SUBJECT No.1

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 36.0 Ω + j·42.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.30dB.
   a) If the power applied at the input port is 7.9 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 66 Ω resistor series with a 0.637 nH inductor, at 6.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 515 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 23.7dB and noise factor F_1 = 3.90dB), A2 (G_2 = 24.8dB, F_2 = 4.23dB) and A3 (G_3 = 21.1dB, F_3 = 5.65dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

U N I V E R S I T A T E A   T E H N I C Ă   " G H E O R G H E   A S A C H I "   D I N   I A Ş I
Faculty / Department: Electronics, Telecommunications and Information Technology
Domain: Telecommunication Technologies and Systems
Course : MDCR - EDID407
Enrollment Year: ___4____, Examination Session ______June_______ / __2024

S U B J E C T N o . 2

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: ________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 56.1 Ω − j·61.4 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.80dB.
   a) If the power applied at the input port is 7.0 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 72 Ω resistor series with a 1.615 nH inductor, at 7.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 315 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 18.8dB and noise factor F_1 = 3.17dB), A2 (G_2 = 22.7dB, F_2 = 4.12dB) and A3 (G_3 = 23.4dB, F_3 = 5.18dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

SUBJECT No.3

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 45.6 Ω − j·36.0 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.10dB.
   a) If the power applied at the input port is 4.8 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 60 Ω resistor series with a 1.220 nH inductor, at 8.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 560 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 23.4dB and noise factor F_1 = 3.81dB), A2 (G_2 = 24.8dB, F_2 = 4.83dB) and A3 (G_3 = 19.1dB, F_3 = 5.30dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A3, A2? **(1.5p)**

S U B J E C T N o . 4

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 32.5 Ω + j·33.1 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.60dB.
   a) If the power applied at the input port is 5.9 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 73 Ω resistor paralel with a 0.544 pF capacitor, at 7.0 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 575 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 19.5dB and noise factor F_1 = 3.88dB), A2 (G_2 = 19.7dB, F_2 = 4.25dB) and A3 (G_3 = 24.6dB, F_3 = 5.46dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T   N o . 5

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 60.9 Ω + j·54.2 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.70dB.
   a) If the power applied at the input port is 8.7 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 25 Ω resistor series with a 0.474 nH inductor, at 9.9 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 325 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.0dB and noise factor F_1 = 3.01dB), A2 (G_2 = 15.9dB, F_2 = 4.20dB) and A3 (G_3 = 21.8dB, F_3 = 5.64dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

SUBJECT No.6

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 52.4 Ω + j·57.7 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.75dB.
   a) If the power applied at the input port is 5.3 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 55 Ω resistor paralel with a 1.133 nH inductor, at 9.6 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, maximally flat low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 455 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 17.0dB and noise factor F_1 = 3.63dB), A2 (G_2 = 18.6dB, F_2 = 4.37dB) and A3 (G_3 = 23.6dB, F_3 = 5.31dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A3, A2? **(1.5p)**

S U B J E C T N o . 7

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 42.4 Ω + j·55.7 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 8.05dB.
   a) If the power applied at the input port is 2.4 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 63 Ω resistor series with a 0.302 pF capacitor, at 7.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 535 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 23.4dB and noise factor F_1 = 3.55dB), A2 (G_2 = 15.3dB, F_2 = 4.83dB) and A3 (G_3 = 16.4dB, F_3 = 5.13dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

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S U B J E C T   N o . 8

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 48.1 Ω − j·45.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.75dB.
   a) If the power applied at the input port is 2.6 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 25 Ω resistor paralel with a 0.428 pF capacitor, at 6.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 530 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 18.4dB and noise factor F_1 = 3.24dB), A2 (G_2 = 18.6dB, F_2 = 4.62dB) and A3 (G_3 = 20.7dB, F_3 = 5.59dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T   N o . 9

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 33.6 Ω − j·58.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.75dB.
   a) If the power applied at the input port is 5.5 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 74 Ω resistor series with a 0.828 pF capacitor, at 6.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 400 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 20.7dB and noise factor F_1 = 3.52dB), A2 (G_2 = 19.9dB, F_2 = 4.29dB) and A3 (G_3 = 21.0dB, F_3 = 5.86dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T N o . 1 0

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 37.8 Ω + j·44.1 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.60dB.
   a) If the power applied at the input port is 9.5 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 57 Ω resistor paralel with a 0.412 pF capacitor, at 8.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 370 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 20.8dB and noise factor F_1 = 3.35dB), A2 (G_2 = 19.2dB, F_2 = 4.34dB) and A3 (G_3 = 16.8dB, F_3 = 5.20dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T N o . 1 1

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: __________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.

Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 49.2 Ω − j·35.9 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.20dB.
   a) If the power applied at the input port is 8.3 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 50 Ω resistor series with a 0.643 nH inductor, at 7.2 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 585 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 18.8dB and noise factor F_1 = 3.19dB), A2 (G_2 = 15.4dB, F_2 = 4.57dB) and A3 (G_3 = 17.9dB, F_3 = 5.09dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T N o . 1 2

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 42.5 Ω − j·55.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.45dB.
   a) If the power applied at the input port is 8.1 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 58 Ω resistor series with a 0.843 pF capacitor, at 6.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 300 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 16.2dB and noise factor F_1 = 3.16dB), A2 (G_2 = 23.1dB, F_2 = 4.46dB) and A3 (G_3 = 22.0dB, F_3 = 5.80dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

S U B J E C T   N o . 1 3

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.

Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 63.3 Ω − j·52.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.55dB.
   a) If the power applied at the input port is 7.3 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 33 Ω resistor paralel with a 0.342 pF capacitor, at 9.1 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 585 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 15.2dB and noise factor F_1 = 3.52dB), A2 (G_2 = 23.3dB, F_2 = 4.37dB) and A3 (G_3 = 23.1dB, F_3 = 5.49dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

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S U B J E C T   N o . 1 4

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 61.1 Ω − j·60.9 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.60dB.
   a) If the power applied at the input port is 7.0 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 57 Ω resistor paralel with a 0.618 nH inductor, at 8.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 580 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 15.4dB and noise factor F_1 = 3.44dB), A2 (G_2 = 21.5dB, F_2 = 4.13dB) and A3 (G_3 = 21.3dB, F_3 = 5.60dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A2, A1? **(1.5p)**

S U B J E C T N o . 1 5

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: ________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 58.5 Ω − j·51.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.25dB.
   a) If the power applied at the input port is 7.6 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 27 Ω resistor series with a 0.536 pF capacitor, at 8.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 305 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.2dB and noise factor F_1 = 3.58dB), A2 (G_2 = 19.7dB, F_2 = 4.54dB) and A3 (G_3 = 21.0dB, F_3 = 5.82dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

SUBJECT No.16

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 31.5 Ω + j·41.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.55dB.
   a) If the power applied at the input port is 9.5 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 54 Ω resistor paralel with a 0.557 nH inductor, at 8.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 500 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 18.3dB and noise factor F_1 = 3.73dB), A2 (G_2 = 18.7dB, F_2 = 4.31dB) and A3 (G_3 = 24.2dB, F_3 = 5.33dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A3, A2? **(1.5p)**

S U B J E C T N o . 1 7

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.

Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 63.9 Ω + j·40.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**

2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.45dB.
   a) If the power applied at the input port is 4.4 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**

3. For a load composed from a 41 Ω resistor paralel with a 0.349 pF capacitor, at 7.2 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**

4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 595 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**

5. You must cascade three amplifiers, A1 (having gain G_1 = 24.3dB and noise factor F_1 = 3.33dB), A2 (G_2 = 20.5dB, F_2 = 4.39dB) and A3 (G_3 = 20.0dB, F_3 = 5.90dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

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SUBJECT No.18

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 64.6 Ω + j·35.5 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.00dB.
   a) If the power applied at the input port is 4.1 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 36 Ω resistor paralel with a 0.972 nH inductor, at 9.9 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 345 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 21.4dB and noise factor F_1 = 3.46dB), A2 (G_2 = 19.1dB, F_2 = 4.07dB) and A3 (G_3 = 21.6dB, F_3 = 5.39dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

S U B J E C T N o . 1 9

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 38.2 Ω − j·33.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.25dB.
   a) If the power applied at the input port is 6.3 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 74 Ω resistor paralel with a 0.264 pF capacitor, at 9.0 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 565 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 20.7dB and noise factor F_1 = 3.59dB), A2 (G_2 = 24.1dB, F_2 = 4.41dB) and A3 (G_3 = 18.5dB, F_3 = 5.57dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

