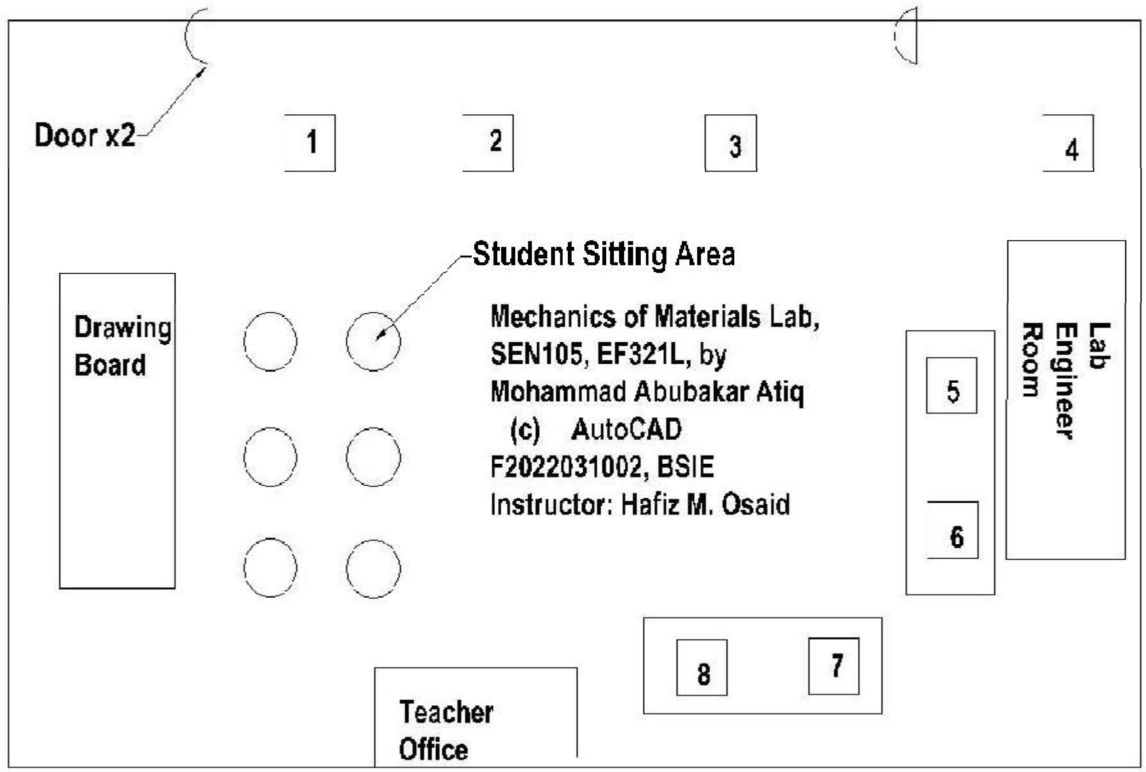
Lab 01 Layout Design and Introduction to Mechanics of Materials



Legend

1. Shear Center Apparatus
2. Fatigue Testing Machine
3. Hooke's Law Apparatus, UMT-24663
   Deflection of Curved Beam Apparatus, UMT-24766
4. Eccentric Loading Apparatus, UMT-27221
5. Torsion of Bar Apparatus
6. Torsion testing machine
7. Column & Becking Apparatus
8. Unsymmetrical Loaded Contilever Apparatus

By:
Mohammad Abubakar Atiq, F2022031002
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Batch/Program	BSIE

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Lab 02 To verify the validity of hookes law and determine the spring constant

