BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
FIRST SEMESTER 2023-24
EEE G581 RF AND MICROWAVE ENGINEERING
COMPREHENSIVE EXAMINATION (OPEN BOOK)

Date: 12-12-2023   **Duration: 180 Minutes**   **Marks: 65**

__Instruction:__ Answer all questions. Unclear or randomly presented answers will not be evaluated

Q1) A microstrip transmission line is fabricated on Polyimide substrate which is available with ε_r in the range of 2.3-13.4. For maximum bandwidth operation, what value of ε_r should be selected? Find the maximum bandwidth if the substrate thickness is 2 mm.   [5 M]

Q2) VNA measurement of the reflection coefficient is performed for a standard coaxial cable at a frequency of 2.45 GHz. The VNA reads $0.7\angle-75^0$ when the cable termination is *MATCHED* while it reads $0.3\angle175^0$ when the termination is changed to *SHORT*. Obtain the S-matrix for the cable.   [5 M]

Q3) A load impedance of 60–j45 Ω needs to be transformed to Z_{in}=120+j22.5 Ω. Design an open-circuited single-stub tuner to be added in shunt with the line to achieve the transformation. The design should result in the shortest stub location. Assume Z_0=75 Ω for all transmission lines used. Use **__Smith chart-I__** for the design.   [15 M]

Q4) Test the amplifier circuit for stability whose S-matrix is given below. Shade the stabile region on **Smith chart-II** with clear marking of all parameters   [20 M]

$$S = \begin{bmatrix} 0.70\angle-70^0 & 0.20\angle-10^0 \\ 5.50\angle+85^0 & 0.7\angle-45^0 \end{bmatrix}$$

Q5) A BJT amplifier circuit has scattering parameters, $S = \begin{bmatrix} 0.55\angle-140^0 & 0.00 \\ 2.00\angle+85^0 & 0.75\angle-40^0 \end{bmatrix}$.

   (a) The source circuit of this amplifier is designed to have a gain 1 dB less than its maximum value. What is the maximum transducer gain of this amplifier in dB ?
   (b) Draw the constant gain (G_S) circle on **Smith chart-III**
   (c) Assume $\Gamma_s = 0.40\angle94^0$ is selected from the gain circle as the design value. Draw the corresponding constant noise figure circle with R_F=0.36 and $\angle\Gamma_{opt}$=56^0 on the same chart and hence find C_F
       [20 M]

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