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S U B J E C T N o . 2 0

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: ________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 52.1 Ω + j·56.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.05dB.
   a) If the power applied at the input port is 4.2 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 70 Ω resistor paralel with a 1.343 nH inductor, at 8.9 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 595 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 16.8dB and noise factor F_1 = 3.79dB), A2 (G_2 = 22.2dB, F_2 = 4.56dB) and A3 (G_3 = 19.5dB, F_3 = 5.44dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T N o . 2 1

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: ________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 46.9 Ω + j·49.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.00dB.
   a) If the power applied at the input port is 7.7 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 28 Ω resistor paralel with a 0.562 pF capacitor, at 9.6 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 575 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 20.9dB and noise factor F_1 = 3.68dB), A2 (G_2 = 18.7dB, F_2 = 4.24dB) and A3 (G_3 = 19.8dB, F_3 = 5.98dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

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SUBJECT No.22

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: __________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 48.4 Ω + j·35.1 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.95dB.
   a) If the power applied at the input port is 1.7 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 31 Ω resistor series with a 0.325 pF capacitor, at 6.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 500 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.9dB and noise factor F_1 = 3.97dB), A2 (G_2 = 15.7dB, F_2 = 4.95dB) and A3 (G_3 = 16.8dB, F_3 = 5.84dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

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S U B J E C T N o . 2 3

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: __________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 33.4 Ω + j·31.0 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.35dB.
   a) If the power applied at the input port is 9.8 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 69 Ω resistor series with a 0.569 nH inductor, at 8.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 335 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 19.2dB and noise factor F_1 = 3.32dB), A2 (G_2 = 19.2dB, F_2 = 4.63dB) and A3 (G_3 = 21.3dB, F_3 = 5.94dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T N o . 2 4

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: __________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 36.1 Ω − j·64.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.40dB.
   a) If the power applied at the input port is 7.5 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 32 Ω resistor paralel with a 1.180 nH inductor, at 10.0 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, maximally flat low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 315 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 21.3dB and noise factor F_1 = 3.68dB), A2 (G_2 = 18.1dB, F_2 = 4.64dB) and A3 (G_3 = 22.2dB, F_3 = 5.93dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A3, A2? **(1.5p)**

U N I V E R S I T A T E A T E H N I C Ă " G H E O R G H E A S A C H I " D I N I A Ş I
Faculty / Department: Electronics, Telecommunications and Information Technology
Domain: Telecommunication Technologies and Systems
Course : MDCR - EDID407
Enrollment Year: ___4____, Examination Session ______June_______ / __2024

S U B J E C T N o . 2 5

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 37.7 Ω − j·39.9 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.10dB.
   a) If the power applied at the input port is 9.7 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 66 Ω resistor series with a 0.981 nH inductor, at 7.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 380 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.7dB and noise factor F_1 = 3.79dB), A2 (G_2 = 17.1dB, F_2 = 4.89dB) and A3 (G_3 = 20.2dB, F_3 = 5.23dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

S U B J E C T N o . 2 6

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 61.2 Ω + j·49.5 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.55dB.
   a) If the power applied at the input port is 3.3 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 58 Ω resistor series with a 0.324 pF capacitor, at 9.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 315 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 20.0dB and noise factor F_1 = 3.55dB), A2 (G_2 = 15.9dB, F_2 = 4.97dB) and A3 (G_3 = 15.4dB, F_3 = 5.43dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

S U B J E C T N o . 2 7

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.

Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 51.4 Ω + j·31.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.70dB.
   a) If the power applied at the input port is 8.0 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 65 Ω resistor paralel with a 0.681 nH inductor, at 8.1 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 520 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 17.8dB and noise factor F_1 = 3.22dB), A2 (G_2 = 23.7dB, F_2 = 4.64dB) and A3 (G_3 = 20.7dB, F_3 = 5.59dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

S U B J E C T   N o . 2 8

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 54.6 Ω + j·50.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.85dB.
   a) If the power applied at the input port is 4.8 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 30 Ω resistor series with a 1.292 nH inductor, at 8.0 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 330 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 17.0dB and noise factor F_1 = 3.95dB), A2 (G_2 = 21.9dB, F_2 = 4.10dB) and A3 (G_3 = 15.2dB, F_3 = 5.64dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A3, A2? **(1.5p)**

SUBJECT No.29

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: ________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 56.5 Ω − j·59.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**