Apparatus Hookes Law Apparatus, UMT-29663

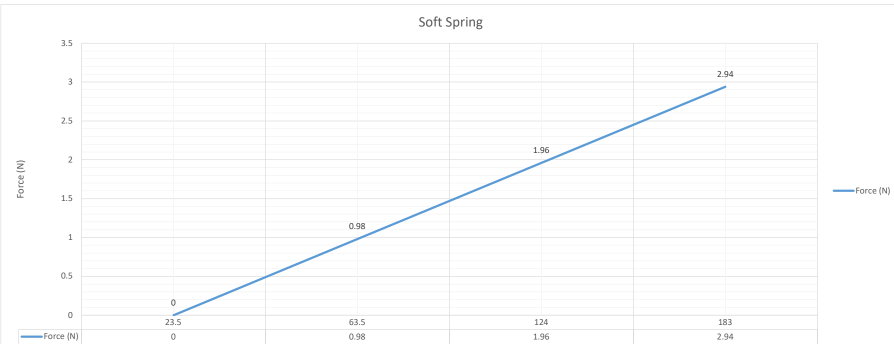
Material

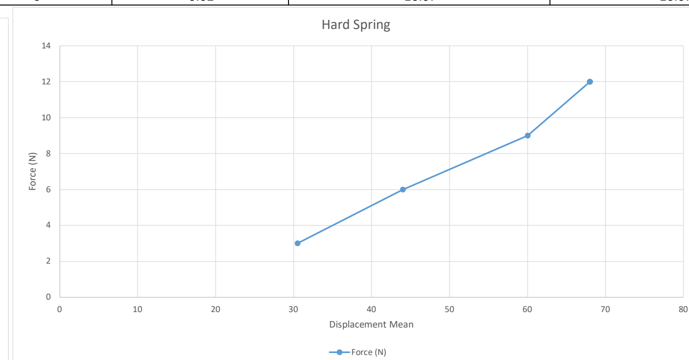
3 springs, hardness different

wire thickness is inversely proportional to hardness of the spring

Soft Spring 1:

Mass (g)	Mass (Kg)	Force (N)	Deflection 1 of loading (mm)	Deflection 2 of unloading (mm)	Displacement Mean	Change in Length (mm)	Spring Constant (k) (N/mm)	Spring Constant (k) (N/m) (Experimental)	Spring Constant (k) (N/m) (Theoretical)
0	0	0	23	24	23.5	1	0.00	0.00	0.00
100	0.1	0.98	62	65	63.5	3	0.02	15.43	15.81
200	0.2	1.96	123	125	124	2	0.02	15.81	15.93
300	0.3	2.94	183	183	183	0	0.02	16.07	16.07





Hard Spring

Mass (g)	Mass (Kg)	Force (N)	Deflection 1 of loading (mm)	Deflection 2 of unloading (mm)	Displacement Mean	Change in Length (mm)	Spring Constant (k) (N/mm)	Spring Constant (k) (N/m) (Experimental)	Spring Constant (k) (N/m) (Theoretical)
306.122449	0.306122449	3	30	31	30.5	1	0.10	98.36	100.00
612.244898	0.612244898	6	43	45	44	2	0.14	136.36	139.53
918.3673469	0.918367347	9	59	61	60	2	0.15	150.00	152.54
1224.489796	1.224489796	12	68	68	68	0	0.18	176.47	176.47

Lab 3

To determine the relationshi between shear load and shear strain

G=(Shear stress)/(Shear Strain)

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Observation

Least Count (mm)	0.05
Length (L) mm	303
Thickness (t) mm	26.1
Width (W) mm	103.1
Area (L*t)	7908.3

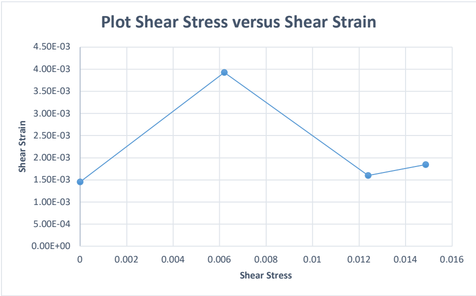
$$\gamma = \left(\frac{\delta l}{\delta w}\right) = \frac{Mean}{Width}$$

$$\tau = \frac{F}{A}$$

$$G = \frac{\tau}{\gamma}$$

			Shear Deformation					
Serial No	Mass (kg)	Load (N)	Deflection Upon Loading (mm)	Deflection Upon Unloading (mm)	Mean (mm)	Angle of Distortion= change in width/original width	Shear stress=(force/Area)	Modulus of Rigidity=Shear Stress/ Angle of Distortion
1	0	0	0	0.3	0.15	1.45E-03	0	0
2	5	49	0.7	0.11	0.405	3.93E-03	0.006196022	1.577308291
3	10	98	0.15	0.18	0.165	1.60E-03	0.012392044	7.743149794
4	12	117.6	0.19	0.19	0.19	1.84E-03	0.014870453	8.069177154

