CSS221: Computer Graphics
Final Mock Exam

curated by The Peanuts

Name.............ID.............Section.............Seat No.............

Conditions: Semi-Closed Book (5 pages of A4, both sides)

Directions:

1. This exam has 10 pages (including this page).
2. Please write your name on each page.
3. The space at the back of each page can be used if necessary.
4. Please use a pen or pencil for your answers. Attempting to use a 3D input device or graphics tablet will not be recognized by the paper.
5. Solve the problems and provide a clear solution except multiple choice problems.
6. Senseless copies from the lecture notes, misleading or dubious solutions, intentionally unclear writing are given 0 or a negative score.

For solution, click here.

Problem 1

Analyze the 6 codes below. Select 1 incorrect statement.

```
S1
F1[x_, y_] := Sin[x^2] + Cos[y^2]
Plot3D[F1[x, y], {x, -2, 2}, {y, -2, 2}, PlotStyle ->
   Opacity[0.6]]
```

```
S2
CirclePoint[t_, R_] := {R*Cos[t], R*Sin[t]}
ParametricPlot[CirclePoint[t, 2], {t, 0, 2 Pi},
   PlotStyle -> {Red, Thick}]
```

```
S3
FF[a_] := {a[[1]] + Sin[a[[2]]], Cos[a[[1]]*a[[2]]]}
ParametricPlot[FF[{t, t^2}], {t, 0, 2 Pi}, PlotStyle ->
   {Blue, Dashed}]
```

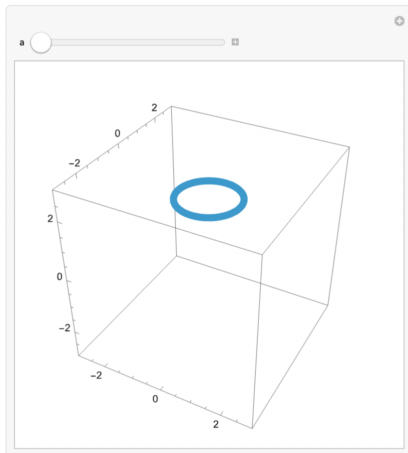
```
S4
RevolutionPlot3D[{t + 2*t, Sin[t]}, {t, 0, 2 Pi}, {p, 0,
    Pi}, BoxRatios -> 1]
```

```
S5
Plot3D[{Sin[x*y], 0.5*x*y}, {x, -2, 2}, {y, -2, 2},
  PlotStyle -> {Yellow, Green}]
```

```
S6
f[x_] = Sin[#] &
Plot[f[x], {x, -Pi, Pi}]
```

Problem 2

Analyze the graphic output below and select the correct code to produce the output below.




```
(*1*)
L1 = 2; CP = {3, 4};
OB1 = {Purple, RegularPolygon[{0, 0}, L1, 5]};
TF1[a_] := Composition[TranslationTransform[CP],
  RotationTransform[a], TranslationTransform[{0, 2}]];
GG1[a_] := Graphics[GeometricTransformation[OB1, TF1[a
   ]],
  Axes -> True, PlotRange -> {{-2, 8}, {-2, 8}}]
Manipulate[GG1[a], {a, 0, 2 Pi}]
```

```
(*2*)
PF[t_] := {t*Cos[t], t*Sin[t], t/5}
OB2 = ParametricPlot3D[PF[t], {t, 0, 4 Pi},
  PlotStyle -> {Thickness[0.015], Blue}][[1]];
TF2[a_] := Composition[TranslationTransform[{0, 0, 4}],
  RotationTransform[a, {0, 1, 0}]];
GG2[a_] := Graphics3D[GeometricTransformation[OB2, TF2[a
   ]],
  Axes -> True, BoxRatios -> 1, PlotRange -> 4]
Manipulate[GG2[a], {a, 0, 2 Pi}]
```

```
(*3*)
R = 2.5;
OB3 = ParametricPlot3D[{Cos[t], Sin[t], 0}, {t, 0, 2 Pi
   },
  PlotStyle -> {Thickness[0.02], Red}][[1]];
TF3[a_] := Composition[RotationTransform[a, {0, 0, 1}],
  TranslationTransform[{R, 0, 0}]];
GG3[a_] := Graphics3D[GeometricTransformation[OB3, TF3[a
   ]],
  Axes -> True, BoxRatios -> 1, PlotRange -> 4]
Manipulate[GG3[a], {a, 0, 2 Pi}]
```

```
(*4*)
TF4[a_] := Composition[TranslationTransform[{0, 0, 2}],
  RotationTransform[a, {1, 0, 0}]];
M4[a_] := Evaluate[TransformationMatrix[TF4[a]]]
TransCir4[a_, t_] := (M4[a].{Cos[t], Sin[t], 0, 1})[[1
   ;; 3]]
GG4[a_] := ParametricPlot3D[TransCir4[a, t], {t, 0, 2*Pi
   },
  PlotStyle -> {Thickness[0.02]}, Axes -> True,
     BoxRatios -> 1,
  PlotRange -> 3]
Manipulate[GG4[a], {a, 0, 2 Pi}]
```

```
(*5*)
S[r_, t_] := {r*Cos[t], r*Sin[t], 0}
OB5 = ParametricPlot3D[S[1, t], {t, 0, 2 Pi},
  PlotStyle -> {Thickness[0.02], Green}][[1]];
TF5[a_] := Composition[RotationTransform[Pi/2, {1, 0,
   0}],
  TranslationTransform[{0, 0, 3}], RotationTransform[a,
     {0, 0, 1}]];
GG5[a_] := Graphics3D[GeometricTransformation[OB5, TF5[a
   ]],
  Axes -> True, BoxRatios -> 1, PlotRange -> 4]
Manipulate[GG5[a], {a, 0, 2 Pi}]
```

