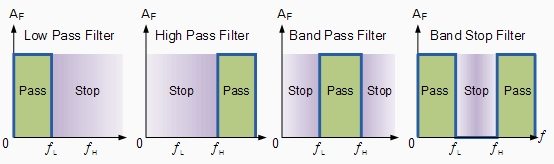
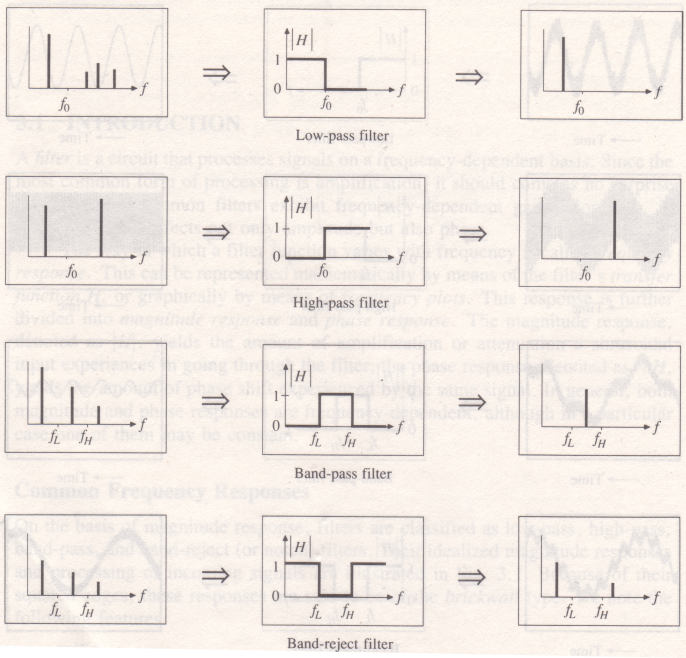


