University of Mumbai
QUTION BANK

Examination: BE Semester VIII

Course Code: ECC801 and Course Name: RF Design

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	The constant image impedance is obtained using
Option A:	Constant K T sections
Option B:	Constant K Pi sections
Option C:	m-derived T sections
Option D:	m-derived Pi sections
2.	The stability factors, μ1 for transistor1 is 1.25 and μ2 of transistor2 is 1.9.
Option A:	Transistor 1 is unstable
Option B:	Transistor 2 is unstable
Option C:	Transistor 1 is more stable than transistor 2
Option D:	Transistor 2 is more stable than transistor 1
3.	In the single stub tuning network, the length of the short circuited stub is 0.095λ. What length of stub would be required if it would be an open circuited stub?
Option A:	0.095λ
Option B:	0.345λ
Option C:	0.155λ
Option D:	Zero
4.	For the Maximally flat filter, for cutoff frequency of 2 GHz, impedance of 50, and at least 15 dB insertion loss at 3 GHz, What is the order of the filter?
Option A:	3
Option B:	4
Option C:	5
Option D:	7
5.	The Intermodulation distortion in diode ring mixers can be reduced
Option A:	By using resistance in parallel to each diode
Option B:	By using resistance in series to each diode
Option C:	By removing resistance from mixer circuits
Option D:	by using more number of diodes
6.	In PLL based synthesizers, coarse steering signal is generated to
Option A:	Reduce frequency
Option B:	Reduce response time
Option C:	to reduce bandwidth
Option D:	to reduce frequency resolution
7.	The speed of DAC converter
Option A:	Limits the high frequency performance of the synthesizer

Option B:	Limits the loop gain
Option C:	Limits the resolution
Option D:	does not affect frequency
8.	The grounded conductor for safety should have a resistance of
Option A:	100 Ω
Option B:	10Ω
Option C:	1Ω
Option D:	0.1 Ω
9.	Differential amplifiers are useful in EMI control as
Option A:	They have high input impedance
Option B:	They have high gain
Option C:	They have large common mode rejection Ratio
Option D:	They have limited bandwidth
10.	Apertures in metallic enclosure act like
Option A:	Paths for air passage from outside to inside
Option B:	Secondary antenna for radiating EMI signals
Option C:	Break in current flow paths
Option D:	Visual path for examining inside activity
11	The two methods of RF filter design are _____.
Option A:	Image prototype method and insertion gain method
Option B:	Image prototype method and insertion loss method
Option C:	Image parameter method and insertion gain method
Option D:	Image parameter method and insertion loss method
12.	The two necessary and sufficient conditions for a transistor to be unconditionally stable are _____.
Option A:	$K > 1, \lvert\Delta\rvert > 1$
Option B:	$K > 1, \lvert\Delta\rvert < 1$
Option C:	$K < 1, \lvert\Delta\rvert > 1$
Option D:	$K < 1, \lvert\Delta\rvert < 1$
13.	One port negative resistance oscillator for steady state oscillation has _____.
Option A:	$\Gamma_L * \Gamma in = 1$
Option B:	$\Gamma_L / \Gamma in = 1$
Option C:	$\Gamma_L + \Gamma in = 1$
Option D:	$\Gamma_L - \Gamma in = 1$
14.	In Indirect frequency synthesizer, the output frequency f_0 is equal to _____.
Option A:	fr/N (fr is reference frequency)
Option B:	N*fr (fr is reference frequency)
Option C:	fr + N (fr is reference frequency)
Option D:	fr - N (fr is reference frequency)
15.	The mechanism that enables electromagnetic energy to be created in an electronic device and coupled to its AC power cord is known as _____.
Option A:	Radiated Emission (RE)

Option B:	Radiated Susceptibility (RS)
Option C:	Conducted Emission (CE)
Option D:	Conducted Susceptibility (CS)
16.	The outer surface of the shield has to be _____to avoid electromagnetic energy leakage through the shield.
Option A:	Covered with insulators
Option B:	Kept in open environment
Option C:	Placed in isolation
Option D:	Grounded
17.	The 'm' value of the terminating sections in composite filter is_____.
Option A:	0.12
Option B:	0.3
Option C:	0.6
Option D:	0.9
18.	If a transistor has the following S parameters S_{11} = 0.5< -90, S_{12} = 0, S_{21} = 2.0< 30, S_{22} = 0.69< -90 What is the maximum unilateral gain (GTU max)?
Option A:	8 dB
Option B:	10 dB
Option C:	12 dB
Option D:	14 dB
19.	Practical diode mixers have a conversion loss between _____ in 1-10 GHz range.
Option A:	0 and 1 dB
Option B:	2 and 3 dB
Option C:	4 and 7 dB
Option D:	8 and 12 dB
20.	The size of an accumulator for a DDFS frequency range 0 to 10 kHz, frequency resolution of at least 0.001 Hz, and spectral purity of at least 40 dB is _____.
Option A:	32 bit
Option B:	26 bit
Option C:	16 bit
Option D:	12 bit

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A	**Solve any Two** **5 marks each**
i.	What are Richards' Transformations? What should be the length of the stubs? Why?
ii.	List out and discuss the performance parameters of frequency synthesizers?
iii.	What are the various reflection coefficients, power levels and gains associated with two port RF amplifier circuits? Define all with a diagram.
B	**Solve any One** **10 marks each**

i.	The S parameters of a BJT at VCE =15 V and Ic = 15 mA at f=500 MHz are as follows. S11=0.761∠-151°, S12=0.025∠31°, S21=11.84∠102°, S22=0.429∠-35° Determine the stability using K-Δ test and μ test. If the transistor is potentially unstable, Draw the input and output stability circles and show the stable and unstable regions.
ii.	Design a third order, maximally flat lumped-element band pass filter having center frequency of 1 GHz, bandwidth is 10 % and impedance of 50 Ω.