Group 1:
Mohammad Abubakar Atiq
Barira Qasim



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Lab 04	To find out the shear modulus of rods under torsional loading.	
Name:		By:
ID:		Mohammad Abubakar Atiq, F2022031002
Apparatus:	Torsion of bar apparatus, vernier caliper, weights	Barira Qasim, F2022031016

Length of shaft (L)=cm	37.4	cm	374	mm	0.374	m
Diameter of shaft (d)=mm	3.9	mm	0.0039	m		
Diameter of Torque pulley (D)=mm	125.2	mm	0.1252	m		
Radius of Torque Pulley (R=D/2)=	118.8	mm	0.1188	m		

Polar moment of insertion of the shaft=J = 2.27122E-11

Theta_1 θ_1 = 6 cm 60 mm 0.06 m

Theta_2 θ_2 = 25 cm 250 mm 0.25 m

$$J = \frac{\pi d^4}{32}$$ = 2.27122E-11

Serial No	Mass	Load (W)	Torque WR	Angle of Twist at 1st measuring arm			Angle of Twist at 2nd measuring arm		
	g	N	Nm	Loading (degree)	Unloading (degree)	Mean	Loading (degree)	Unloading (degree)	Mean
1	0	0	0	0	0	0	0	1	0.5
2	500	4.9	0.58212	4	2	3	4	3	3.5
3	800	7.84	0.931392	6	3	4.5	7	5	6
4	1000	9.8	1.16424	9	5	7	9	5	7

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Apparatus:	Torsion of bar apparatus, vernier caliper, weights	Barira Qasim, F2022031016	

Length of shaft (L)=cm	37.4 cm	374 mm	0.374 m
Diameter of shaft (d)=mm	3.9 mm	0.0039 m	
Diameter of Torque pulley (D)=mm	125.2 mm	0.1252 m	
Radius of Torque Pulley (R=D/2)=	118.8 mm	0.1188 m	
Polar moment of insertion of the shaft=J	=	2.27122E-11	

$$G = \frac{\tau L}{J\theta}, unit\ Pa$$

Angle of Twist at 1st measuring arm			Angle of Twist at 2nd measuring arm			Angle of twist for effective length	Modulus of rigidity
Loading (radian)	Unloading (radian)	Mean, theta_1	Loading (radian)	Unloading (radian)	Mean, theta_2	theta	
0	0	0	0	0.017453293	0.008726646	0.008726646	0
0.06981317	0.034906585	0.052359878	0.06981317	0.052359878	0.061086524	0.008726646	8.37E+07
0.104719755	0.052359878	0.078539816	0.122173048	0.087266463	0.104719755	0.026179939	4.02E+08
0.157079633	0.087266463	0.122173048	0.157079633	0.087266463	0.122173048	0	0.00E+00

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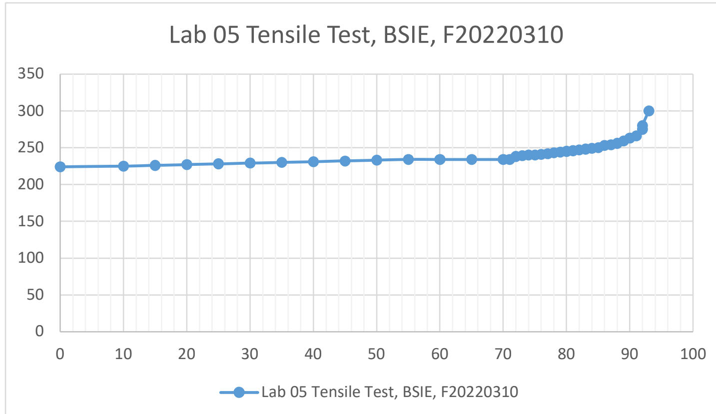
Lab 05

Objective: To determine the tensile strength of a Mild Steel bar with the help of universal testing machine also draw stress strain curve.

