Experiments Manual

Department of Industrial Engineering

College of Engineering

Jazan University

Jazan, Saudi Arabia.

Computer Integrated manufacturing lab

Experiments for Computer Aided Manufacturing course (IE 453) scheduled in 13 weeks for semester as follow:

Exp.1 (3 weeks)

Review on Conventional Manufacturing Processes

Activity: students asked for prepare simple parts by means of conventional machine tools “lath, mill, and drill”

Fig.1

Fig.2

Fig.3

Fig.4

Fig.5

Fig. 6

Fig. 7

Exp. 2 (1 week)

Safety procedures in Computer aided manufacturing lab

Activity: students will visit the FMS lab for the first time, safety procedures- attached- will be illustrated before starting any activity in the lab**.**

Exp. 3 (1 week)

Computer aided manufacturing equipment

Activity: students will visit the FMS lab to know the main equipment in the lab and its functions as an integrated manufacturing system. Explore of the main parts in FMS- *CNC machine tools, Robotics, Conveyors, quality inspection stations and storage unit*- as well as the function of each part.

Exp.4-7 (4 weeks)

Computer Numerical Controlled Turn

Activity: CNC turn is one of manufacturing stations in FMS with CNC Mill, for this visit students will know detailed information about CNC turn-model, type, parts, function and maintenance.

Operation on Computer Numerical Controlled Turn

Activity: students will know how to preparing setting of "CNC turn" before starting work on it as well as work offset and tool offset.

