Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SIXTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION
MAY/ JUNE 2016
SUBJECT: MICROWAVE COMPONENTS & DEVICES (ECE - 304)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.
- Smith chart will be issued on request

1A. Design a double stub system to match a load of (100+j100)Ω to a transmission line with R_o=50Ω. The first stub is placed at 24cm from the load and spacing between the two stubs is 22.5cm. Determine the length of the short circuited inductive stubs when the match is achieved. The operating frequency is 500MHz. Also indicate the forbidden region for the location of the first stub.

1B. Starting from trigonometric equations of transmission line, derive equations for short circuit and open circuit input impedance.

(7+3)

2A. Starting from the voltage and current equation for a lossless line at radio frequency, sketch the voltage and current waveforms for a line of length $3\lambda/2$ when
i)$Z_R = 0$ ii) $Z_R = R_0$ iii) $Z_R = 5R_0$ iv) $Z_R = R_0/5$ (v) $Z_R = \infty$.

2B. A coaxial quarter wave transformer is to match a load of 10 Ω to 80 Ω coaxial line. The matching line is filled with a dielectric with ϵ_r = 2.54. Find the length of the matching line and its inner conductor radius, if the radius of the outer conductor is 0.6cm and the frequency is 3 GHz.

2C. A transmission line has a characteristic impedance of 500 Ω and is terminated by a 200 Ω load. If the load is dissipating continuous sinusoidal power of 100 watts, find the power in the incident and reflected wave.

(5+3+2)

3A. Starting from fundamental equations, derive the expression of field components for a TM wave in parallel plate waveguide and also derive the expression for Z_{TM}.

3B. In a rectangular waveguide with air as dielectric $a = 2.286cm$ and $b = 1.016cm$ with field components

$$E_y = C\frac{-jw\mu}{h^2}\left(\frac{2\pi}{a}\right)sin\left(\frac{2\pi}{a}x\right)cos\left(\frac{3\pi}{b}y\right),\ H_z = C\,cos\left(\frac{2\pi}{a}x\right)cos\left(\frac{3\pi}{b}y\right),$$
$$H_x = C\frac{\gamma}{h^2}\left(\frac{3\pi}{b}\right)cos\left(\frac{2\pi}{a}x\right)sin\left(\frac{3\pi}{b}y\right),$$

and

Operating frequency is 50 GHz. Find a) Mode of wave propagation b) phase constant and Z_{TE}.

3C. Why TE_{00} mode doesn't exist in rectangular waveguide? Which is the dominant mode and give reason?

(5+3+2)

4A. With a neat diagram, explain the working principle of four port circulator constructed using two magic tee and a phase shifter and also derive its S- matrix.

4B. With mathematical equations, explain the properties of "S" matrix of 3*3 elements.

4C. With diagram, explain the working of Rat – Race circuit.

(5+3+2)

5A. With the help of a neat diagram explain the construction of Reflex Klystron. Derive the equation of velocity modulation. Illustrate the bunching process with the help of Applegate diagram and find maximum efficiency of the device.

5B. What are the differences between resonant and non-resonant microwave amplifiers? Describe working of microwave amplifiers which uses non-resonant circuit. Discuss its performance parameters and applications.

(5+5)

6A. Determine the resistive cutoff frequency and self-resonance frequency for a tunnel diode with the following parameters.

i) Junction capacitance (C_j) = 30 pF.
ii) $-g_n$ = - 0.040 mho
iii) Packaging circuit resistance (R_s) = 2.5 Ω
iv) Packaging circuit inductance (L_s) = 5nH

Derive the mathematical expressions used.

6B. What are the limitations of Conventional vacuum tubes? Explain any two with necessary mathematical analysis.

6C. A matched isolator has insertion loss of 0.5dB and isolation 25dB. Find its 'S' matrix.

(5+3+2)