2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.65dB.
   a) If the power applied at the input port is 5.6 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**

3. For a load composed from a 31 Ω resistor paralel with a 1.231 nH inductor, at 7.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**

4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 560 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**

5. You must cascade three amplifiers, A1 (having gain G_1 = 17.0dB and noise factor F_1 = 3.10dB), A2 (G_2 = 18.6dB, F_2 = 4.83dB) and A3 (G_3 = 15.7dB, F_3 = 5.24dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

SUBJECT No.30

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 60.9 Ω + j·63.7 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.70dB.
   a) If the power applied at the input port is 6.4 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 61 Ω resistor paralel with a 0.483 nH inductor, at 9.5 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 590 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 20.9dB and noise factor F_1 = 3.90dB), A2 (G_2 = 23.8dB, F_2 = 4.84dB) and A3 (G_3 = 19.7dB, F_3 = 5.16dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A2, A1? **(1.5p)**

S U B J E C T N o . 3 1

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 36.1 Ω + j·63.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.25dB.
   a) If the power applied at the input port is 7.9 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 62 Ω resistor series with a 1.493 nH inductor, at 7.2 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 380 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 18.4dB and noise factor F_1 = 3.42dB), A2 (G_2 = 20.1dB, F_2 = 4.10dB) and A3 (G_3 = 16.6dB, F_3 = 5.53dB). The order in which you must connect the amplifiers is A3, A2, A1.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

S U B J E C T   N o . 3 2

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: ________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 45.1 Ω − j·60.5 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.15dB.
   a) If the power applied at the input port is 8.6 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 47 Ω resistor paralel with a 0.383 pF capacitor, at 8.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 320 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 18.9dB and noise factor F_1 = 3.81dB), A2 (G_2 = 19.7dB, F_2 = 4.09dB) and A3 (G_3 = 15.2dB, F_3 = 5.40dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

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S U B J E C T N o . 3 3

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 52.8 Ω − j·49.4 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.90dB.
   a) If the power applied at the input port is 3.0 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 39 Ω resistor paralel with a 0.551 nH inductor, at 8.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 330 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 21.6dB and noise factor F_1 = 3.80dB), A2 (G_2 = 22.1dB, F_2 = 4.99dB) and A3 (G_3 = 21.2dB, F_3 = 5.59dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

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S U B J E C T N o . 3 4

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 43.2 Ω + j·62.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 8.45dB.
   a) If the power applied at the input port is 5.8 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 31 Ω resistor series with a 0.234 pF capacitor, at 9.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 505 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.5dB and noise factor F_1 = 3.09dB), A2 (G_2 = 24.4dB, F_2 = 4.11dB) and A3 (G_3 = 20.2dB, F_3 = 5.47dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A3, A2? **(1.5p)**

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S U B J E C T N o . 3 5

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: ___________________________________ Group________

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 36.0 Ω − j·36.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.05dB.
   a) If the power applied at the input port is 4.7 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 60 Ω resistor paralel with a 1.682 nH inductor, at 6.5 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 475 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.4dB and noise factor F_1 = 3.44dB), A2 (G_2 = 22.1dB, F_2 = 4.12dB) and A3 (G_3 = 21.3dB, F_3 = 5.50dB). The order in which you must connect the amplifiers is A3, A2, A1.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

SUBJECT No.36

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.

Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 61.2 Ω − j·51.4 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.75dB.
   a) If the power applied at the input port is 6.5 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 44 Ω resistor series with a 1.201 nH inductor, at 8.5 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 370 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 16.6dB and noise factor F_1 = 3.38dB), A2 (G_2 = 20.3dB, F_2 = 4.60dB) and A3 (G_3 = 16.4dB, F_3 = 5.10dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

SUBJECT No.37

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: ________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 34.8 Ω − j·50.8 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.55dB.
   a) If the power applied at the input port is 9.4 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 61 Ω resistor series with a 0.431 pF capacitor, at 7.5 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 460 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.0dB and noise factor F_1 = 3.08dB), A2 (G_2 = 20.4dB, F_2 = 4.28dB) and A3 (G_3 = 18.4dB, F_3 = 5.26dB). The order in which you must connect the amplifiers is A3, A2, A1.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A3, A2? **(1.5p)**