Fig. 8

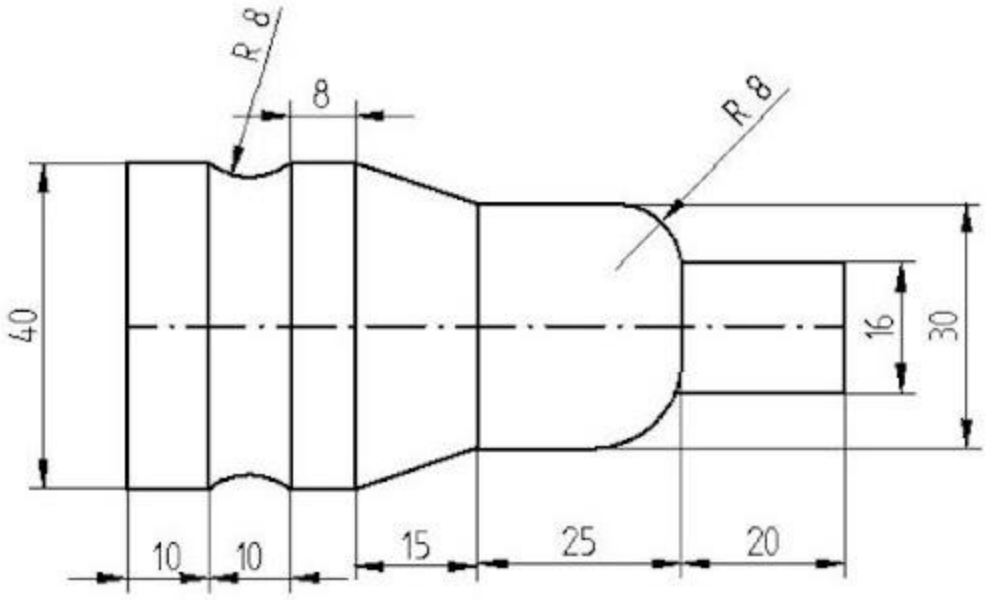

R 8
8
R 8
40
16
30
10
10
15
25
20

Fig. 9

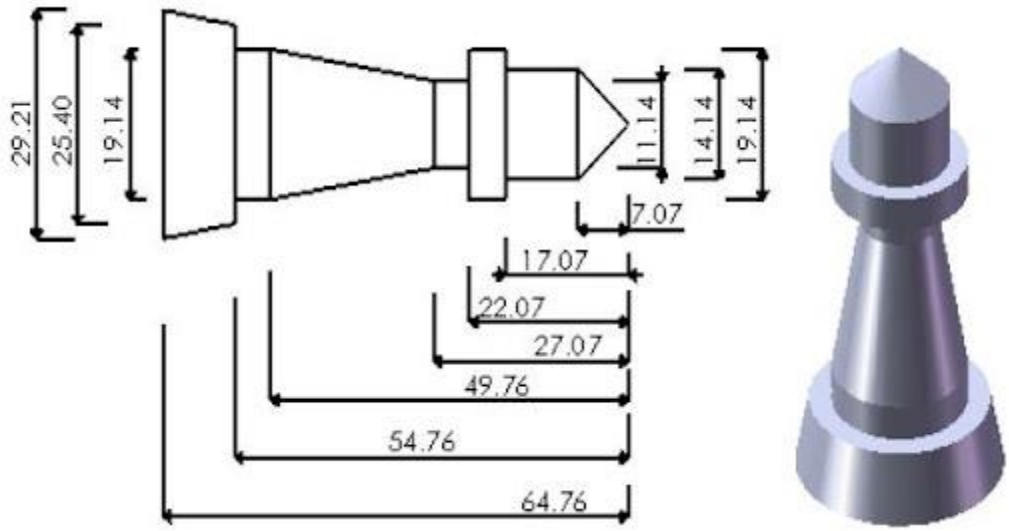

29.21
25.40
19.14
11.14
14.14
19.14
7.07
17.07
22.07
27.07
49.76
54.76
64.76

Fig.10

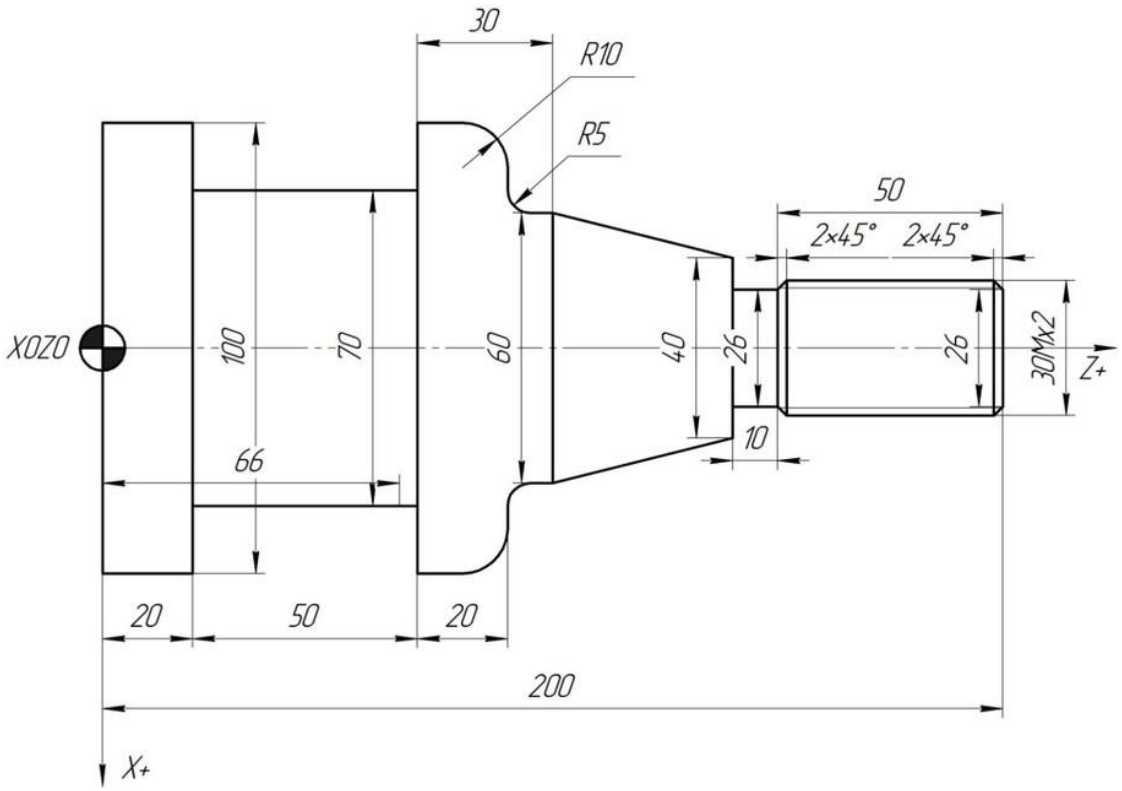

30
R10
R5
50
2×45°
2×45°
X0Z0
100
70
60
40
26
26
30Mx2
Z+
10
66
20
50
20
200
X+

Fig. 11

Exp.8-11(4 weeks)

Computer Numerical Controlled Mill

Activity: CNC mill is the other manufacturing station in FMS, for this visit students will know detailed information about CNC mill- model, type, parts, function and maintenance.

