K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

April – May 2023

(B. Tech) Program: B. Tech. (Electronics and Telecommunication) Scheme: II

Examination: LY Semester: VIII

Course Code: **EXDLC8032** and Course Name: **RF DESIGN**

Date of Exam: 18.05.2023 Duration: 2.5 Hours Max. Marks: 60

Instructions:
(1). All questions are compulsory.
(2). Draw neat diagrams wherever applicable.
(3). Assume suitable data, if necessary.

		Max. Marks	CO	BT level
Q 1	Solve any six questions out of eight:	12		
i)	Draw the final four stage diagram of composite filter and Compare the high pass and low pass composite filter design?	2	1	U
ii)	Calculate the number of elements (N) required to design maximally low pass filter with a cut off frequency of 2 GHz, source and load impedance of 50 Ω and this LPF is having 30 dB decay in amplitude at 4 GHz.	2	1	Ap
iii)	Define: Stability, power gain, available power gain and transducer power gain.	2	2,6	U
iv)	Draw the signal flow graph for linear two port microwave network?	2	2	U
v)	Explain the Kurokawa's criterion for oscillations?	2	3	U
vi)	Justify how field effect transistor (FET) can be used as mixer.	2	4	U
vii)	Explain EMI and its sources.	2	5	U
viii)	What are the three criteria to be satisfied by any system to become electromagnetically compatible?	2	5	U
Q.2	Solve any four questions out of six.	16		
i)	One-port oscillator uses a negative resistance diode having $\Gamma_{in} = 1.25\angle 40^\circ$ ($Z_0 = 50\ \Omega$) at its desired operating point, for f = 6 GHz. Calculate a load matching network (Z_L) for a 50 Ω load impedance.	4	3	Ap
ii)	Write a short notes on insertion loss method of filter design?	4	1	U
iii)	A silicon bipolar junction transistor has the following scattering parameters at 1.0 GHz, with a 50 Ω reference impedance: $S_{11} = 0.38\angle -158^\circ$ $S_{12} = 0.11\angle 54^\circ$ $S_{21} = 3.50\angle 80^\circ$ $S_{22} = 0.40\angle -43^\circ$ The source impedance is $Z_S = 25\ \Omega$ and the load impedance is $Z_L = 40\ \Omega$.	4	2	Ap

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	Compute the power gain, the available power gain, and the transducer power gain.			
iv)	Define: 1-dB compression point, dynamic range, conducted and radiation emission.	4	2,5	U
v)	What do you mean by "EMI Quantification" and give different considerations for the same.	4	5	U
vi)	Compare single ended and balanced mixer.	4	4	U
Q.3	Solve any two questions out of three.	16		
i)	Design a maximally flat low-pass filter with a cutoff frequency of 2 GHz, impedance of 50 Ω, and at least 15 dB insertion loss at 3 GHz. (Use Table for ref.)	8	1	Ap
ii)	Summarize the different types of mixers and compare the properties in terms of VSWR, RF/LO isolation, conversion loss and third order intercept.	8	4	U
iii)	Explain the different types of coupling in details.	8	5	U
Q.4	Solve any two questions out of three.	16		
i)	Design an amplifier for maximum gain at 4 GHz using single-stub matching sections. The transistor is a GaAs MESFET with the following scattering parameters (Z_0 =50 Ω): $[S_{11}] = 0.72\angle -116^\circ$ $[S_{12}] = 0.03\angle 57^\circ$ $[S_{21}] = 2.6\angle 76^\circ$ $[S_{22}] = 0.73\angle -54^\circ$	8	2	Ap
ii)	For two port oscillator at steady state oscillation condition prove that if $\Gamma_L \Gamma_{in}=1$ then $\Gamma_T \Gamma_{OUT}=1$.	8	3	Ap
iii)	Explain the EMI Diagnostics and Fixes.	8	5	U

TABLE Element Values for Maximally Flat Low-Pass Filter Prototypes ($g_0 = 1$, $\omega_c = 1$, $N = 1$ to 10)

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*, Artech House, Dedham, Mass., 1980, with permission.

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