**Passive Filters 설계**

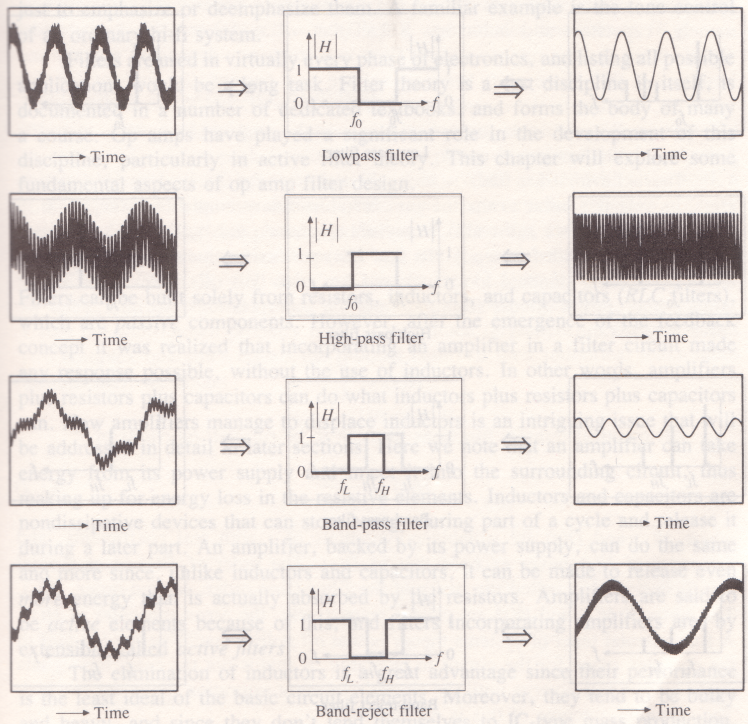


**Frequency Responses of Ideal Filters**

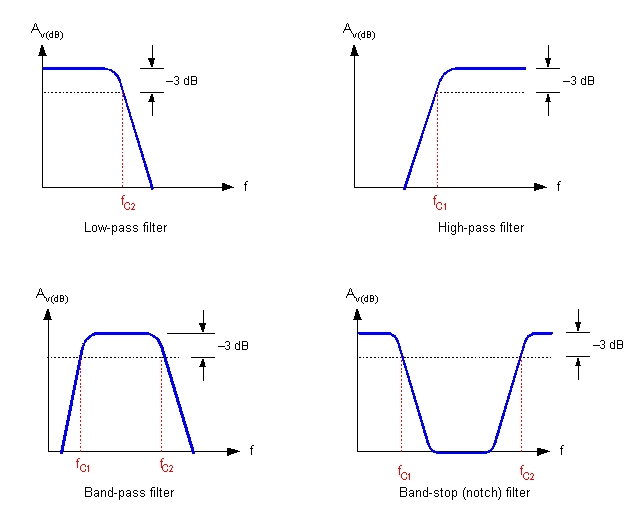


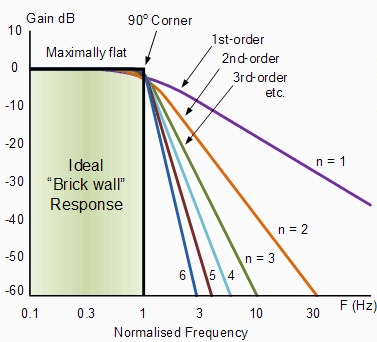


**Filter Functions in Time Domain**



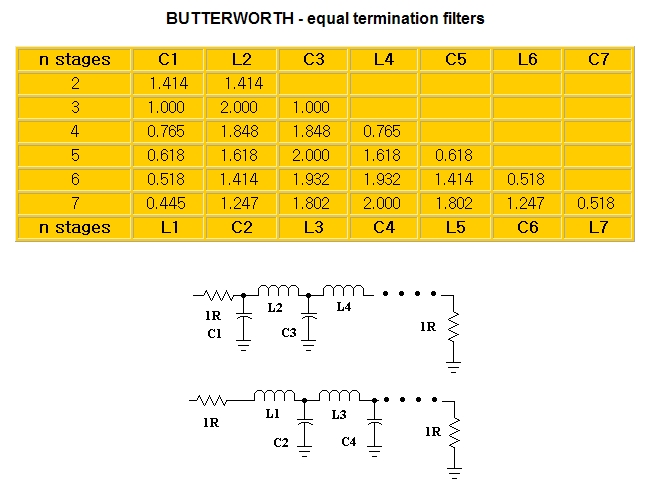
**Frequency Responses of Real Filters**





**Butterworth Polynomial**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **n** | **b0** | **b1** | **b2** | **b3** | **b4** |
| **1** | **1.00000** |  |  |  |  |
| **2** | **1.00000** | **1.41421** |  |  |  |
| **3** | **1.00000** | **2.00000** | **2.00000** |  |  |
| **4** | **1.00000** | **2.61313** | **3.41421** | **2.61313** |  |
| **5** | **1.00000** | **3.23607** | **5.23607** | **5.23607** | **3.23607** |



**Normalized Low pass to Denormalized Low pass**







**Elements exchange**



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**Normalized Low pass to Normalized High Pass**





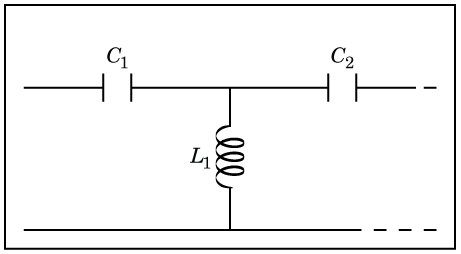
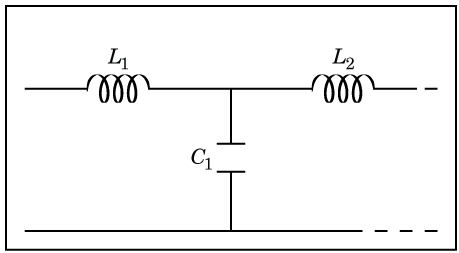


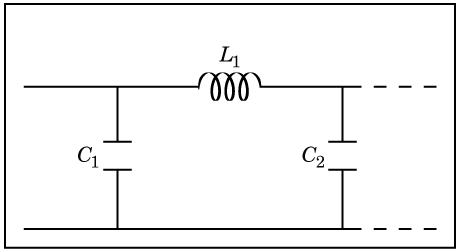
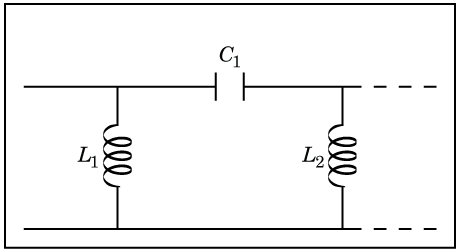
**Elements Exchange**