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S U B J E C T   N o . 3 8

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: __________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 68.8 Ω − j·48.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.60dB.
   a) If the power applied at the input port is 9.0 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 26 Ω resistor paralel with a 0.283 pF capacitor, at 8.4 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 515 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 17.3dB and noise factor F_1 = 3.77dB), A2 (G_2 = 19.4dB, F_2 = 4.78dB) and A3 (G_3 = 19.0dB, F_3 = 5.56dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

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S U B J E C T   N o . 3 9

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 46.1 Ω − j·32.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.55dB.
   a) If the power applied at the input port is 8.0 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 27 Ω resistor series with a 0.328 pF capacitor, at 6.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 370 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 21.0dB and noise factor F_1 = 3.70dB), A2 (G_2 = 19.1dB, F_2 = 4.55dB) and A3 (G_3 = 19.0dB, F_3 = 5.51dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A2, A1? **(1.5p)**

SUBJECT No.40

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.

Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 64.9 Ω + j·54.7 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.35dB.
   a) If the power applied at the input port is 3.9 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 37 Ω resistor paralel with a 0.484 pF capacitor, at 8.6 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 540 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 22.4dB and noise factor F_1 = 3.18dB), A2 (G_2 = 16.4dB, F_2 = 4.47dB) and A3 (G_3 = 19.9dB, F_3 = 5.09dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

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SUBJECT No.41

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 50.1 Ω + j·64.9 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.55dB.
   a) If the power applied at the input port is 7.1 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 56 Ω resistor series with a 0.323 pF capacitor, at 6.9 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 495 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 15.9dB and noise factor F_1 = 3.86dB), A2 (G_2 = 18.3dB, F_2 = 4.59dB) and A3 (G_3 = 15.1dB, F_3 = 5.52dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A2, A1? **(1.5p)**

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S U B J E C T N o . 4 2

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 32.3 Ω + j·68.4 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.85dB.
   a) If the power applied at the input port is 1.1 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 61 Ω resistor series with a 1.168 nH inductor, at 6.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 330 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 17.7dB and noise factor F_1 = 3.93dB), A2 (G_2 = 17.9dB, F_2 = 4.72dB) and A3 (G_3 = 19.1dB, F_3 = 5.74dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

SUBJECT No.43

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: ________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 50.9 Ω + j·41.4 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.20dB.
   a) If the power applied at the input port is 3.4 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 32 Ω resistor paralel with a 0.897 nH inductor, at 8.5 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 530 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 20.8dB and noise factor F_1 = 3.06dB), A2 (G_2 = 23.3dB, F_2 = 4.76dB) and A3 (G_3 = 24.8dB, F_3 = 5.96dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

S U B J E C T N o . 4 4

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 53.2 Ω + j·68.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.90dB.
   a) If the power applied at the input port is 7.3 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 35 Ω resistor series with a 0.731 pF capacitor, at 6.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 410 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 19.3dB and noise factor F_1 = 3.53dB), A2 (G_2 = 18.3dB, F_2 = 4.47dB) and A3 (G_3 = 20.0dB, F_3 = 5.91dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

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SUBJECT No.45

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: ________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 61.0 Ω + j·64.9 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.25dB.
   a) If the power applied at the input port is 8.1 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 47 Ω resistor series with a 0.362 pF capacitor, at 8.0 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 395 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 21.5dB and noise factor F_1 = 3.63dB), A2 (G_2 = 18.2dB, F_2 = 4.41dB) and A3 (G_3 = 22.8dB, F_3 = 5.97dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

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SUBJECT No.46

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 53.7 Ω − j·35.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.40dB.
   a) If the power applied at the input port is 6.6 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 67 Ω resistor series with a 1.460 nH inductor, at 8.2 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 405 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.5dB and noise factor F_1 = 3.28dB), A2 (G_2 = 24.6dB, F_2 = 4.64dB) and A3 (G_3 = 23.1dB, F_3 = 5.25dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

S U B J E C T N o . 4 7

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.

Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 52.8 Ω + j·56.0 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.25dB.
   a) If the power applied at the input port is 2.2 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 28 Ω resistor series with a 1.204 nH inductor, at 8.9 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 450 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 21.8dB and noise factor F_1 = 3.27dB), A2 (G_2 = 15.3dB, F_2 = 4.49dB) and A3 (G_3 = 18.1dB, F_3 = 5.87dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

U N I V E R S I T A T E A T E H N I C Ă "G H E O R G H E A S A C H I" D I N I A Ş I
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S U B J E C T N o . 4 8

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 49.6 Ω + j·68.3 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.70dB.
   a) If the power applied at the input port is 8.1 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 71 Ω resistor paralel with a 0.318 pF capacitor, at 9.7 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 335 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 17.8dB and noise factor F_1 = 3.03dB), A2 (G_2 = 16.8dB, F_2 = 4.22dB) and A3 (G_3 = 20.4dB, F_3 = 5.76dB). The order in which you must connect the amplifiers is A2, A3, A1.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

S U B J E C T N o . 4 9

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.

Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 57.2 Ω − j·62.1 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.40dB.
   a) If the power applied at the input port is 1.0 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 73 Ω resistor paralel with a 0.280 pF capacitor, at 9.6 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 365 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 21.8dB and noise factor F_1 = 3.20dB), A2 (G_2 = 15.3dB, F_2 = 4.02dB) and A3 (G_3 = 15.3dB, F_3 = 5.96dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

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SUBJECT No.50

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 30.8 Ω + j·63.5 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.10dB.
   a) If the power applied at the input port is 4.4 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 69 Ω resistor series with a 0.326 pF capacitor, at 9.6 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 515 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 19.4dB and noise factor F_1 = 3.88dB), A2 (G_2 = 24.9dB, F_2 = 4.68dB) and A3 (G_3 = 20.6dB, F_3 = 5.59dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T N o . 5 1

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: ________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 68.3 Ω + j·52.0 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.20dB.
   a) If the power applied at the input port is 3.0 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 73 Ω resistor series with a 1.155 nH inductor, at 7.5 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 440 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 23.8dB and noise factor F_1 = 3.50dB), A2 (G_2 = 21.4dB, F_2 = 4.00dB) and A3 (G_3 = 24.5dB, F_3 = 5.07dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

SUBJECT No.52

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: __________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 69.4 Ω − j·64.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.40dB.
   a) If the power applied at the input port is 2.7 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 43 Ω resistor paralel with a 0.410 pF capacitor, at 7.1 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 500 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 22.8dB and noise factor F_1 = 3.49dB), A2 (G_2 = 21.3dB, F_2 = 4.36dB) and A3 (G_3 = 23.5dB, F_3 = 5.42dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

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S U B J E C T   N o . 5 3

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: ________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 53.4 Ω − j·67.9 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 6.90dB.
   a) If the power applied at the input port is 8.2 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 70 Ω resistor paralel with a 1.342 nH inductor, at 8.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (0.5dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 315 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 23.5dB and noise factor F_1 = 3.81dB), A2 (G_2 = 16.2dB, F_2 = 4.65dB) and A3 (G_3 = 16.9dB, F_3 = 5.29dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A2, A3? **(1.5p)**

S U B J E C T   N o . 5 4

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 62.8 Ω + j·47.4 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.05dB.
   a) If the power applied at the input port is 3.0 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 59 Ω resistor series with a 0.267 pF capacitor, at 8.0 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 595 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 15.0dB and noise factor F_1 = 3.06dB), A2 (G_2 = 18.2dB, F_2 = 4.84dB) and A3 (G_3 = 16.9dB, F_3 = 5.83dB). The order in which you must connect the amplifiers is A3, A1, A2.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**

SUBJECT No.55

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 43.7 Ω + j·30.0 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.80dB.
   a) If the power applied at the input port is 6.2 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 60 Ω resistor series with a 1.179 nH inductor, at 9.3 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, equal ripple (3dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 540 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 23.8dB and noise factor F_1 = 3.47dB), A2 (G_2 = 24.9dB, F_2 = 4.11dB) and A3 (G_3 = 20.4dB, F_3 = 5.23dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

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SUBJECT No.56

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: _________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 58.1 Ω + j·38.9 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 8.00dB.
   a) If the power applied at the input port is 6.2 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 63 Ω resistor paralel with a 0.930 pF capacitor, at 6.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 405 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.1dB and noise factor F_1 = 3.81dB), A2 (G_2 = 20.2dB, F_2 = 4.84dB) and A3 (G_3 = 15.2dB, F_3 = 5.92dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

