ENGR 244 (Mechanics of Materials)

Lab No. 1: BRINELL HARDNESS TEST

DATA AND CALCULATION SHEET

Student Name:________________________________Student ID:_________________________________Lab Group:_______________

SAMPLE	No. of Trial	Ball Diameter, D (mm)	Diameter of impression, d (mm)			Load, P		Depth of indentation, t (mm)	Area of indentation, A (mm²)	Brinell Hardness, HB (Kg/mm^2)	Average Brinell Hardness HB (Kg/mm^2)
			d_x	d_y	d = ½(d_x+d_y)	in Newton (N)	in Kg (N/9.81)				
Steel	1	10.00									
	2										
	3										
Aluminum	1	10.00									
	2										
	3										

Formula used

$$HB = \frac{P(kg)}{A(mm^2)} \text{ and } A = \pi D t = \frac{\pi D\,(D-\sqrt{D^2-d^2}\,)}{2}$$

where:

P = applied load in kg (Load (N)/g).

g = acceleration due to gravity (9.81 m/s^2)

A = area of the indentation (mm²)

D = diameter of the ball (mm)

d = mean diameter of the impression (mm)

t = depth of indentation (mm)

ENGR 244 (Mechanics of Materials)

Lab No. 2: TENSION TEST ON METALS

DATA SHEET

Student Name:______________________ Student ID____________________ Lab Group__________

Sample	Before Fracture	After Fracture
Steel	Li = ... mm, di =. ....mm	Lf = ...mm, df = ... mm
Aluminum	Li= ....mm, di = ...mm	Lf = ...mm, df =.................mm

ALUMINUM				STEEL			
Load, P(N)	Deformation, δ (mm)	Load, P(N)	Deformation, δ (mm)	Load, P (N)	Deformation, δ (mm)	Load, P (N)	Deformation, δ (mm)
Maximum Load, P_{max} = ... N				Maximum Load, P_{max} =...................... .... N			

ENGR 244 (Mechanics of Materials)

Lab No. 3: TORSION TEST ON METALS

DATA AND CALCULATION SHEET

Student Name: ______________________ Student ID:_________________________ Lab Group:

Sample	Diameter, D = $(D_1+D_2+D_3)/3$	Gauge Length, L	Polar Moment of inertia, J
Steel	mm	mm	mm^4
Aluminum	mm	mm	mm^4
Brass	mm	mm	mm^4

Steel				
T (N.m)	θ (Deg.)	θ (Rad.)	G (GPa)	G_{av} (GPa)
1.50				
3.00				
4.50				
6.00				
7.50				
9.00				
10.50				

Aluminum				
T (N.m)	θ (Deg.)	θ (Rad.)	G (GPa)	G_{av} (GPa)
1.00				
2.00				
3.00				
4.00				
5.00				
6.00				

Brass				
T (N.m)	θ (Deg.)	θ (Rad.)	G (GPa)	G_{av} (GPa)
1.00				
2.00				
3.00				
4.00				
5.00				
6.00				

Formulas

$J = (\pi D^4)/32$ where T = Torque (N.mm), L= Gauge length (mm), D = Diameter of the specimen (mm)

$G = TL/ \theta J$ θ = angle of twist (radians), J= Polar Moment of inertia (mm^4)

ENGR 244 (Mechanics of Materials)

Lab No. 4: STRESS ANALYSIS OF BEAMS USING STRAIN GAUGES

Student Name: Student ID: Lab Group:

Properties of the steel beam:

Span length between supports, L = 455 mm,

Width, b=______________mm,

Height, h=______________mm

Span length between the two loading points:

2c =______________ mm.

Applied Load, P (N)	Strain Indicator reading units are in micro-strain (10^{-6} strain)					
	Channel # 1	Channel # 2	Channel #3	Channel # 4	Channel # 5	Channel # 6
1000						
2000						
3000						
4000						
5000						
Unload						

ENGR 244 (Mechanics of Materials)

Lab No. 5: DEFLECTION OF BEAMS
DATA SHEET

Student Name: ____________________Student ID:________________Lab Group:_________

Dimensions	BRASS	STEEL	ALUMINUM
Span Length, L (mm)	455	455	455
Width, w (mm)			
Height, h (mm)			

DEFLECTION OF BEAM, δ (mm)						
Applied Load	**BRASS**		**STEEL**		**ALUMINUM**	
	at x = L/2	at x = L/4	at x = L/2	at x = L/4	at x = L/2	at x = L/4
200 N						
400 N						
600 N						
800 N						
1000 N						

PART 2 : CANTILEVER BEAMS

Brass width x height …….x……..(mm), **Steel** width x height ……x……..(mm), **Alum** width x height………x……..(mm)

CANTILEVER BEAM DEFLEXION, δ (mm)						
Applied Load	**BRASS span L=……..mm**		**STEEL span L=……..mm**		**ALUM span L=……..mm**	
	x=L/2	x=L	x=L/2	x=L	x=L/2	x=L
100 gm						
200 gm						
300 gm						
400 gm						
500 gm						

Analysis & Discussion: Follow the instructions given on page # 21 of your lab manual.

EXPERIMENT 6: Typical DATA Sheet

Type of column	Column Length, L (mm)	End Condition	Effective length factor, k	Effective length, L_{eff} (mm)	Inner diameter, d_{in} (mm)	Outer diameter, d_{out} (mm)	Cross sectional area, A (mm^2)	Moment of inertia, I (mm^4)	Radius of gyration, r (mm)	Slender-ness ratio, λ	Allowable Stress, σ_{all} (MPa)	Theoretical Critical load, P_{cr} (N)	Theoretical Critical stress, σ_{cr} (MPa)	Experimental Critical Load, P_{cr} (N)	Experimental Critical stress, σ_{cr} (MPa)
	75	Pin-Pin	1	75											
	125	Pin-Pin	1	125											
Hollow	225	Pin-Pin	1	2:25											
	225	Pin-Fixed	0.707												
	225	Fixed-Fixed	0.5												
	225	Pin-Pin	1	225											
Solid	225	Pin-Fixed	0,707												
	225	Fixed-Fixed	0.5												

Report:

1. Tabulate the critical loads measured for various specimens
2. On <u>ONE</u> graph, show the comparison of the followings:
   (i) Theoretical σ_{cr} vs. λ,
   (ii) Experimental σ_{cr} vs. λ, and
   (iii) Allowable stress vs. λ,

Discussion: Answer all <u>FOUR</u> questions given in your Lab Manual.

Effective Length factor, k

One end fixed, one end free	Both ends pinned	One end fixed, one end pinned	Both ends fixed
K = 2	K= 1	$K = \frac{1}{\sqrt{2}}$	$K=\frac{1}{2}$

(Sometimes ‘Fixed’ is called ‘clamped’, ‘pinned’ is called ‘hinged’)