(3 Hrs) **Marks: 80**

1. Question No. 1 is compulsory
2. Out of remaining questions, attempt any three questions.
3. Assume suitable additional data if required and justify the same.
4. Figures in brackets on the right hand side indicate full marks.

Q.1 (a) Compare microwave amplifier with microwave oscillators. (05)
(b) Write a short note on balanced FET mixers. (05)
(c) Write a short note on Green's functions. (05)
(d) Compare HMICs with MMICs. (05)

Q.2 (a) Give the key processing techniques of hybrid microwave integrated circuits (HMICs). (10)

(b) A BJT has the following *S*-parameters as a function of three frequencies. Determine in which of these cases, device is unconditionally stable and which has greatest stability. (10)

frequency (MHz)	S_{11}	S_{12}	S_{21}	S_{22}
500	$0.70 \angle -57°$	$0.04 \angle 47°$	$10.5 \angle 136°$	$0.79 \angle -33°$
750	$0.56 \angle -78°$	$0.05 \angle 33°$	$8.6 \angle 122°$	$0.66 \angle -42°$
1000	$0.96 \angle -97°$	$0.06 \angle 22°$	$7.1 \angle 112°$	$0.57 \angle -48°$

Q.3 Design a lange coupler with a center frequency of 4 GHz and $N = 4$, $C = 0.5$, $Z_{on} = 30\ \Omega$. Determine the width, spacing, and length of the microstrip line for 90° phase shift at 4 GHz. Take the substrate with thickness $h = 0.635$ mm and the dielectric constant $\varepsilon_r = 9.8$. Assume that the substrate is non-magnetic and $\mu_r = \mu_e = 1$. (20)

Q.4 (a) For two port oscillator at steady state oscillation, prove that if: (10)
$\Gamma_L \Gamma_{in} = 1$ then $\Gamma_T \Gamma_{out} = 1$.

(b) Calculate the voltage coupling coefficient for a 10 dB power coupling. (10)

Q.5 (a) Discuss the various power gains in microwave amplifier design. (10)

(b) Develop wave equation for coupled lines. (10)

Q.6 Write short notes on any two: (20)
(a) Directional coupler.
(b) Effect of discontinuities (such as open circuits and gaps, microstrip corners) in microstrip line.
(c) Field distribution in even and odd mode for microstrip.

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