S U B J E C T N o . 5 7

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian Student: __________________________________ Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 45.7 Ω + j·60.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 7.80dB.
   a) If the power applied at the input port is 5.3 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 32 Ω resistor paralel with a 0.581 nH inductor, at 7.5 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (0.5dB) high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 395 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 18.1dB and noise factor F_1 = 3.80dB), A2 (G_2 = 15.2dB, F_2 = 4.42dB) and A3 (G_3 = 21.9dB, F_3 = 5.52dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A3, A1? **(1.5p)**

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S U B J E C T   N o . 5 8

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: _________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 48.2 Ω − j·43.0 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.45dB.
   a) If the power applied at the input port is 5.3 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 71 Ω resistor paralel with a 0.326 pF capacitor, at 8.1 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, equal ripple (3dB) low-pass filter (LPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 445 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 24.8dB and noise factor F_1 = 3.12dB), A2 (G_2 = 18.9dB, F_2 = 4.36dB) and A3 (G_3 = 16.9dB, F_3 = 5.17dB). The order in which you must connect the amplifiers is A1, A2, A3.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A1, A3, A2? **(1.5p)**

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Faculty / Department: Electronics, Telecommunications and Information Technology
Domain: Telecommunication Technologies and Systems
Course : MDCR - EDID407
Enrollment Year: ___4____, Examination Session ______June_______ / __2024

S U B J E C T   N o . 5 9

Time allowed: 2 hours; All materials/equipment authorized

Instructor: Assoc. Prof. Radu Damian   Student: __________________________________   Group_______

Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 37.9 Ω + j·33.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 5.50dB.
   a) If the power applied at the input port is 4.4 dBm compute the power at the coupled port (**<u>in dBm</u>**). **(0.5p)**
   b) In the same situation compute the power at the through port (**<u>in dBm and mW</u>**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 60 Ω resistor paralel with a 0.546 pF capacitor, at 7.0 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5^{th} order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 315 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 19.3dB and noise factor F_1 = 3.19dB), A2 (G_2 = 19.2dB, F_2 = 4.02dB) and A3 (G_3 = 16.5dB, F_3 = 5.91dB). The order in which you must connect the amplifiers is A2, A1, A3.
   a) Compute the overall gain (**<u>in linear scale</u>**). **(0.5p)**
   b) Compute the overall noise factor (**<u>in dB</u>**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A3, A1, A2? **(1.5p)**

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S U B J E C T N o . 6 0

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Note. Except where otherwise specified, assume 50Ω reference impedance.
Note. Any CAD solution (Matlab, Mathcad, ADS) must contain relevant intermediate results for maximum points.

1. For a impedance equal to 63.0 Ω − j·59.6 Ω compute the normalized admittance **(1p)** and then plot on a Smith Chart (external circle and complex plane axes) the corresponding point **(1p)**
2. An ideal lossless quadrature coupler (matched on all ports with infinite isolation) has coupling factor C = 4.75dB.
   a) If the power applied at the input port is 2.4 dBm compute the power at the coupled port (**in dBm**). **(0.5p)**
   b) In the same situation compute the power at the through port (**in dBm and mW**). **(1.5p)**
   c) Design the coupler. **(1p)**
3. For a load composed from a 69 Ω resistor paralel with a 0.457 pF capacitor, at 6.8 GHz:
   a) Compute the corresponding reflection coefficient. **(1p)**
   b) Plot on a Smith Chart (external circle and complex plane axes) the corresponding point. **(0.5p)**
   c) Design the match for this load to a 50 Ω source with stubs (shunt stub, at least one solution) **(2p)**
   d) Draw the match schematic. **(0.5p)**
4. Design a 5th order, maximally flat high-pass filter (HPF) using reactive lumped elements (L/C). The filter must be designed with a cutoff frequency 575 MHz and with 50 Ω both source and load.
   a) Compute all the filter elements. **(1.5p)**
   b) Draw the filter schematic. **(0.5p)**
   c) Draw an estimate filter output (attenuation vs. frequency). **(1p)**
5. You must cascade three amplifiers, A1 (having gain G_1 = 16.5dB and noise factor F_1 = 3.42dB), A2 (G_2 = 24.4dB, F_2 = 4.13dB) and A3 (G_3 = 23.7dB, F_3 = 5.94dB). The order in which you must connect the amplifiers is A1, A3, A2.
   a) Compute the overall gain (**in linear scale**). **(0.5p)**
   b) Compute the overall noise factor (**in dB**). **(1p)**
   c) What are the changes you expect if you connect the amplifiers in this wrong order: A2, A1, A3? **(1.5p)**