Operation on Computer Numerical Controlled Mill

Activity: students will know how to preparing setting of "CNC Mill" before starting work on it as well as work offset and tool offset.

Operation on Computer Numerical Controlled Mill

Activity: students helped to prepare and execute a part program on CNC mill for simple parts "rectangular parts with different shapes and configurations"

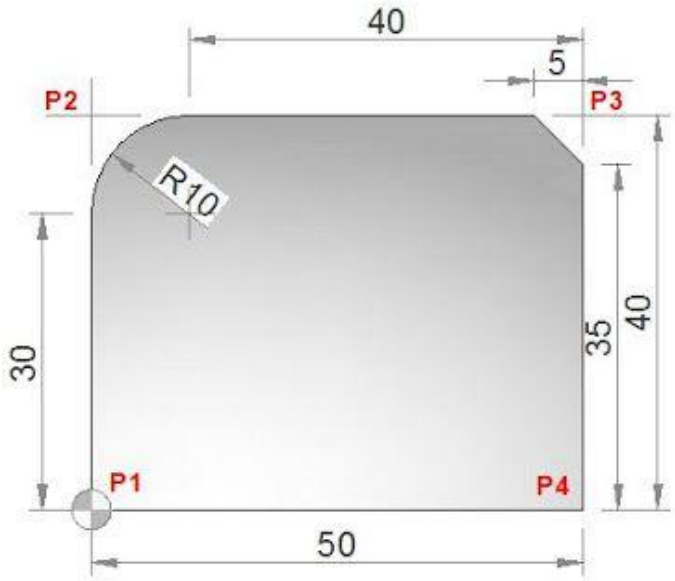


Fig. 12

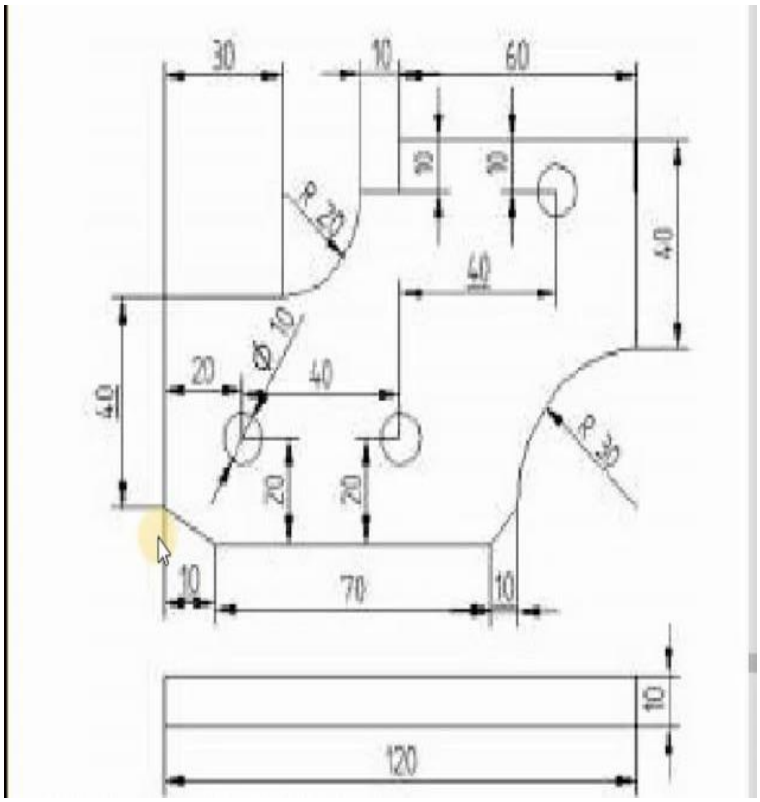


Fig. 13

Question 7): Write G-code program to machine the part shown in the figure below using CNC milling machine. Use sub programming commands (M98 and M99) in the pocket cutting. Maximum depth of cut is 5 mm.

