BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
FIRST SEMESTER 2022-23
EEE G581 RF AND MICROWAVE ENGINEERING
COMPREHENSIVE EXAMINATION (OPEN BOOK)

Date: 22-12-2022   **Duration: 180 Minutes**   **Marks: 60**

Instruction: *Answer all questions. Unclear / illegible answers will not be evaluated*

Q1) A double-stub tuner uses shunt stubs to match a load admittance $Y_L/Y_0 = 0.4+j1.2$. The stubs are separated by $3\lambda/8$ and stub-1 is placed at the load. Choose stub-1 as SC stub and stub-2 as OC stub. Obtain the stub lengths (both solutions) in units of wavelength. Use **Smith chart-1** for the design.   [15 M]

Q2) A low-pass filter must be designed and realized for 50 Ω impedance, 5 GHz cut-off frequency and 0.25 dB equi-ripple passband. Corresponding prototype element values are given below,

$$g_0=1,\ g_1=1.3034,\ g_2=1.1463,\ g_3=1.3034,\ g_4=1$$

Start the lumped model with an inductor. Next realize the filter using all-shunt commensurate length ($\lambda/8$) microstrip lines. Present the design evolution using *neat and clear* diagrams showing *every detail* of element values, impedances, lengths etc. at every design stage. (Need not calculate the microstrip line widths)   [20 M]

Q3) A GaAs HBT has the following S-matrix measured at 5 GHz, and 50 Ω reference impedance.
$$S = \begin{bmatrix} 0.75\angle-140^0 & 0.07\angle+65^0 \\ 3.00\angle+85^0 & 0.55\angle-40^0 \end{bmatrix}$$

(a) If an amplifier is built using the above device, could it become potentially unstable?

(b) *Neatly shade* the unstable (or stable) region of the amplifier in **Smith chart-2**.

(c) If the amplifier is connected to a source with $Z_S=25$ Ω and load with $Z_L=100$ Ω, calculate the transducer power gain in dB.

(d) Compare the above gain with the gain calculated under unilateral assumption.   [25 M]

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