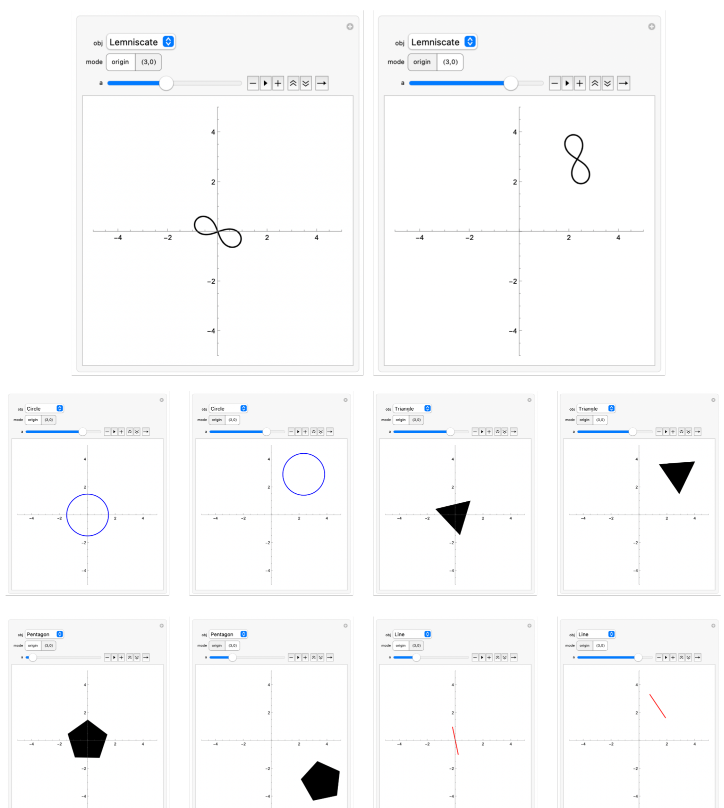
```
(*6*)
F6[a_] := Composition[TranslationTransform[{4, 0, 0}],
  TranslationTransform[{0, 0, 2}], RotationTransform[a,
     {0, 1, 0}]];
M6[a_] := Evaluate[TransformationMatrix[F6[a]]]
TransCir6[a_, t_] := (M6[a].{Cos[t], Sin[t], 0, 1})[[1
   ;; 3]]
GG6[a_] := ParametricPlot3D[TransCir6[a, t], {t, 0, 2*Pi
   },
  PlotStyle -> {Thickness[0.02]}, Axes -> True,
     BoxRatios -> 1]
Manipulate[GG6[a], {a, 0, 2 Pi}]
```

Problem 3

Animate a 2D object rotating around the origin and around its center at the distance 3. The PopupMenu controls the rotating object as follows:

- Lemniscate: Cu[t_]:={Sin[t]/(1+Cos[t]^2), Sin[t]Cos[t]/(1+Cos[t]^2)}, {t,0,2Pi}
- Circle: Circle with the R=1.5, Blue, Thick
- Triangle: Equilateral triangle with R=1.5
- Pentagon: Pentagon R=1.5
- Line: A piece of line from {-1,0} to {1,0} - Red, Thick

Hint: Convert the curve into a primitive.