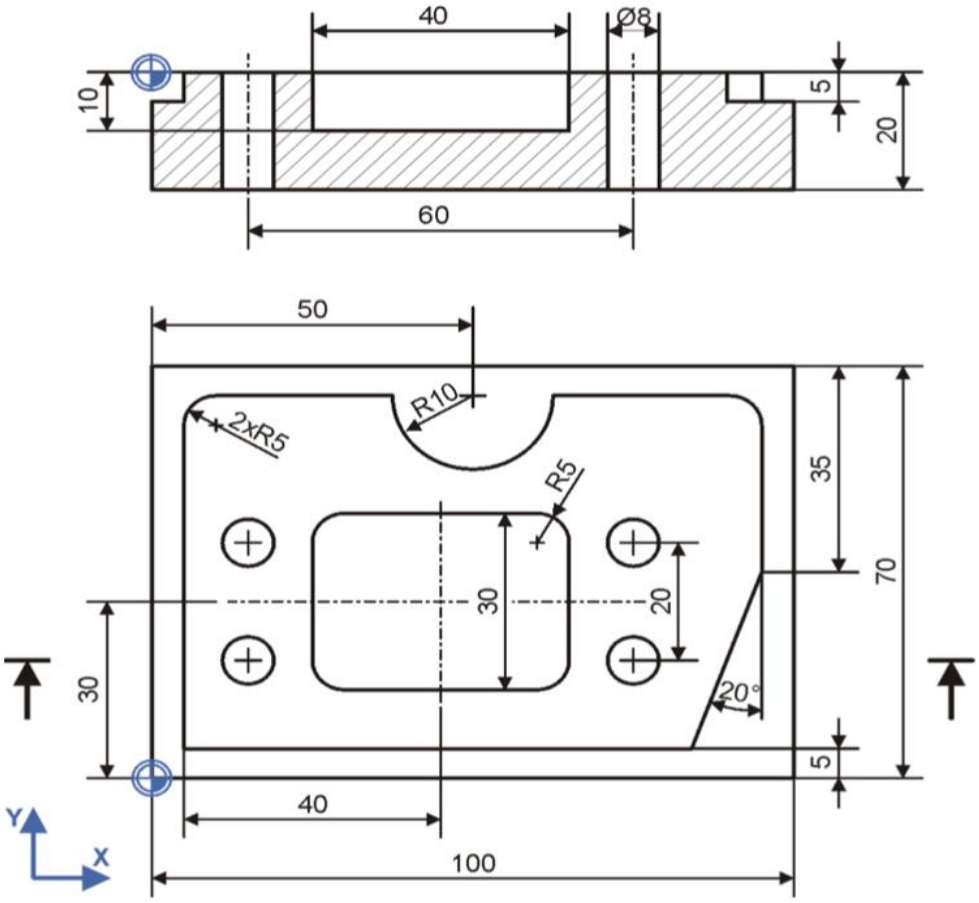


Fig. 14

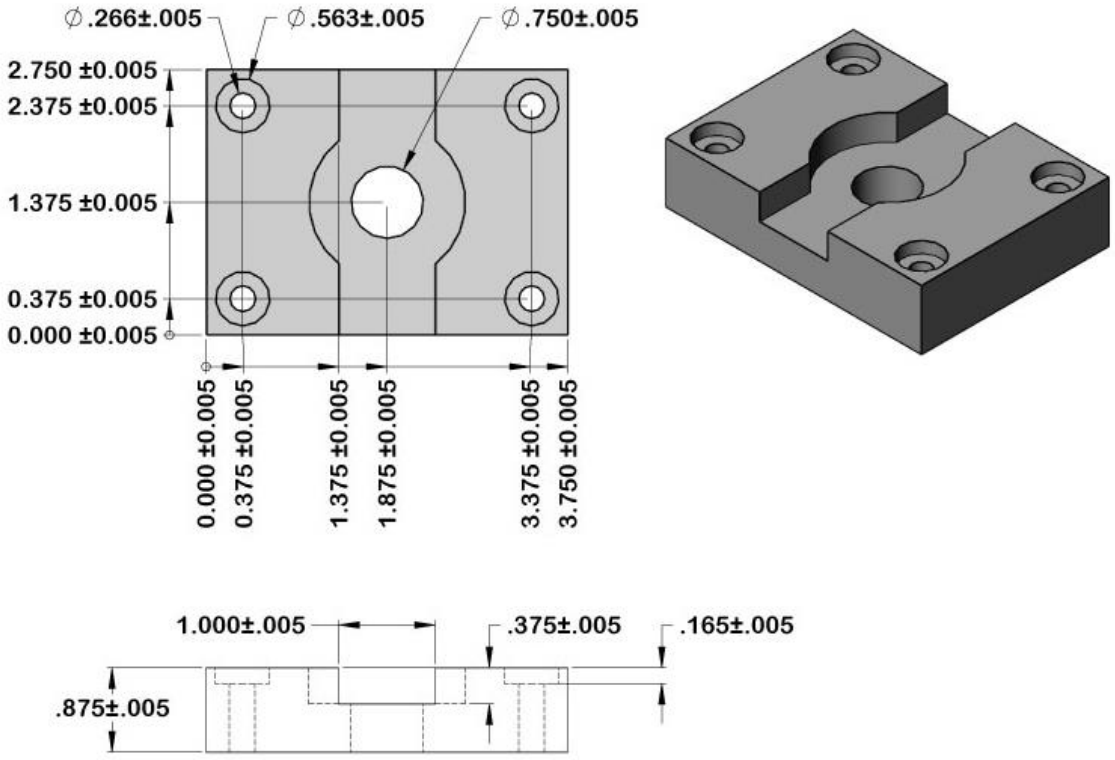

∅.266±.005
∅.563±.005
∅.750±.005
2.750 ±0.005
2.375 ±0.005
1.375 ±0.005
0.375 ±0.005
0.000 ±0.005
0.000 ±0.005
0.375 ±0.005
1.375 ±0.005
1.875 ±0.005
3.375 ±0.005
3.750 ±0.005
1.000±.005
.375±.005
.165±.005
.875±.005

Fig. 15

Experiments in Work Study Lab

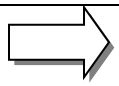
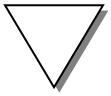
Experiment: 1

Object: -To draw Outline Flow Process Chart of any Activity using Standard Chart Symbols.

Tools and Equipment required:

- Standard Chart Symbols
- Car
- New Tyre to be replaced
- Jack
- Tools required to un-screw the bolts of the tyres.

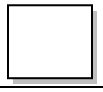
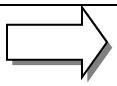
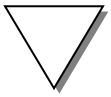
Standard Flow Process Chart Symbols:

S.No	Symbols	Symbol Description
1.		**Inspection**
2.		**Operation**
3.		**Transportation**
4.		**Delay**
5.		**Storage**

Experiment: 2

Object: -To draw Outline Flow Process Chart of any Activity using Standard Chart Symbols.

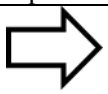
Standard Flow Process Chart Symbols:

S.No	Symbols	Symbol Description
1.		Inspection
2.		Operation
3.		Transportation
4.		Delay
5.		Storage

Experiment: 3

Object-: To Estimate Total time and distance for improving layout and Material handling to reduces delay eliminates or combines events with the help of

Flow process diagram (Material Type)

	Existing			Proposed
	No	**Distance**	**Time**	
 Inspection				
 Transportation				
 Storage				
 Delay				
 Operation				

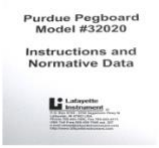
Experiment: 4

Object:- Left and Right Hand Process Chart for a assembly of Pin, Washer and Collar Using Purdue Pegboard

Tools And Equipments Required:

i. Purdue Pegboard Test (Model # 32020)

ii. Instruction Manual.



iii. Test Board.

iv. Pins, Collars and Washers.

v. Score Sheet.

vi. One Testing Table of at least 30 inches Tall.

vii. Stop watch or Clock that reads in seconds. 