N	g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	g_{10}	g_{11}
1	2.0000	1.0000									
2	1.4142	1.4142	1.0000								
3	1.0000	2.0000	1.0000	1.0000							
4	0.7654	1.8478	1.8478	0.7654	1.0000						
5	0.6180	1.6180	2.0000	1.6180	0.6180	1.0000					
6	0.5176	1.4142	1.9318	1.9318	1.4142	0.5176	1.0000				
7	0.4450	1.2470	1.8019	2.0000	1.8019	1.2470	0.4450	1.0000			
8	0.3902	1.1111	1.6629	1.9615	1.9615	1.6629	1.1111	0.3902	1.0000		
9	0.3473	1.0000	1.5321	1.8794	2.0000	1.8794	1.5321	1.0000	0.3473	1.0000	
10	0.3129	0.9080	1.4142	1.7820	1.9754	1.9754	1.7820	1.4142	0.9080	0.3129	1.0000

Source: Reprinted from G. L. Matthaei, L. Young, and E. M. T. Jones, *Microwave Filters, Impedance-Matching Networks, and Coupling Structures* (Dedham, Mass.: Artech House, 1980) with permission.

Table: Element values for maximally flat low pass filter g_0=1,ω_c=1, N=1 to 10

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A	**Solve any Two** **5 marks each**
i.	What do we understand by 'characteristic - impedance' of a cable? How do we use this property of cables to reduce emissions and susceptibility?
ii.	Define shielding effectiveness. How can this be measured and the result expressed as?
iii.	Explain various performance parameters of Microwave Mixers.
B	**Solve any One** **10 marks each**
i.	Design a microwave oscillator at 2.75 GHz using a BJT in its common base configuration. S parameters of a transistor are as below

S_{11}	S_{21}	S_{12}	S_{22}
1.6733∠99.1	1.9755∠-138.68	0.6945∠94.71	1.13∠-101.3

ii.	Explain DDS frequency synthesizers and comment on methods of reducing switching time.
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A	**Solve any Two** **5 marks each**
i.	Differentiate between frequency generator and frequency synthesizer. Give the classification of frequency synthesizers.
ii.	Compare various filter design methods?
iii.	Discuss the importance and method of quantification of communication system EM.
B	**Solve any One** **10 marks each**
i.	What is the phase noise in oscillators? How do we characterize it? What are the effects of phase noise.
ii.	A GaAs MESFET is having following S parameter

	Freq (GHz)	S11	S21	S12	S22
	3	0.8∠-90	2.8∠100	0	0.66∠-50
	4	0.75∠-120	2.5∠80	0	0.6∠-70
	5	0.71∠-140	2.3∠60	0	0.68∠-85
	Design an amplifier to operate at 4 GHz for a gain of 11 dB. Plot and use the constant gain circles for Gs = 2 dB and GL=1 dB to realize the gain.				

Q	**Solve any Four out of Six (5 marks each)**
A	Discuss the disadvantages of constant-k filter section and how are they overcome by an m-derived filter section?
B	Distinguish the two types of stability for a transistor amplifier.
C	A single-ended FET mixer is to be designed for a wireless local area network receiver operating at 2.4 GHz. The parameters of the FET are R_d = 300 Ω, R_i = 10 Ω, C_{gs} = 0.3 pF, and g_1 = 10 mS. Calculate the maximum possible conversion gain.
D	Describe in brief the different types of frequency synthesizers.
E	Explain the functions, working of LISNs and why we need different LISNs
F	Elaborate the need for EMC specifications, standards and measurements.

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A	**Solve any Two (5 marks each)**
i.	Describe tests for unconditional stability used in RF amplifier design.
ii.	Explain in brief Oscillator Phase Noise.
iii.	Differentiate between radiated Common-Mode (CM) and Differential-Mode (DM) coupling with suitable example.
B	**Solve any One (10 marks each)**
i.	Design a composite low-pass filter by the image parameter method with the following specifications: R_0 = 50 Ω, f_c = 5.25 MHz and f∞ = 5.4 MHz. Draw the filter circuit indicating the designed parameters.
ii.	Explain the following mixer characteristics: Image frequency, Conversion loss, noise figure of SSB and DSB signal.

Q	**Solve any Two Questions out of Three (10 marks each)**
A	Implement a low-pass filter for fabrication using microstrip lines using Richards' Transformation and Kuroda's identities. The specificationsinclude a cutoff frequency of 4 GHz, an impedance of 50 Ohm, and a third-order3 dB equal-ripple passband response (g_1 = 3.3487,g_2 = 0.7117,g_3 = 3.3487, g_4 = 1.0000).

B	The S-parameters at 10 GHz for a microwave transistor with a 50 ohms reference impedance are: S_{11}= 0.5∠100°, S_{12}= 0.01∠-20°, S_{21}=2.0 ∠20° S_{22}=0.4∠-100° The source impedance is 25 ohms and the load impedance is 40 ohms. Calculate the power gain, the available power gain and the transducer power gain.
C	Explain the terms EMI and EMC. Describe the different sources of EMI in detail with examples.

Note: This is the sample Question bank. The questions from question bank may or may not be included in final examination.