

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**ME - SEMESTER-1 (NEW) EXAMINATION – WINTER 2018**

**Subject Code: 3710514****Date: 04/01/2019****Subject Name: RF and Microwave Circuit Design****Time: 02:30 PM To 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full mark.

- Q.1** (a) Explain the structure and working principle of Gunn diode. **07**  
 (b) Draw lumped element circuit model for a transmission line. Derive expression of a characteristic impedance  $Z_0$  and phase velocity for lossless line. **07**
- Q.2** (a) Design an L-section matching network to match a series RC load with an impedance  $Z_L = 200 - j100 \Omega$  to a  $100 \Omega$  line, at a frequency of 500MHz. Use Smith Chart. **07**  
 (b) Compute Transmission (ABCD) matrix of a transmission line section. **07**
- OR**
- (b) Write a short note on High-electron-mobility transistor (HEMT). **07**
- Q.3** (a) Draw electric equivalent circuit for a high frequency wire wound resistor, capacitor and inductor. Draw impedance vs. frequency graph for resistor, capacitor and inductor in comparison to ideal components. **07**  
 (b) Design a low pass filter for fabrication using micro strip lines(stubs). The specifications are: cutoff frequency of 4 GHz, third order, impedance of  $50 \Omega$  and 3 dB equi-ripple characteristic.  $g_1 = 3.3487$ ,  $g_2 = 0.7117$ ,  $g_3 = 3.3487$ ,  $g_4 = 1$ . Use Richard's transformation and Kuroda identity. **07**
- OR**
- Q.3** (a) Calculate microstripline width for a line impedance of  $50 \Omega$ . The PCB board material is FR-4 with a relative dielectric constant of 4.6 and thickness of 40 mil. Take frequency of 2 GHz and  $w/h < 2$ . **07**  
 (b) Write a short note on two-port transistor oscillator. **07**
- Q.4** (a) Design a bandpass filter having a 0.5 dB equal-ripple response, with  $N = 3$ . The center frequency is 1 GHz, the bandwidth is 10%, and the impedance is  $50 \Omega$ .  $g_1 = 1.5963$ ,  $g_2 = 1.0967$ ,  $g_3 = 1.5963$ ,  $g_4 = 1$ . **07**  
 (b) Write a short note on design of single stage transistor amplifier design for maximum gain. **07**
- OR**
- Q.4** (a) Draw and explain RF circuit for One-port oscillator. Design a load matching network ( $Z_L$ ) for one port oscillator for  $50 \Omega$  load impedance that uses a diode having  $\Gamma_{in} = 1.25 \angle 40^\circ$  at desired operating point, for  $f = 6$  GHz. **07**  
 (b) For Low noise amplifier design, derive expression to compute the center and radius of noise figure circle. **07**
- Q.5** (a) Derive scattering parameters for Wilkinson equal power divider with even-odd mode analysis. Design equal split Wilkinson power divider for  $50 \Omega$  system impedance. **07**  
 (b) With circuit diagram and its equivalent, explain the Single ended FET mixer. **07**
- OR**

- Q.5** (a) Explain Ring Hybrid with even-odd mode analysis. Design Ring Hybrid for  $50\Omega$  system impedance. **07**
- (b) A rectangular waveguide cavity is made from a piece of copper WR-187 H-band waveguide, with  $a=4.755$  cm and  $b=2.215$  cm. The cavity is filled with polyethylene ( $\epsilon_r=2.25$ ,  $\tan\delta =0.0004$ ). If resonance is to occur at  $f=5$  GHz, find the required length,  $d$ , and resulting  $Q$  for  $l=1$ , resonant mode. Surface resistivity of copper is  $R_s=1.84 \times 10^{-2}$  . The intrinsic impedance is  $\eta = 251.3$  . **07**

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