Experiment: 5

Object: To Calculate the Basic Time requires completing the assembly task using Purdue Pegboard Assembly Test.

Back Ground:

The Purdue Pegboard Test was first developed by Joseph Tiffin, Ph.D., an Industrial Psychologist at Purdue University in 1948. Since that time, this device has been used extensively to aid in the selection of employees for jobs that require fine and gross motor dexterity and coordination skills.

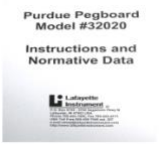
Purdue Pegboard Test Comprises of 6 Test Batteries.

i. Right Hand Test Battery.
ii. Left Hand Test Battery.
iii. Both Hands Test Battery.
iv. Right +left + Both Hands test Battery which is actually not a test but a mathematical Sum Calculation.
v. **Assembly Test Battery**.

Tools And Equipments Required:

viii. Purdue Pegboard Test (Model # 32020)

ix. Instruction Manual.



x. 1 Test Board.

xi. Pins, Collars and Washers.

xii. Stop watch or Clock that reads in seconds.

Parameters:

i. Parameters are Subject's Age, Weight, Gender, Hands-Eyes-Fingers co-ordination and the Time Management skills.

Experiment: 6

Object: To calculate the Standard Time (ST) for an Activity called Minnesota Dexterity Placing Test.

Tools and Equipment required:

i. Minnesota Manual Dexterity Test Model#32023

ii.

iii. 1 Test Board

iv. 60 Black / Red Plastic Disks

v. Stop watch.

Parameters:

Parameters are Subject's Age, Weight, Gender, Both hands and eye co-ordination and Time Management.

Experiment: 7

Object – To calculate the basic Time, standard time from the given observations for a desire accuracy ±5% with confidence level 95% for activity.

i) The Elemental time recorded on a time study sheet by a time study observer indicates following times:

0.14,0.15,0.14,0.20,0.15,0.20,0.18,0.17,0.18,0.14,0.17,0.19,0.13,0.15,0.17,

0.17,0.19,0.14,0.17,0.18,0.16,0.14,0.16,0.13,0.19,0.14,0.14,0.13,0.14,

0.17, 0.12, 0.13, 0.14, 0.18, 0.14, 0.19.

ii) Westing house Rating From the Table (attached)

Skill			
Effort			
Condition			
Consistency			

iii)

Allowance 20%

Experiment: 8

WORK SAMPLING

Object: A Particular task observation was taken .To verify these observations are sufficient for ± 5% accuracy also indicates the minimum number of observation required.

Task 1:

Check whether the number of observations is sufficient for _____% Accuracy and _____% confidence level if:

i. The number of observations of Machine working =_____

ii. The number of observation of Machine Idle = _____

iii. Total number of observations = _____

Useful Formulas:

i. $$P = \frac{\text{The number of observation of Machine Idle}}{\text{The total number of observation}}$$

ii. **The total number of observation =** The number of observations of Machine working+ The number of observation of Machine Idle

iii.

$$SP = K\sqrt{\frac{P(1-P)}{N}}$$

Where

S= Relative or Derived Accuracy

P = Percentage of Accuracy

N= Total Number of random Observations (Sample Size)

Note:

For Confidence level = 68 %, K=1

For Confidence level = 95 %, K=2

For Confidence level = 99%, K=3

WORK SAMPLING-II

Object – To calculate the Number of observation required by given number of frequency

i) The Elemental time recorded on a time study sheet by a time study observer indicates following times:

0.15, 0.14, 0.20, 0.15, 0.20, 0.18, 0.18, 0.19, 0.13, 0.15, 0.17, 0.19, 0.14,

0.17 ,0.17,0.19,0.14,0.17,0.18,0.16,0.14,0.16,0.13,0.19,0.14,0.13, 0.17,

0.12, 0.13, 0.18, 0.19.

Experiments in Human Factor Engineering Lab

Experiment: 1

Experiment on Human Skeleton

Aim:

An Introduction to Human Skeleton and to study the various parts of Human Skeleton.

Equipment Required:

1. Model of Human Skeleton

Project Parameters:

1. Draw the skeleton-Label.
2. Draw the Eyes-Label.
3. Draw the ears –Label.
4. Draw the spinal cord- Label.

Project Procedure:

Write the Function of Parts of the Body.

