENT THE FORCE IS CALLED RESTORING FORCE BECAUSE IT ALWAYS ACTS ON THE OBJECT TO RETURN IT TO EQUILIBRIUM POSITION	(5)
b)(i)	$K = \frac{mg}{x} = \frac{20 \times 9.81}{0.03} = 6540 \text{ N/m}$	(2)
	$\therefore f = \frac{1}{2\pi} \sqrt{\frac{k}{m}} = \frac{1}{2\pi} \sqrt{\frac{6540}{20}} = 2.87 \text{ Hz}$	(3)
(ii)	$T = \frac{1}{f} = \frac{1}{2.87} = 0.347 \text{ secs}$	(5)
(iii)	$\omega = \sqrt{\frac{k}{m}} \quad \text{As } F = Kx$ $F = 6540 \times 0.02$ $F = 130.8 \text{ N}$	(5)
(iv)	$V = \omega \sqrt{r^2 - x^2}$ $V = 18.08 \sqrt{(0.02)^2 - (0.01)^2}$ $V = 0.313 \text{ m/s}$	(5)
		28