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**Normalized Low pass to Normalized Band Pass**



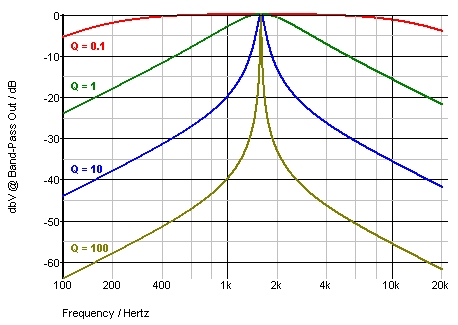






* *ωo*: center freq.
* BW(B) : Bandwidth
* Quality factor, Q





**Elements Exchange**















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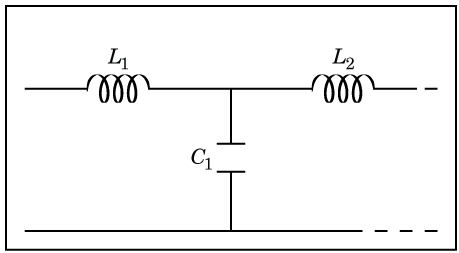
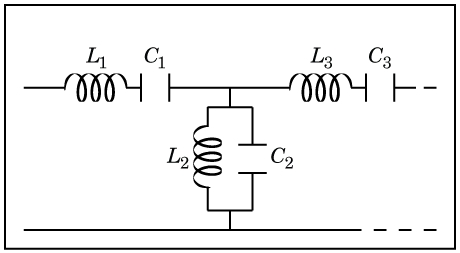


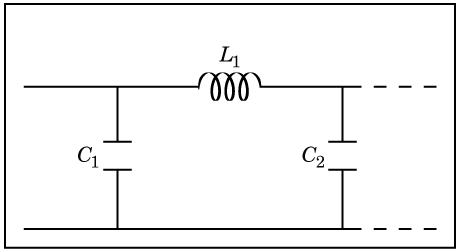
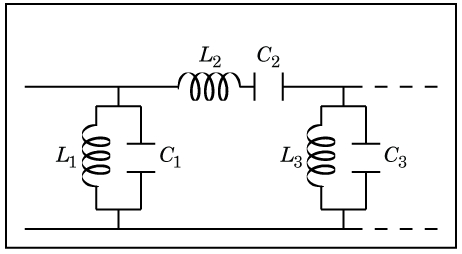












**Normalized Low pass to Normalized Band Stop**



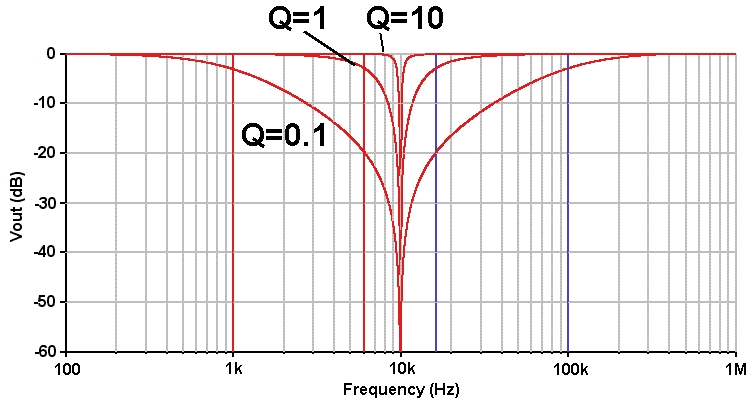






* *ωo*: center freq.
* BW(B) : Bandwidth
* Quality factor, Q





**Elements Exchange**











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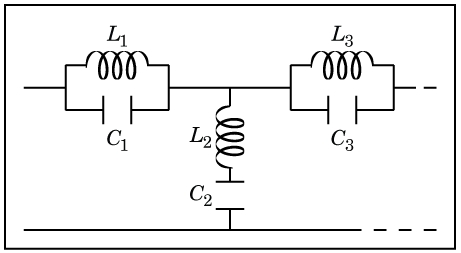
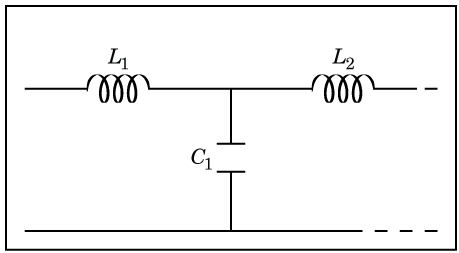