- Spinal Cord.
- Hands.
- Fingers.
- Legs
- Joints.
- Brain.
- Neck.

Experiment: 2

Experiment on Treadmill Exercising Machine

Aim:

To study the variations in various Human Body parameters like Pulse rate, Total Calories burnt and Blood Pressure at various speeds and inclination with the help of graphs and by using Treadmill Exercising Machine.

Equipment Required:

i. Treadmill exercising Machine

ii. Digital Blood Pressure Monitoring Machine.

iii. Stethoscope.

Parameters:

Parameters are Subject's Age, Gender, Weight, Pulse Rate, Blood Pressure, total Calories burnt and their variations after work out on Treadmill Exercising Machine.

Experiment: 3

Experiment on Ergometer Exercising Machine

Aim:

To study the variations in various human body parameters like Temperature, Pulse rate, Blood pressure and total calories burned at various speeds and inclination using Ergo Meter Exercising Machine.

Equipment Required:

i. Stop Watch.

ii. Ergo Meter Exercising Machine.

iii. Digital Blood Pressure Monitoring machine.

iv. Thermometer.

v. Stethoscope.

Parameters:

Parameters are Subject's Age, Gender, Weight, Pulse Rate, Blood Pressure, total Calories burnt and their variations after work out on Ergo meter Exercising Machine.

Experiment: 4

Experiment on Elliptical Trainer Machine

Aim:

To study the variation in various Human Body Parameters like Temperature, Pulse rate, Blood pressure and Total calories burnt at various Time Periods using Elliptical Trainer Exercising Machine.

Equipment Required:

i. Elliptical Trainer

ii. Digital Blood Pressure Monitoring machine.

iii. Thermometer.

iv. Stethoscope.

Parameters:

Parameters are Subject's Age, Gender, Weight, Pulse Rate, Blood Pressure, Body Temperature, Total Calories burnt and their variation after work out for different Time Periods on Elliptical Trainer Exercising Machine.

Experiment: 5

Experiment on Pilates Performer Exercising Machine.

Aim:

To study the variations in various Human Body parameters like Temperature, Pulse rate, Blood pressure and Total Calories burnt at various types of Exercises using Pilates Performer/Rejuvenator

Equipment Required:

i. Pilates Performer/Rejuvenator

ii. Digital Blood Pressure Monitoring machine.

iii. Thermometer.

iv. Stethoscope.

Parameters:

Parameters are Subject's Age, Gender, Weight, Pulse Rate, Blood Pressure, Body Temperature, Total Calories burnt and their variation after work out on Pilate Performer/Rejuvenator Exercising Machine.

Experiment: 6

Experiment on Butterfly Exercising Machine

Aim:

To study the variations in various Human Body parameters like Pulse rate, total Calories burnt and blood pressure at various weights limits using Butterfly Exercising Machine.

Equipments Required:

i. Butter Fly Exercising Machine.

ii. Digital Blood Pressure Monitoring Machine.

iii. Thermometer.

iv. Stethoscope.

Parameters:

Parameters are Subject's Age, Gender, Weight, Pulse Rate, Blood Pressure, Total Calories burnt and their variation after work out on Butterfly Exercising Machine.

Modeling and Simulation lab

This lab serve more than course under IE program. Beside 3D printers this lab consist of several software applications installed on more than 25 PCs for under graduate and research purposes. Examples of software are MAT Lab, SIMIO, Minitab, and TORA. Following are some examples of IE courses that using this lab.

