COMPUTER PROGRAMMING & APPLICATIONS
ME-214

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Open-Ended Lab (10 M)

Question # 01 (05 M)

Three engines (EFI, Diesel and Petrol) are tested on dynamometer. The results are shown in table given below.

EFI Engine		Diesel Engine		Petrol Engine	
Engine RPM	**BHP (HP)**	**Engine RPM**	**BHP (HP)**	**Engine RPM**	**BHP (HP)**
1522	4.029	1517	1.023	994	0.823
1691	4.916	1707	1.207	1097	0.785
1803	5.644	1922	1.437	1200	1.853
1898	5.800	2009	1.809	1309	1.911
2000	6.025	2224	1.744	1395	1.841

1. Estimate the constants of each engine based on quadratic relation.
2. Plot the equations with the actual data on a single graph.
3. Estimate the errors and form a table.
4. Evaluate the BHP for all three engines at 1500 rpm.
5. Why we use quadratic relation for rpm vs power, instead of linear relationship? (Use your Internal Combustion Engine knowledge to answer this question). To support your answer, draw lines of linear and quadratic equation on a single plot. (Students are encouraged to use subplot command to present your analysis)

Additional Information

Use different colour, marker and line type for each curve. Label axes, show title, open grid and show text next to each line defining type of engine.

Script File:

```
%==>OEL(Open Ended Lab) Assignment:-
%==>Question No 1:-
%==>Part 1:-
%==>Data for EFI Engine:
rpm_EFIEngine =[1522 1691 1803 1898 2000];
bhp_EFIEngine=[4.029 4.916 5.644 5.800 6.025];
```

```
p_EFIEngine=polyfit(rpm_EFIEngine,bhp_EFIEngine,2);
BHP_EFIEngine=polyval(p_EFIEngine,rpm_EFIEngine);

%==>Data for Diesel Engine:
rpm_DieselEngine=[1517 1707 1922 2009 2224];
bhp_DieselEngine=[1.023 1.207 1.437 1.809 1.744];
p_DieselEngine=polyfit(rpm_DieselEngine,bhp_DieselEngin
e,2);
BHP_DieselEngine=polyval(p_DieselEngine,rpm_DieselEngin
e);

%==>Data for Petrol Engine:
rpm_PetrolEngine=[994 1097 1200 1309 1395];
bhp_PetrolEngine=[0.823 0.785 1.853 1.911 1.841];
p_PetrolEngine=polyfit(rpm_PetrolEngine,bhp_PetrolEngin
e,2);
BHP_PetrolEngine=polyval(p_PetrolEngine,rpm_PetrolEngin
e);

disp(' part 01:')
%==>For Equations:
fprintf('Constants of EFI Engine:    a=%f , b=%f
,c=%f\n',p_EFIEngine(1),p_EFIEngine(2),p_EFIEngine(3))
fprintf('Constants of Diesel Engine: a=%f , b=%f
,c=%f\n',p_DieselEngine(1),p_DieselEngine(2),p_DieselEn
gine(3))
fprintf('Constants of Petrol Engine: a=%f , b=%f
,c=%f\n\n',p_PetrolEngine(1),p_PetrolEngine(2),p_Petrol
Engine(3))

%==>part 02:
disp(' part 02:')
fprintf('Graph is displayed: \n\n')
figure
plot(rpm_EFIEngine,bhp_EFIEngine,'or',rpm_EFIEngine,BHP
_EFIEngine,'-
b',rpm_DieselEngine,bhp_DieselEngine,'dm',rpm_DieselEng
ine,BHP_DieselEngine,'-
b',rpm_PetrolEngine,bhp_PetrolEngine,'pk',rpm_PetrolEng
ine,BHP_PetrolEngine,'-b','linewidth',3)
grid on
```

```
xlabel('RPM'),ylabel('Power'),title('Observational data
vs Calculated data')
legend('observational data','Calculation data')

%==>part 03:
disp(' part 03:')
error_EFIEngine   =abs(bhp_EFIEngine-BHP_EFIEngine);
error_DieselEngine=abs(bhp_DieselEngine-
BHP_DieselEngine);
error_PetrolEngine=abs(bhp_PetrolEngine-
BHP_PetrolEngine);

A={'bhp_EFIEngine','BHP_EFIEngine','error_EFIEngine','b
hp_DieselEngine','BHP_DieselEngine','error_DieselEngine
','bhp_PetrolEngine','BHP_PetrolEngine','error_PetrolEn
gine'};
table=table(bhp_EFIEngine',BHP_EFIEngine',error_EFIEngi
ne',bhp_DieselEngine',BHP_DieselEngine',error_DieselEng
ine',bhp_PetrolEngine',BHP_PetrolEngine',error_PetrolEn
gine','VariableNames',A);
disp(table)

%==>part 04:
disp(' part 04:')
e =
@(a)p_EFIEngine(1)*a^2+p_EFIEngine(2)*a+p_EFIEngine(3);
BHP_EFIEngine1= e(1500)
d =
@(b)p_DieselEngine(1)*b^2+p_DieselEngine(2)*b+p_DieselE
ngine(3);
BHP_DieselEngine1 = d(1500)
p =
@(c)p_PetrolEngine(1)*c^2+p_PetrolEngine(2)*c+p_PetrolE
ngine(3);
BHP_PetrolEngine1 = p(1500)

%==>part 05:
disp(' part 05:')
figure
subplot(3,1,1);
EFIEngine_l=polyfit(rpm_EFIEngine,bhp_EFIEngine,1);
```

