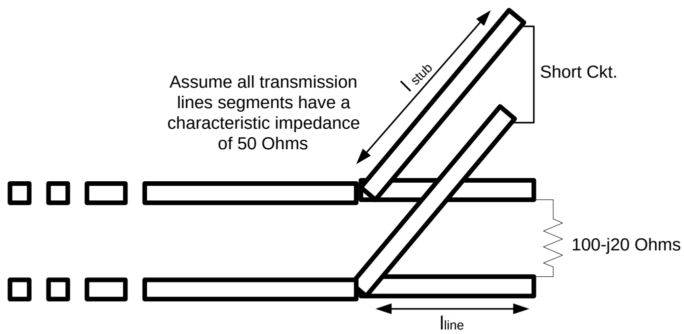
Instructions: This exam is closed book, except for one 8.5"x11" sheet of handwritten notes (as specified for exam I).

Coaxial Cables

RG #	AWG Material	Insulation	# Shields	Jacket	Nom. O.D. (inch)	Nom. Imp. (Ohms)	Nom. Vel. Of Prop.	Nom. Cap. (pF/ft.)	Nom. Attenuation per 100' MHz	dB	Standard Spool Lengths
14/U	20 Copper	Poly-ethylene	1	Black Vinyl	.420	95	66%	16.0	100 200 400	3.0 4.5 6.0	100, 500
14A/U	20 Copper	Poly-ethylene	1	Black Vinyl	.420	92	66%	16.0	100 200 400	3.5 5.0 7.0	100, 500
16A/U	18 Copper	Cellular Poly-ethylene	1	Black Vinyl	.195	50	78%	30.8	100 200 400	5.0 7.0 9.5	100,500 1000
18/U	18 Copper	Cellular Poly-ethylene	1	Black Vinyl	.280	75	78%	24	100 200 400	4.0 6.0 8.0	100,500 1000

Problem #1) A **single-stub tuner**, consisting of a Z_o=50Ω main line connected in parallel with a Z_o=50Ω short-circuited stub, is used to match a load of Z_R=(100 – j20)Ω to a 50Ω system. Determine the **lengths** $\mathbf{l_{line}}$ and $\mathbf{l_{stub}}$ in centimeters if the lines are air-filled and the operational frequency is 2 GHz.



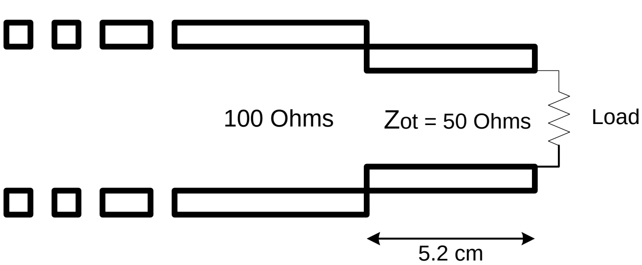
$\mathbf{l_{line}}$ = ________**1.995**____________cm
$\mathbf{l_{stub}}$ = ________**2.235**____________cm

Note that there is a second valid solution.

Problem #2) When an air-filled, slotted-line is terminated with a "short-circuit", voltage minima are measured at positions of 10cm and 25cm on the line. When an **"unknown load"** is connected to the line, the VSWR on the line is 2.4, and voltage minima are detected at 16cm and 31cm. Determine the **impedance value** of the load (in rectangular form), the **reflection coefficient** of the load (in polar form), and the **frequency** of operation if the characteristic impedance of the line is 50Ω.
(You must <u>use and label</u> a Smith Chart for your impedance and reflection coefficient solutions)

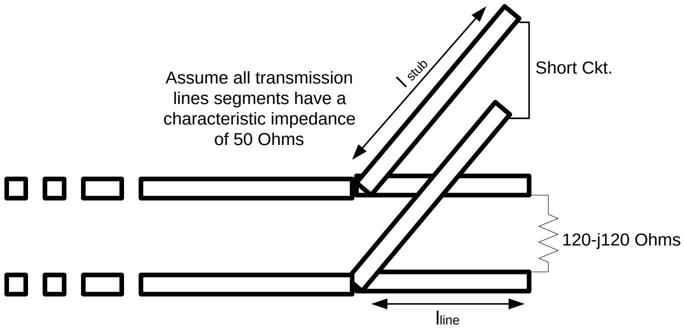
$\mathbf{Z_{Load}}$ = ______**82.5+j47.5**_______Ω
$\mathbf{\Gamma_R}$ = ________**0.42∠36°**_________
f = ___________**1G**__________Hz