Length: 52.6 cm 526 mm After experiment, length change = 58.8cm
Diameter: 11.55 cm 115.5 mm

Sr#	Load (kN)	Deflection (mm)
1	0	224
	10	225
	15	226
	20	227
	25	228
	30	229
	35	230
	40	231
	45	232
	50	233
	55	234
	60	234
	65	234
	70	234
	71	234
	72	238
	73	239
	74	240
	75	240
	76	241
	77	242
	78	243
	79	244
	80	245
	81	246
	82	247
	83	248
	84	249
	85	250
	86	253
	87	254
	88	256
	89	259
	90	263
	91	266
	92	275
	92	280
	93	300



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Lab 06

Objective: To determine the compressive stength of a Mild steel bar with the help of universal testing machine.

Height	29.5	cm	295	mm
Diameter:	15	cm	150	mm

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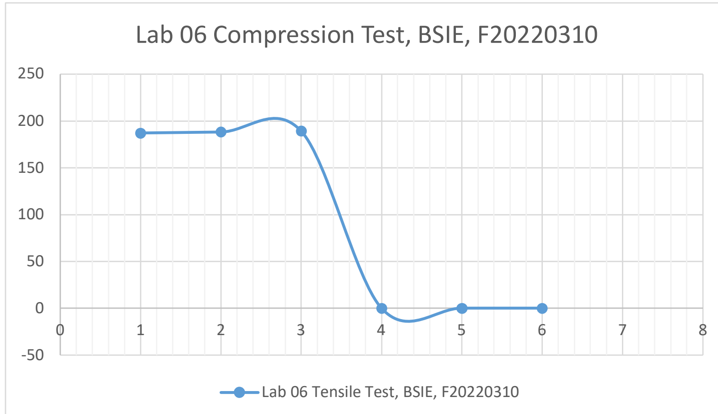
Sr#	Load (kN)	Deflection (mm)
1	0	187
2	110	188
3	190	189
4	250	0
5	259	0
6	260	0
	Materials Crack	



By:
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Lab 07 To determine central deflection of a simply supported beam loaded at mid span.

Name: Mohammad Abubakar Atiq

ID: F2022031002

1	Effective length of beam (L):	=	134	cm	1.34	m	52.75593	in
2	Width of beam (w):	=	25	mm	0.025	m	0.984253	in
3	Height of beam (h):	=	7.2	mm	0.0072	m	0.283465	in
4	Area moment of inertia (I): $I = \frac{wh^3}{12}$	=	7.776E-10	m^4	3.06142E-08	in^4		
5	Modulus of elasticity E:	=	2.006	GPa				

Serial No.	Mass (g)	Mass (Kg)	Applied Load (W) N	Experimental Deflection (W) Loading mm	Unloading mm	Average (W) mm	Average (W) m	Theoretical Deflection $\delta_{CT} = \frac{wL^3}{48(EI)}$		
1	100	0.1	0.98	0.47	0.47	0.47	0.00047	3.67501E-14	0.00047	0.00047
2	200	0.2	1.96	0.87	0.89	0.88	0.00088	6.88086E-14	0.00087	0.00089
3	300	0.3	2.94	1.34	1.39	1.365	0.001365	1.06732E-13	0.00134	0.00139
4	400	0.4	3.92	1.79	1.79	1.79	0.00179	1.39963E-13	0.00179	0.00179