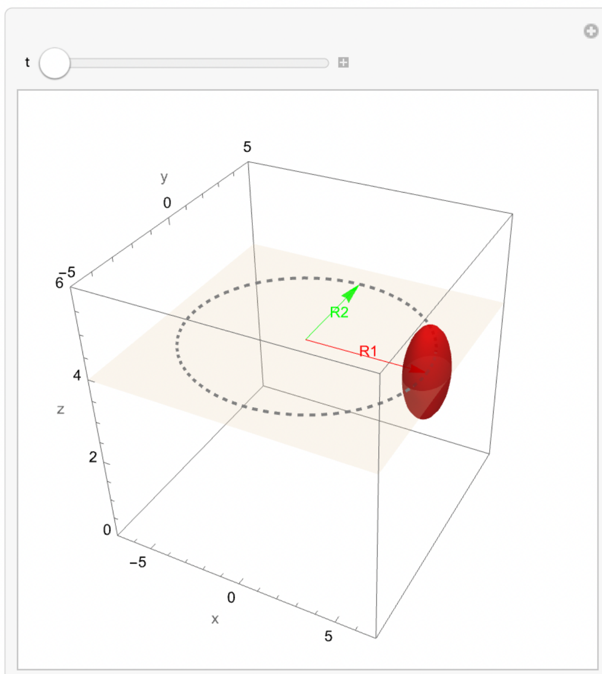


Problem 4

Animate a sphere given by:

$$\{R \cdot \cos(u) \cdot \sin(v), R \cdot \sin(u) \cdot \sin(v), R \cdot \cos(v)\}, \{u, 0, 2\pi\}, \{v, 0, \pi\}$$

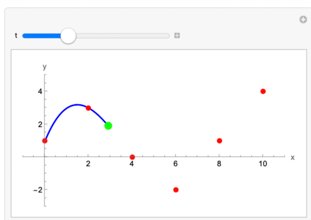
moving along an elliptical path lying in the plane z = 4. The 2D equations of the ellipse are $x = R1 \cdot \cos(t)$, $y = R2 \cdot \sin(t)$, $\{t, 0, 2\pi\}$ (convert into the 3D flat ellipse), where $R1$ and $R2$ are the radii on x and y axes, with $R1 = 6$ and $R2 = 4$. Show $R1$ and $R2$ using arrows from the origin (using Arrow[{p1,p2}]).

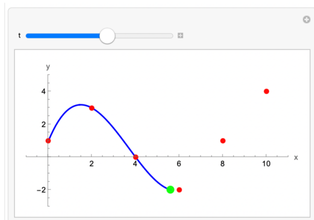


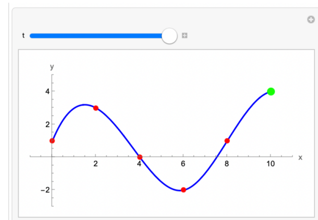
Problem 5

Interpolate the given data points and create an animation of a growing curve that passes through these points. Also display a green point at the front of the growing curve.

Data = {{0,1},{2,3},{4,0},{6,-2},{8,1},{10,4}}





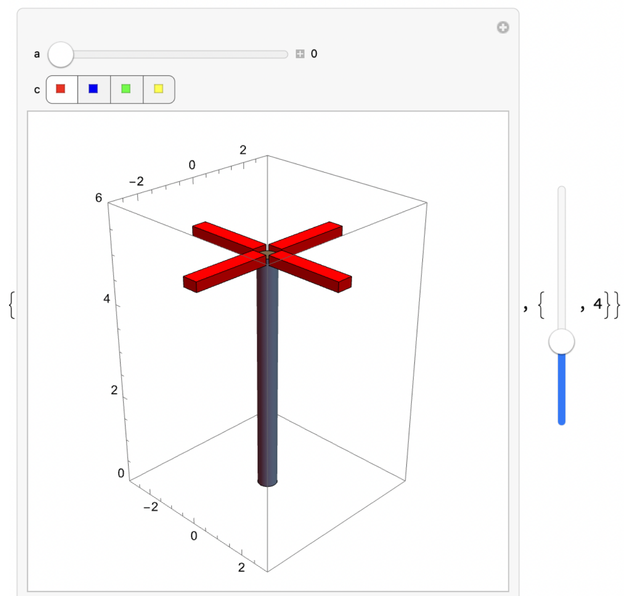


Problem 6

Write a code to animate a windmill turbine as shown below. The windmill should consist of:

- A vertical tower represented by Cylinder[{p1,p2},R], where p1={0,0,0} and p2={0,0,5}, with radius R=0.3
- Multiple rectangular blades made of Cuboid primitives

(Hint: Use Table to generate evenly-spaced blades around the center)



Bonus Problem

Create an animation of a parametric surface:

$$
\begin{aligned}
x(u,v) &= (4+\cos(v))\cdot\cos(u)\\
y(u,v) &= (4+\cos(v))\cdot\sin(u)\\
z(u,v) &= \sin(v)
\end{aligned}
$$

for $\{u, 0, 2\pi\}$, $\{v, 0, 2\pi\}$
that is deforming over time by multiplying $z(u,v)$ by a parameter a that ranges from 0.5 to 3. Additionally, implement a feature to display a point that moves along the parametric curve defined by setting $v = a \cdot \pi/3$ while u varies from 0 to 2π.