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MEMS 5001: Hw 5 %%%

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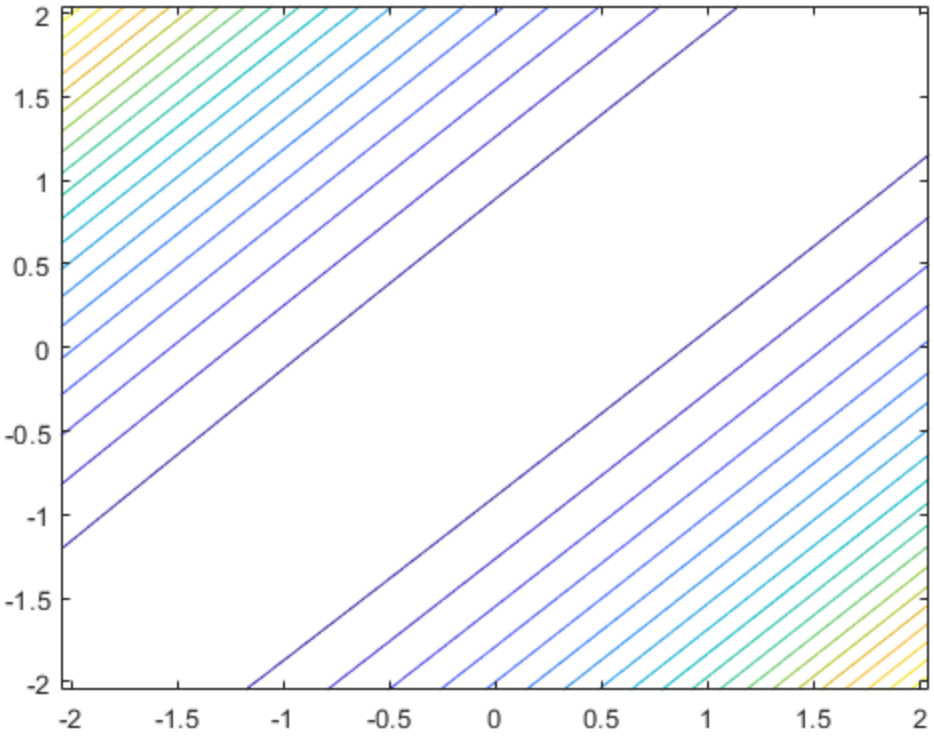
Problem 1

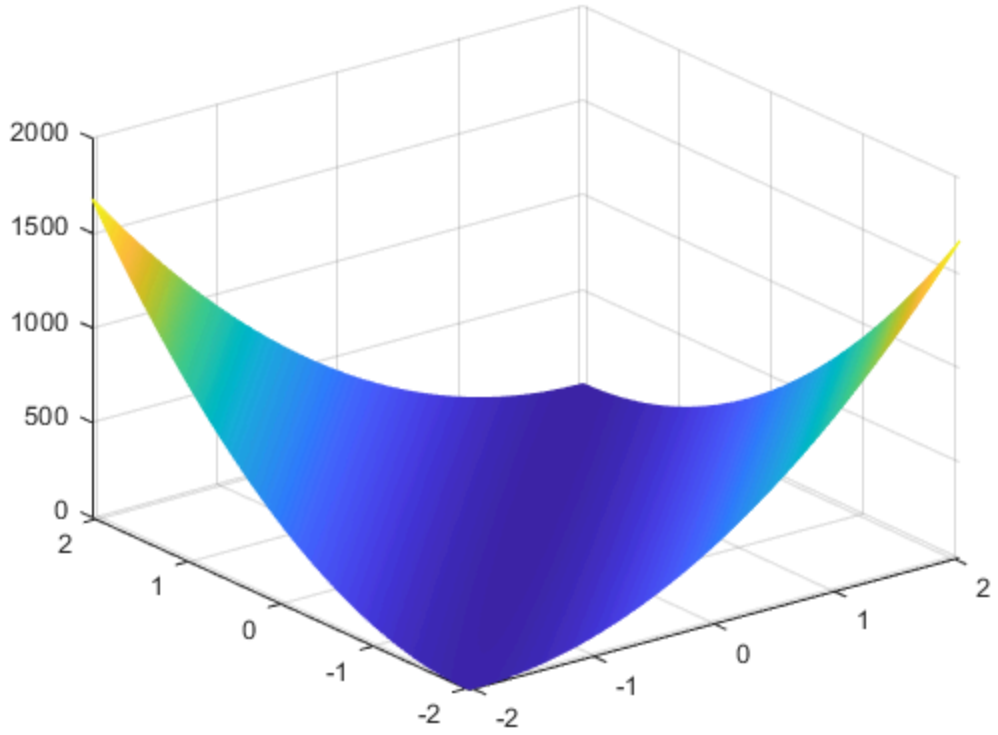
Part A: GA Obj. Function

```
f = @(x) 100*(x(1) - x(2))^2 + (1-x(1))^2;

% Linear Inequality Constraints
A = [];
b = [];

% Linear Equality Constraints
Aeq = [];
beq = [];

% Boundry Conditions
LB = [-2.048 -2.048];
UB = [2.048 2.048];
nonlcon = [];

nvars = 2;
opts = optimoptions(@ga,'PlotFcn', {@gaplotbestf});
[x_ga,fval_ga,exitflag_ga,output_ga,population_ga] =
 ga(f,nvars,A,b,Aeq,beq,LB,UB,nonlcon,opts);