Serial No.	Mass (g)	Mass (Kg)	Applied Load (W) N	Experimental Deflection (W) Loading mm	Unloading mm	Average (W) mm	Average (W) m	Theoretical Deflection $\delta_{CT} = \frac{wL^3}{48(EI)}$		
1	100	0.1	2.943	0.6015	0.00116	0.30133	0.00030133	2.35615E-14	0.000602	1.16E-06
2	200	0.2	5.886	0.06219	0.0021	0.032145	0.000032145	2.51347E-15	6.22E-05	2.1E-06
3	300	0.3	8.829	0.00324	0.0033	0.00327	0.00000327	2.55687E-16	3.24E-06	3.3E-06
4	400	0.4	11.772	0.00433	0.0043	0.004315	0.000004315	3.37397E-16	4.33E-06	4.3E-06

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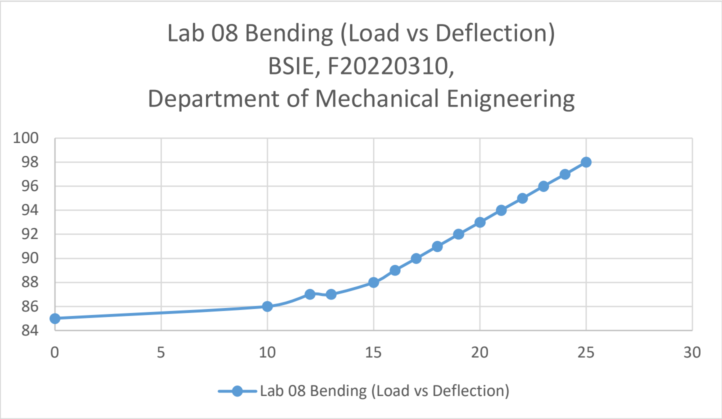
Lab 08, EF321L Mechanics of Materials
Objective:
To analyze the response of metal under bending and determine bending strength of the specimen.
Workpiece: Wood By: Mohammad Abubakar Atiq, F2022031002 Date: 8th January, 2025

Sr#	Load (kN)	Deflection (mm)
1	0	85
2	10	86
3	12	87
4	13	87
5	15	88
6	16	89
7	17	90
8	18	91
9	19	92
10	20	93
11	21	94
12	22	95
13	23	96
14	24	97
15	25	98



Lab 09 To determine central deflection of a fixed ended beam loaded at mid span.

Name: Mohammad Abubakar Atiq

ID: F2022031002

1	Effective length of beam (L):	=	134	cm	1.34	m	52.75593	in
2	Width of beam (w):	=	25.5	mm	0.0255	m	1.003938	in
3	Height of beam (h):	=	6.6	mm	0.0066	m	0.259843	in
4	Area moment of inertia (I): $I = \frac{wh^3}{12}$	=	6.109E-10	m^4	2.40523E-08	in^4		
5	Modulus of elasticity E:	=	2.01E+12	GPa				

Serial No.	Mass (g)	Mass (Kg)	Applied Load (W) N	Experimental Deflection (W) Loading mm	Unloading mm	Average (W) mm	Average (W) m	Theoretical Deflection $\delta_{CT} = \frac{wL^3}{192I}$		
1	294.3	0.2943	2.943	0.47	0.47	0.47	0.00047	3.59834E-15	0.00047	0.00047
2	588.6	0.5886	5.886	0.87	0.89	0.88	0.00088	6.73731E-15	0.00087	0.00089
3	882.9	0.8829	8.829	1.34	1.39	1.365	0.001365	1.04505E-14	0.00134	0.00139
4	1177.2	1.1772	11.772	1.79	1.79	1.79	0.00179	1.37043E-14	0.00179	0.00179

Serial No.	Mass (g)	Mass (Kg)	Applied Load (W) N	Experimental Deflection (W) Loading mm	Unloading mm	Average (W) mm	Average (W) m	Theoretical Deflection $\delta_{CT} = \frac{wL^3}{192I}$		
1	100	0.1	2.943	0.6015	0.00116	0.30133	0.00030133	2.30699E-15	0.0006015	0.00000116
2	200	0.2	5.886	0.06219	0.0021	0.032145	0.000032145	2.46103E-16	0.00006219	0.0000021
3	300	0.3	8.829	0.00324	0.0033	0.00327	0.00000327	2.50352E-17	0.00000324	0.0000033
4	400	0.4	11.772	0.00433	0.0043	0.004315	0.000004315	3.30358E-17	0.00000433	0.0000043

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Lab 10 — To determine deflection for a cantilever beam.