Problem #3) A **¼-wavelength tuner** is used to match a load to a 100Ω line. If the characteristic impedance of the ¼-wavelength tuner is Z_{ot} = 50Ω, the tuner line is Polyethylene filled (ε_r = 2.3), and the length of the tuner is 5.2cm, determine the **load value** and the **operational frequency**.



$\mathbf{Z_{load}}$ = __________**25**____________Ω
f = ____________**951**__________MHz

Problem #4) A **single-stub tuner**, consisting of an adjustable-length, Z_o=50Ω, main line connected in parallel with an adjustable-length, Z_o=50Ω, short circuited stub is used to match a load of 120-j120 Ω to a Z_o=50Ω transmission line. Determine the **lengths l_{line}** and **l_{stub}** in centimeters if the line is air-filled and the frequency of operation is 2.4 GHz.



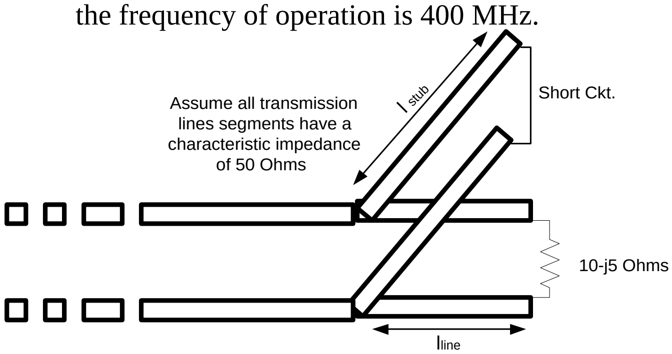
l_{line} = __________**1.875**___________cm
l_{stub} = __________**1.04**____________cm

Note that there is a second valid solution.

Problem #5) When a slotted-line is terminated with a "short-circuit", voltage minima are measured at positions of 10cm and 35cm on the line. When an **"unknown load"** is connected to the line, the VSWR on the line is 2, and voltage minima are detected at 20cm and 45cm. Determine the **impedance value** of the load (in rectangular form), the **reflection coefficient** of the load (in polar form), and the **frequency** of operation. Assume that the characteristic impedance of the line is 50Ω.

Z_{Load} = ______**77.5+j34**_______Ω
Γ_R = _________**0.33∠36°**__________
f = ___________**600M**____________Hz

Problem #6) A **single-stub tuner**, consisting of an adjustable-length, Z_o=50Ω, main line connected in parallel with an adjustable-length, Z_o=50Ω, short circuited stub is used to match a load of 10-j5 Ω to a Z_o=50Ω transmission line. Determine the **lengths l_{line}** and **l_{stub}** in centimeters if the lines are RG 14/U and the frequency of operation is 400 MHz.



	Solution 1	**Solution 2**	
l_{line} =	**22.2**	**4.1**	cm
l_{stub} =	**4.0**	**20.7**	cm

Problem #7) When an air-filled, slotted-line is terminated with a "short-circuit", voltage minima are measured at positions of 26.2cm and 44.9cm on the line. When an **"unknown load"** is connected to the line, the VSWR on the line is 3, and a voltage minimum is detected at a position of 30cm. Determine the **impedance value** of the load (in rectangular form), the **reflection coefficient** of the load (in polar form), and the **frequency** of operation if the characteristic impedance of the line is 50Ω.

Z_{Load} = ______**25+j31**______________Ω
Γ_R = _________**0.5∠107°**_____________
f = ____________**802M**____________Hz

Problem #8) A 6cm long piece of RG 16A/U coaxial cable is used as a **¼-wavelength tuner** to match a load to a 600Ω source. Assuming that the cable may be considered lossless due to the short length, determine the **load impedance** and the **frequency** of operation for the tuner.

Z_{Load} = _______**4.167**__________Ω
f = ___________**975M**_________Hz