ECN-347: Introduction to Microwave Semiconductor Device Modelling Techniques

QUIZ -1

24.2.2023 **SPRING 2022-23** **Total Marks: 25**

NAME: **ENR NO.:**

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1. In microwave circuits, the semiconductor devices can be used as:

   (a) switch, attenuator, and phase shifter
   (b) switch and phase-shifter only
   (c) switch and attenuator only
   (d) attenuator and phase shifter only

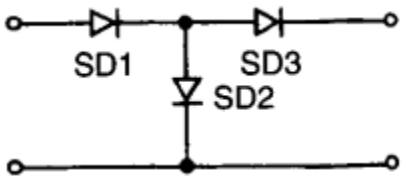
2. If *P* (watts) is the power handling capability of a *pin* diode, then the switching time τ of this *pin* diode switch can be approximately equal to

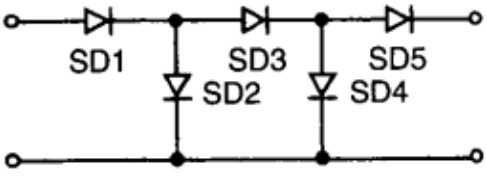
   (a) $\sqrt{P}$ ns
   (b) $25/\sqrt{P}$ ns
   (c) $\sqrt{P}/25$ ns
   (d) 25 ns

3. If for a *pin* diode, *W* is the width (thickness) of the intrinsic layer, and τ is the switching time, then which of the following statement is TRUE:

   (a) a large *W* gives rise to a smaller τ.
   (b) a small *W* gives rise to a smaller τ.
   (c) a small *W* gives rise to a larger τ.
   (d) there is no such relationship exists between *W* and τ of a *pin* diode.

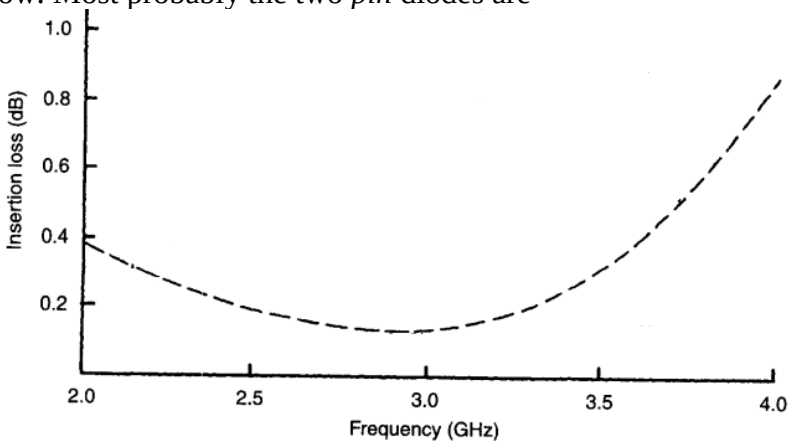
4. Assume that all the *pin* diodes used in these switching circuits shown below are identical. Which of the following statements is correct?





   (a) The isolation performance of the 5-device switching configuration will degrade compared to the 3-device switching configuration because of the greater number of diodes used.
   (b) The isolation performance of the 3-device switching configuration will be better because of the smaller number of diodes used.
   (c) The isolation performance of the 5-device switching configuration will be better.
   (d) There will be a drastic change in the insertion loss of one configuration from the other.

5. The insertion loss plot of an SPDT switch designed to operate at 3 GHz using two *pin* diodes is shown below. Most probably the two *pin* diodes are



(a) series mounted
(b) shunt mounted
(c) series-shunt mounted
(d) shunt-series mounted

6. At an operating frequency of 1 GHz, the minimum switching delay contributed by the biasing networks is about:

(a) 10 ns
(b) 2.48 ns
(c) 1.24 ns
(d) 0.5 ns

7. The equivalent circuit parameters of a commercially available *pin* diode are given in the following table.

Parameters	MA47892-109
C_j	1 pF
R_f	0.4 Ω
R_r	0.5 Ω
L_{int}	0.3 nH
C_p	0.08 pF
τ	5 μs
f_{cs} $[=1/(2\pi C_j\sqrt{R_r R_f})]$	350 GHz

The *pin* diode is used as a switch in a microstrip circuit connected in a series-mounted form. Assume that there is no package capacitance and the switch is considered to operate at 3.18 GHz with $Z_0 = 50\ \Omega$. The insertion loss in this case is:

(a) 0.05 dB
(b) 0.50 dB
(c) 1.00 dB
(d) 1.50 dB

8. (continuation of Q.7) The isolation in this case is:

(a) 16.08 dB
(b) 8.05 dB
(c) 4.06 dB
(d) 0.805 dB

9. An amplifier with a gain of 15 dB, a bandwidth of 200 MHz, and a noise figure of 3dB feeds a demodulator with a noise temperature of 800 K. The noise figure of the overall system is:

(a) 3.76 dB
(b) 2.09 dB
(c) 3.20 dB
(d) 15.0 dB

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SPACE FOR WRITING ANSWERS

Q. No.	Marks	Answer (a, b, c, d)	√ / ×	Marks Obtained
1.	2	a		
2.	2	c		
3.	2	b		
4.	2	c		
5.	2	b		
6.	3	c		
7.	4	a		
8.	4	d		
9.	4	c		
			Total Marks	