x_ga
fval_ga
% Part B: Design Space
[x1,x2] = meshgrid(-2.048:0.01:2.048,-2.048:0.01:2.048);
func = 100*(x1-x2).^2 + (1-x1).^2;

figure(1);
contour(x1,x2,func, 20);

figure (2);
mesh(x1,x2,func)
```

```
Optimization terminated: maximum number of generations exceeded.
```

```
x_ga =

    1.2063    1.2078

fval_ga =

    0.0428
```





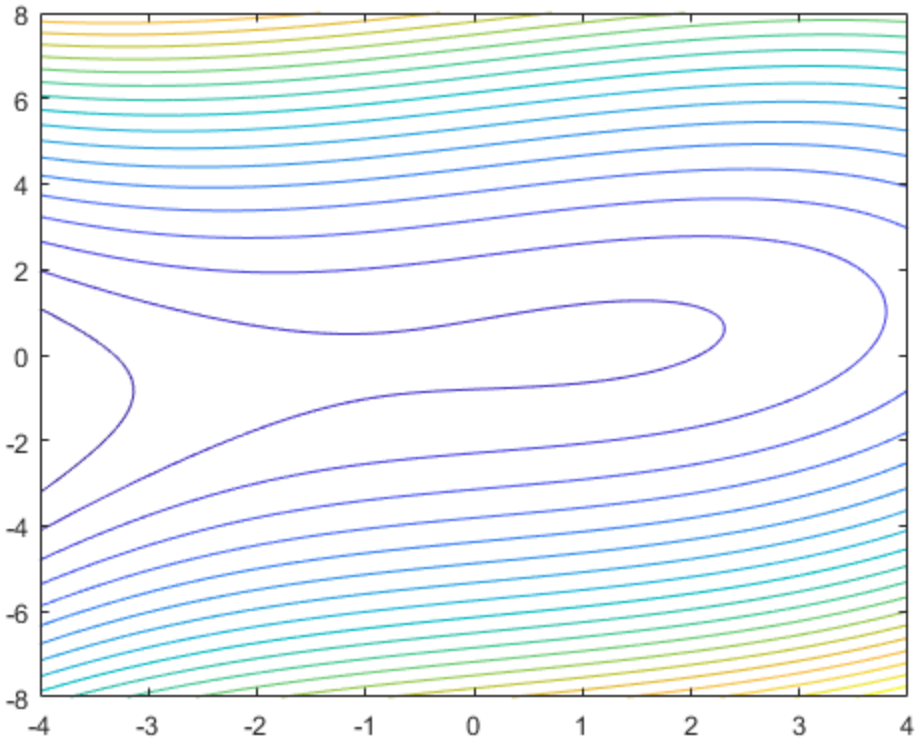
Probem 2

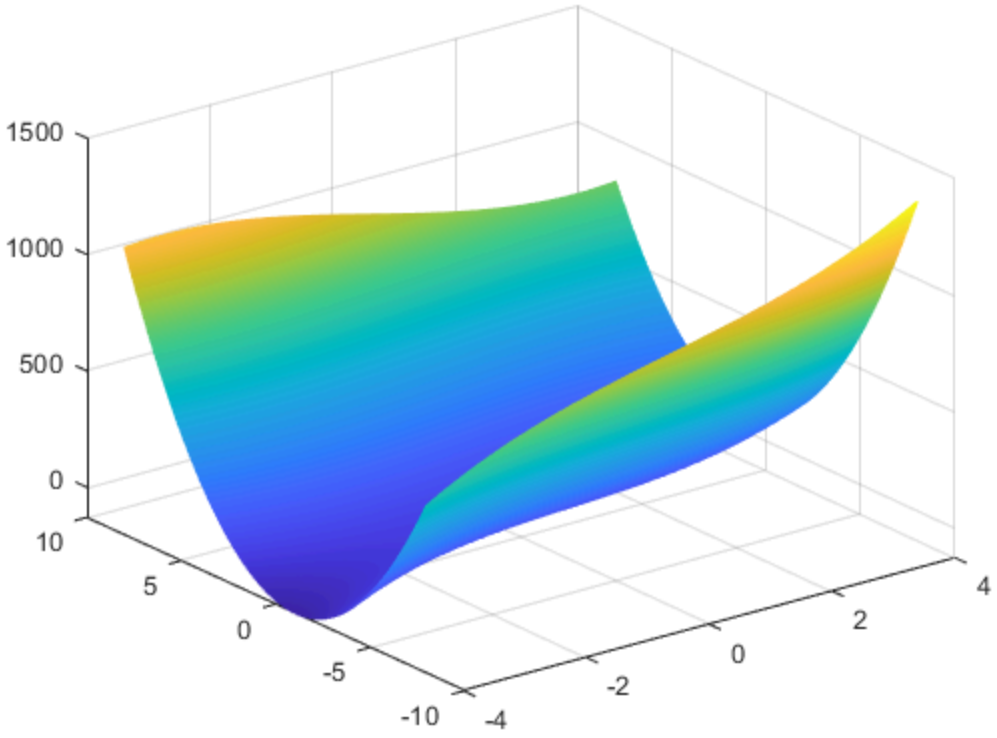
```
% Part A: GA
% Obj. Function
f2 = @(x) 2.*x(1).^3 + 15.*x(2).^2 - 8.*x(1).*x(2) - 4.*x(1);

% Linear Inequality Constraints
A = [];
b = [];

% Linear Equality Constraints
Aeq = [];
beq = [];

% Boundry Conditions
LB = [-4 -8];
UB = [4 8];
nonlcon = @hw5NoLinearIneq;

nvars = 2;
opts = optimoptions(@ga,'PlotFcn', {@gaplotbestf});
[x2_ga,fval2_ga,exitflag_ga,output_ga,population_ga] =
 ga(f2,nvars,A,b,Aeq,beq,LB,UB,nonlcon,opts);

x2_ga
```

```
fval2_ga
```

```
% Part B: Design Space
[x1,x2] = meshgrid(-4:0.01:4,-8:0.01:8);
func2 = 2*x1.^3 + 15*x2.^2 - 8*x1.*x2 - 4*x1;

figure(1)
contour(x1,x2,func2, 20);
figure(2)
mesh(x1,x2,func2)
```

```
Optimization terminated: average change in the fitness value less than
 options.FunctionTolerance
 and constraint violation is less than options.ConstraintTolerance.