1- Computer Application in Industrial Engineering

The practices will be distributed over a period of 13 weeks starting in the third week as follows

Lab week no.	**Semester Week no.**	**Lab duty**
1	Exp.1	*Introduction to Computer Applications in Industrial Engineering*
2	Exp.2	*Mathematical Modeling Numerical Methods*
3	Exp.3	*MATLAB Fundamentals Assignment*
4	Exp.	*MATLAB Fundamentals Assignment*
5	Exp.4	*MATLAB Fundamentals Mathematical Operations*
6	Exp.5	*Programming with MATLAB* *(M – Files)*
7		
8	Exp.6	*Programming with MATLAB*

		(Input-Output)
9	Exp.7	*Roots: Bracketing Methods* *(Roots in Engineering and Science)*
10	Exp.8	*Roots: Bracketing Methods* *(Graphical Methods)*
11	Exp.9	*Linear Algebraic Equations and Matrices (Matrix Algebra Overview)*
12		*Linear Algebraic Equations and Matrices (Matrix Algebra Overview)*
13		*Exam*
14		

2- Modeling and simulation

The practices will be distributed over a period of 14 weeks starting in the third week as follows

Lab week no.	Semester Week no.	Lab duty
1	Exp.1	*Introduction to SIMIO Software,* *Opening SIMIO Window*
2	Exp.2	*ICE Cream Store Simulation*
3	Exp.3	*Modeling Distance and Travel*
4	Exp.4	*Branched Paths, Rate Tables, and entity dependences: Airport Revisited*
5	Exp.5	
6	Exp.6	*Sequences and Travelers: Manufacturing Cells*
7		
8	Exp.7	*Batching, Functions, State Variable and statistics: Assembly of memory boards*
9	Exp.8	
10	Exp.9	*SIMIO Processes: Memory assembly reconsidered*
11	Exp.10	*Part specific processing times and single part source*
12	Exp.11	*Consumed materials*

13	Exp.12	*Handling multiple resources with failures*
14	Exp.13	*Modeling multiple resources with multiple servers*

LASER Cutting lab

This lab consist of LASER cutting unite that can be used to provide different cuttings and shapes for several types of materials. The lab shall meet the following functions:

1- Capability to cut and engrave glass, wood and acrylic in automated mode;

2- Capability to cut and engrave simultaneously;

3- Capability to handle and produce different objects;

4- Capability to measure temperature of the material during processing, and trigger an alarm in case of high temperature;

5- Capability to collect the dust produced during cutting and engraving via a dedicated exhaust system including air flow and filtering device.

Following are some specifications of laser cutting lab

#1 Process	Cuts materials (wood, Acrylic, paper) using a laser.
#2 Equipment	Epilog Laser Helix (40W, 45*60 cm).
#3 Personal Protective Equipment (PPE)	Safety glasses and hearing protection, plus minimum shop PPE.
#4 Environmental / Ventilation controls.	Ensure equipment is secure so it doesn't move when in use. A dust collection system should be attached near the cutting area.

#5 Required training or approval	{Supervisor's approval or task-specific training} • Get approval from the Shop Safety Coordinator before use. • Review and observe general safety practices outlined in the Machine Shop Equipment Safety Guidelines. • Refer to the manufacturer's operating manual for all operating procedures. Refer to the cutting manual for appropriate engraving and cutting Power and Speed settings for varied materials.
#6 Inspection requirements before use	• Safety shields and guards are in place prior to turning the machine on. Ensure air compressor and air filter are on. • Beware of FLAMMABLE materials while using the laser cutter. Certain materials are NOT allowed in the laser cutter, including: Foam Core, Any PVC material and reflective materials. • Ensure all safety shields and guards are in place before turning the laser on. • Ensure that all body parts, loose clothing, jewelry, hair and other objects are clear of the cutting area prior to turning the laser on.
#7 Safe operating procedures or precautions	• The laser cutter will generally not cut anything greater than 0.25" (6mm), anything thicker will require several passes. • To engrave glass, put a masking on top before engraving. • Turn off the laser cutter after every 4 to 5 projects (for the laser to recharge.) • ALWAYS make sure the lines are hairline for vector cutting. • NEVER LEAVE THE LASER CUTTER when it is on. • Never reach into the cutting area prior to the laser coming to a complete stop. • Disconnect the laser from power source and follow LOTO

	procedures or manufacturer's instructions if making repairs, servicing or making adjustments. • When an operator has finished working on the laser cutter, and before leaving the laser for any reason, the power must be shut off and the machine must come to a complete stop.
#8 Chemicals/ spill procedures/waste disposal	Avoid waste material build up and clean as you go to prevent a potential dust explosion. Check the dust collection system and make sure it is properly maintained and material is removed frequently.

This lab serve manufacturing processes courses for IE program and other faculty programs.