Question 4 - Part a

```
BW = 20e9; % hz
ext_r_db = 20; % db (extinction ratio)
dist = 250; % km
BW_def = 12.5e9; % hz (optical bandwidth from the definition)

OSNR_db = 10:0.2:25; % dB
OSNR = 10.^(OSNR_db/10); % convert DB to non log component
ext_r = 10^(ext_r_db/10);

% find Q and BER
Q = sqrt((BW_def*OSNR*(1 - sqrt(ext_r))^2)/(BW*(1+ext_r)))
```

```
Q = 1×76
    2.2388    2.2910    2.3443    2.3990    2.4548    2.5120    2.5705    2.6304 ···
```

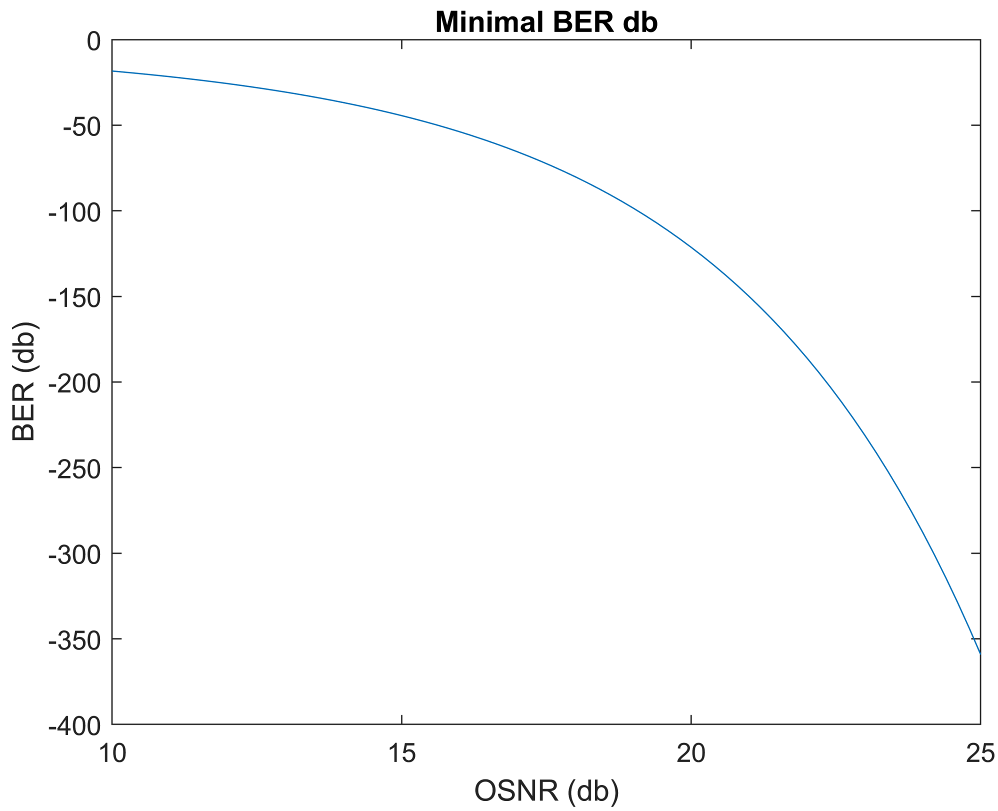
```
BER = exp(- Q.^2 / 2) ./ (Q * sqrt(2*pi))
```

```
BER = 1×76
    0.0145    0.0126    0.0109    0.0094    0.0080    0.0068    0.0057    0.0048 ···
```

```
BER_db = 10 * log10(BER)
```

```
BER_db = 1×76
  -18.3754  -18.9883  -19.6254  -20.2879  -20.9768  -21.6936  -22.4393  -23.2155 ···
```

```
plot(OSNR_db, BER_db)
title('Minimal BER db')
xlabel('OSNR (db)')
ylabel('BER (db)')
```



Part b

```
P_in_db = 12; % dbm
alpha = 0.18; % db/km
n = 5;
noise_f_db = 4; % db

losses = alpha * dist; % db

OSNR_db = 60 + P_in_db - noise_f_db - losses - 10 *log10(n) % use the approximate 60
```

```
OSNR_db = 16.0103
```

```
OSNR = 10^(OSNR_db/10); % convert DB to non log component

% find Q and BER
Q = sqrt((BW_def*OSNR*(1 - sqrt(ext_r))^2)/(BW*(1+ext_r)))
```

```
Q = 4.4724
```

```
BER = exp(- Q.^2 / 2) ./ (Q * sqrt(2*pi))
```

```
BER = 4.0457e-06
```