x2_ga =

   -4.0000   -1.9998


fval2_ga =

 -116.0044
```





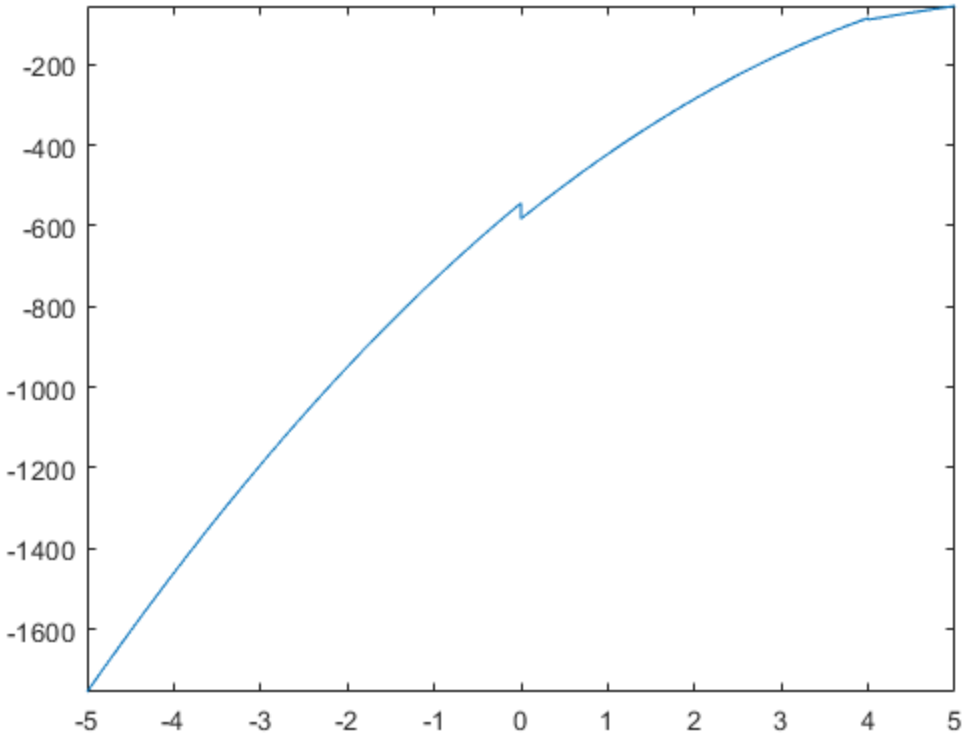
Problem 3

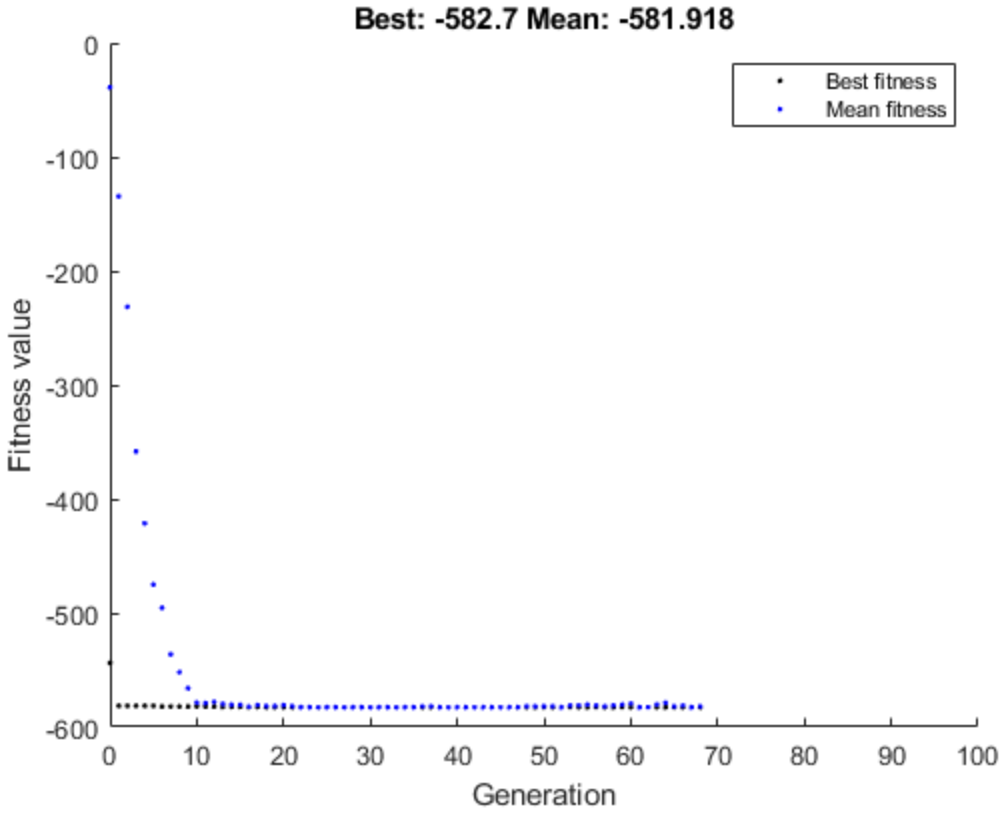
```
% Part 1
% Obj. Function
 f = @(x) (-1*(1*(x-2).^2 + 2) + 45)*(0 >= x & x< 4)...
        + (-1*(10*(x-6).^2 + 1) + 45)*(4>= x & x < 8)...
        + (-1*(2*(x-12).^2 + 10) + 45)*(8>= x & x < 16)...
        + (-1*(0.1*(x-24).^2 + 1.1) + 45)*(16>= x & x <= 31);

% Part 2
fplot(f)

% Part 3
% Linear Inequality Constraints
A = [];
b = [];

% Linear Equality Constraints
Aeq = [];
beq = [];

% Boundry Conditions
LB = [0];
UB = [31];
nonlcon = [];
```

```
nvars = 1;
opts = optimoptions(@ga,'PlotFcn', {@gaplotbestf});
[x_ga,fval_ga,exitflag_ga,output_ga,population_ga] =
 ga(f,nvars,A,b,Aeq,beq,LB,UB,nonlcon, opts);

x_ga
fval_ga



%x = 0:0.01:31;
%func = (-1*(1*(x-2).^2 + 2) + 45).*(0 >= x & x< 4)...
%         + (-1*(10*(x-6).^2 + 1) + 45).*(4>= x & x < 8)...
%         + (-1*(2*(x-12).^2 + 10) + 45).*(8>= x & x < 16)...
%         + (-1*(0.1*(x-24).^2 + 1.1) + 45).*(16>= x & x <= 31);



% Part of Problem 2: Nonlinear constraint
% Non-linear constraints for Non-Linear Constraint Example
function [ c,ceq ] = hw5NoLinearIneq( x )
% Inputs:
% @x - variable used (i.e. x vector)
% Outputs:
% @c - nonlinear inequality constraints
% @ceq - nonlinear equality constraint function

% Functions must  be in the form f(x) <=0 for c and f(x) = 0 for ceq
% if the Left Side of the equality/inequality is not zero, you must rewrite
% the equation

% Nonlinear constraint for the to do problem
c(1) = x(1) - 0.25.*x(2).^2 - 1;
c(2) = -x(1) - x(2).^2;

ceq = [];


end
```

```
Warning: Function behaves unexpectedly on array inputs. To improve
 performance,
properly vectorize your function to return an output with the same size and
shape as the input arguments.
Optimization terminated: average change in the fitness value less than
 options.FunctionTolerance.

x_ga =

   1.4901e-08


fval_ga =
```

```
-582.7000
```





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