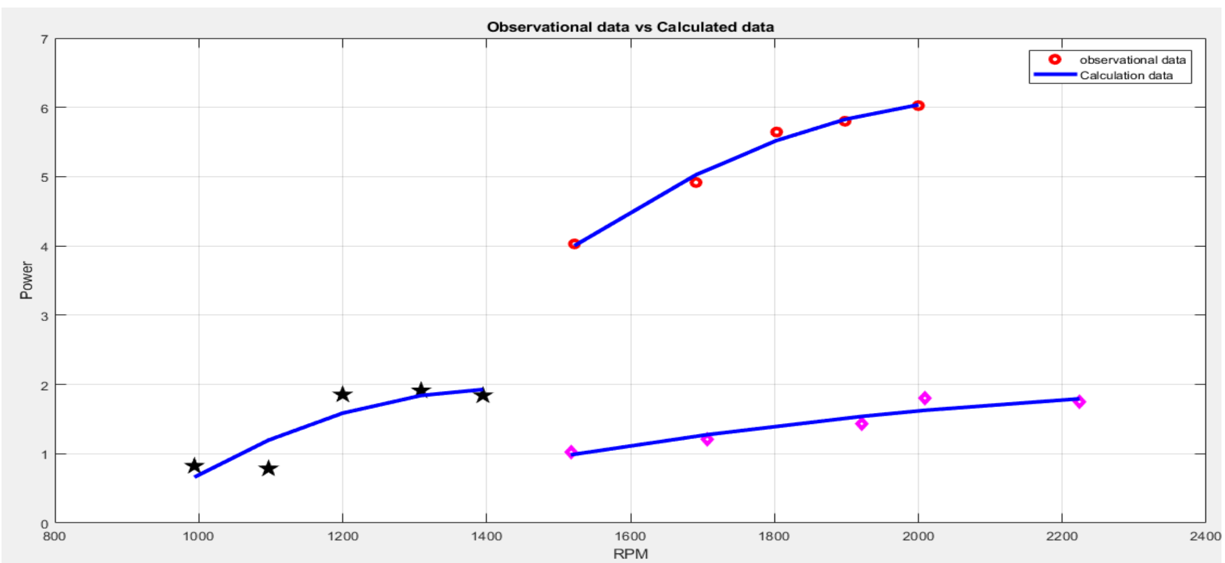
```
EFIEngineBHP_l=polyval(EFIEngine_l,rpm_EFIEngine);
plot(rpm_EFIEngine,EFIEngineBHP_l,'-
k',rpm_EFIEngine,BHP_EFIEngine,'-b','linewidth',3);
grid on
title({
['Linear data vs Quadratic data']
['EFI Engine']
});
legend('Linear data','Quadratic data');
subplot(3,1,2);
PetrolEngine_l=polyfit(rpm_DieselEngine,bhp_DieselEngin
e,1);
DieselEngineBHP_l=polyval(PetrolEngine_l,rpm_DieselEngi
ne);
plot(rpm_DieselEngine,DieselEngineBHP_l,'-
m',rpm_DieselEngine,BHP_DieselEngine,'-
r','linewidth',3);
grid on
title('Diesel Engine');
ylabel('Power')
legend('Linear data','Quadratic data');

subplot(3,1,3);
PetrolEngine_l=polyfit(rpm_PetrolEngine,bhp_PetrolEngin
e,1);
PetrolEngineBHP_l=polyval(PetrolEngine_l,rpm_PetrolEngi
ne);
plot(rpm_PetrolEngine,PetrolEngineBHP_l,'-
c',rpm_PetrolEngine,BHP_PetrolEngine,'-
y','linewidth',3);
grid on
legend('Linear data','Quadratic data');
title('Petrol Engine');
xlabel('rpm');
```

Result:

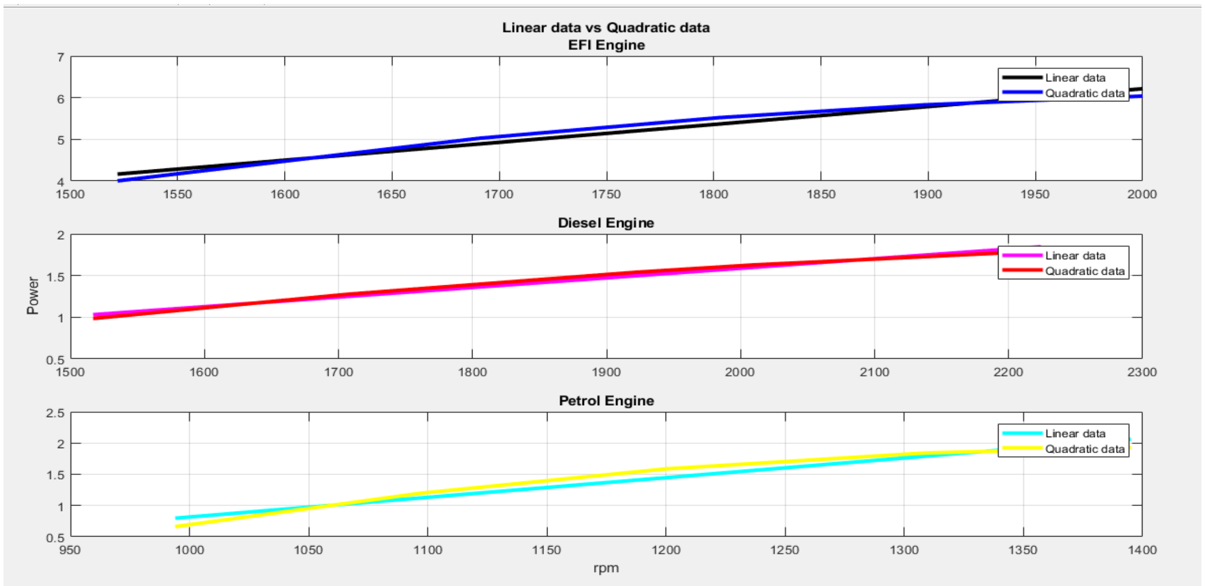
Command Window

```
 part 01:
Constants of EFI Engine:    a=-0.000006 , b=0.024798 ,c=-20.229539
Constants of Diesel Engine: a=-0.000001 , b=0.003945 ,c=-3.277625
Constants of Petrol Engine: a=-0.000007 , b=0.019435 ,c=-11.923432

 part 02:
Graph is displayed:

 part 03:
```

bhp_EFIEngine	BHP_EFIEngine	error_EFIEngine	bhp_DieselEngine	BHP_DieselEngine	error_DieselEngine
4.029	4.0025	0.026525	1.023	0.98451	0.038495
4.916	5.0264	0.1104	1.207	1.2755	0.068498
5.644	5.5214	0.12258	1.437	1.5396	0.10258
5.8	5.8266	0.026611	1.809	1.6268	0.18222
6.025	6.0371	0.012096	1.744	1.7936	0.049636




```
 part 04:
BHP_EFIEngine1 =
    3.8447
BHP_DieselEngine1 =
    0.9558
BHP_PetrolEngine1 =
    1.8969
 part 05:
```



Question # 02 (05 M)

The transmission of light through a transparent solid can be described by the equation:

$$I_T = I_0(1-R)^2 e^{-\beta L}$$

where I_T is the transmitted intensity, I_0 is the intensity of the incident beam, β is the absorption coefficient, L is the length of the transparent solid, and R is the fraction of light which is reflected at the interface. If the light is normal to the interface and the beams are transmitted through air, $R = \left(\frac{n-1}{n+1}\right)^2$ where n is the index of refraction for the transparent solid. Experiments measuring the intensity of light transmitted through specimens of a transparent solid of various lengths are given in the following table. The intensity of the incident beam is 5 W/m^2.

L (cm)	0.5	1.2	1.7	2.2	4.5	6.0
I_T (W/m^2)	4.2	4.0	3.8	3.6	2.9	2.5

Use this data and curve fitting to determine the absorption coefficient and index of refraction of the solid.

Script File:

```
% QUESTION # 02
clear,clc
% Incident Beam Intensity
I=5;
% Transparent Solid Length
L=[0.5 1.2 1.7 2.2 4.5 6.0];
% Intensity of Light transferred
It=[4.2 4.0 3.8 3.6 2.9 2.5];
%Assigning length value in form of x
x=L;
%Value of It will transfer by LOG into y
y=log(It);
% now for curve using polyfit command
Cf=polyfit(x,y,1);
% Finding Absorption Coefficient
Beta=-Cf(1);
fprintf(' Absorption Coefficient IS :%f\n',Beta)
%Finding R that is reflective interference of light
R=1-sqrt(exp(Cf(2))/I);
% for index
n=2/(1-sqrt(R))-1;
fprintf('Refraction of solid is :%f\n',n)
% for graph plotting
plot(n,Beta,L,It, '--ro')
title('plot of the curve fiting of index and absorption
of refraction is')
```

Result:

Command Window

```
 Absorption Coefficient IS :0.095611
Refraction of solid is :1.624238
fx >>
```