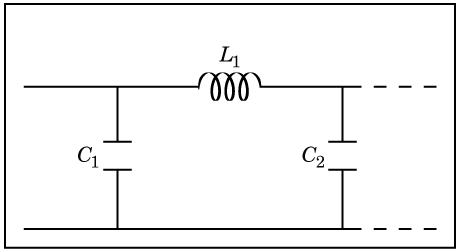
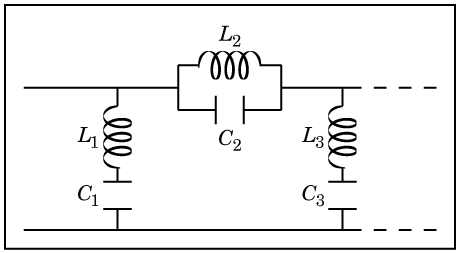








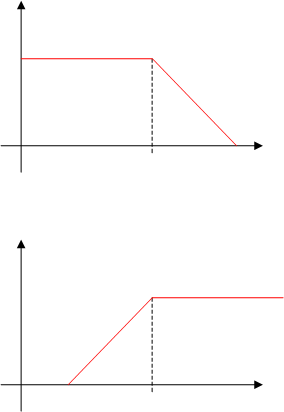




**Impedance Scaling**

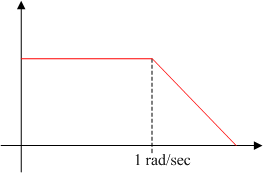
 

**Frequency Scaling**



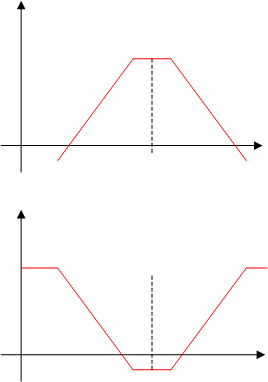
**Desired reference frequency ; ,**

**(Denormalized)**



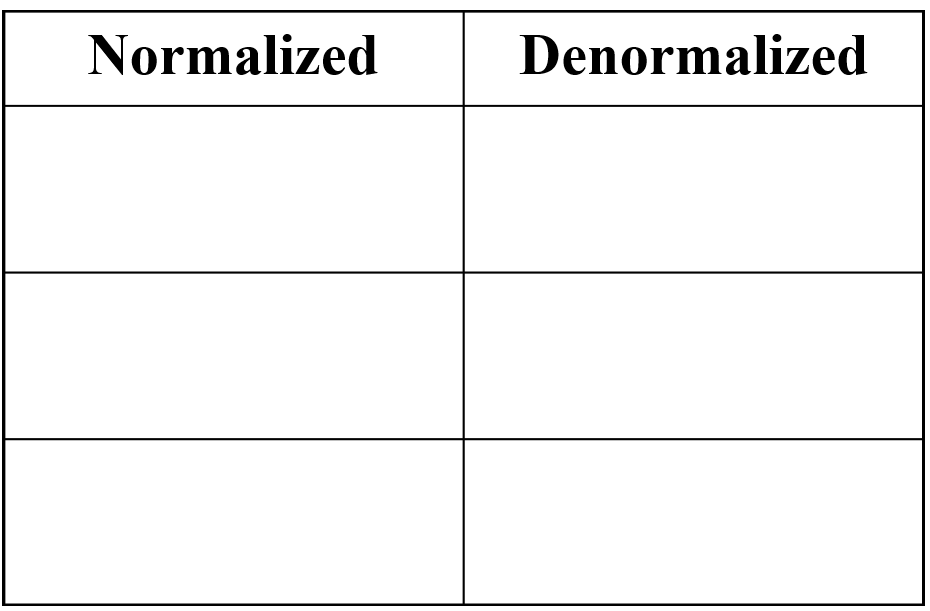
**Existing reference frequency**

**(Normalized)**





**Impedance and Frequency Scaling**













**(Design Problem)**

* Design a 6th-order Band Pass Filter with
  + Center frequency of ωo = 100,000 rad/sec
  + Quality factor of Q = 10
  + Using resistance = 1kΩ



**(Example) 3-way Speaker System**