Name: Mohammad Abubakar Atiq — Barira Qasim

ID: F2022031002 — F2022031016

1	Effective length of beam (L):	=	48	cm		0.48	m	18.89765 in
2	Width of beam (w):	=	27.2	mm		0.0272	m	1.070867 in
3	Height of beam (h):	=	16.7	mm		0.0167	m	0.657481 in
4	Area moment of inertia (I): $I = \frac{wh^3}{12}$	=	1.05569E-08	m^4	4.15627E-07	in^4		
5	Modulus of elasticity E:	=	2.06E+11	GPa				

Serial No.	Mass (g)	Mass (Kg)	Applied Load (W) N	Experimental Deflection (W) Loading mm	Unloading mm	Average (W) mm	Average (W) m	Theoretical Deflection $\delta_{CT} = \frac{wL^3}{3(EI)}$	Loading m	Unloading m
1	0	0	0	0	0.01	0.005	0.000005	4.01E-04	0	0.00001
2	200	0.2	2.943	0.29	0.3	0.295	0.000295	2.36E-02	0.00029	0.0003
3	400	0.4	5.886	0.58	0.41	0.495	0.000495	3.97E-02	0.00058	0.00041
4	600	0.6	8.829	0.89	0.89	0.89	0.00089	7.14E-02	0.00089	0.00089

Serial No.	Mass (g)	Mass (Kg)	Applied Load (W) N	Experimental Deflection (W) Loading mm	Unloading mm	Average (W) mm	Average (W) m	Theoretical Deflection $\delta_{CT} = \frac{wL^3}{3(EI)}$		
1	100	0.1	0.98	0.18	0.18	0.18	0.00018	1.44E-02	0.00018	0.00018
2	200	0.2	1.96	0.34	0.34	0.34	0.00034	2.73E-02	0.00034	0.00034
3	300	0.3	2.44	0.56	0.56	0.56	0.00056	4.49E-02	0.00056	0.00056
4	400	0.4	11.772	0.00433	0.0043	0.004315	0.000004315	3.46E-04	0.00000433	0.0000043

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Lab 11: To determine the horizontal deflection and vertical deflection of different curved beams due to point loading.

1/1/2025

By

Mohammad Abubakar Atiq, F2022031002, Barira Qasim, F2022031016

Length (L):	=	48	cm	0.48	m
Width of ring (b):	=	27.2	mm	0.0272	m
Height (h):	=	16.7	mm	0.0167	m

M	Bending moment		
E	Modulus of elasticity of beam material	193-203	GPa
I	Moment of inertia of the beam		
EI	Flexural rigidity of beam		
L	Length of beam		

For Ring, Case 01

Dia (d) = 300 mm 0.3 m Radius ® = 0.15 m

Horizontal deflection = $\Delta H = \frac{0.114PR^3}{EI}$

Vertical deflection = $\Delta V = \frac{0.149PR^3}{EI}$

Moment of inertia (I) = $I = \frac{bd^3}{12}$ = 6.12E-05 m^4

E = 2.06E+11 GPa

Sr#	Mass (g)	Mass (kg)	P (N)	Loading Vertical Deflection @ Loading	Horizontal deflection @ Loading	Unloading Vertical Deflection @ Unloading	Horizontal deflection @Unloading	Average Average Vertical Deflection	Average Horizontal Deflection	ΔH	ΔV
1	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00E+00	0.00E+00
2	300	0.3	2.940	0.410	0.100	0.480	0.400	0.445	0.250	3.36E-19	6.13E-20
3	600	0.6	5.880	0.910	0.300	0.950	0.900	0.930	0.600	6.72E-19	1.36E-19
4	900	0.9	8.820	1.400	0.990	1.400	0.990	1.400	0.990	1.01E-18	2.09E-19