Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

FIFTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION
DECEMBER 2020/JANUARY 2021
SUBJECT: MICROWAVE ENGINEERING (ECE - 3154)

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

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. A symmetric directional coupler with infinite directivity and a forward attenuation of 20 dB is used to monitor the power delivered to a load Z_l (see Figure 1A below). Bolometer 1 introduces a VSWR of 2 on arm 4; bolometer 2 is matched to arm 3. If bolometer 1 reads 8mW and bolometer 2 reads 2mW, find: (a) the amount of power dissipated in the load Z_l; (b) the VSWR on arm 2.

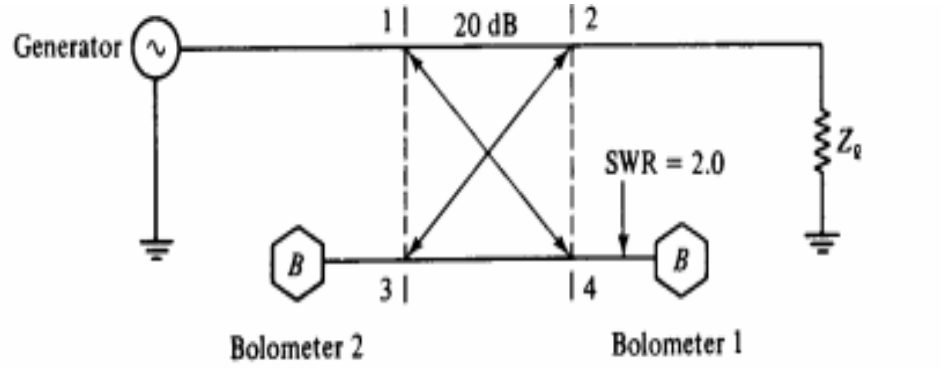

Figure 1A: Power measurement by directional coupler

1B. With detailed diagram, explain the principle and working of multi cavity Klystron. Also, list out its important characteristics.

(5+5)

2A. Design a rectangular microstrip patch antenna, based on the dominant mode that can be mounted on the roof of a car to be used for satellite cellular telephone. The designed centre frequency is 1.6 GHz, the dielectric constant of the substrate is 10.2 (i.e. RT/duroid), and the thickness of the substrate is 0.127 cm. Determine the dimensions of the rectangular patch (in cm).

2B. Calculate maximum operating range (d) of a millimetre wave antenna considering path loss, average noise per bit and tolerable path loss using the millimetre wave link design concept.

(5+5)

3A. Describe briefly,
a) Fractal Antennas.
b) Channel performance at 60 GHz.

3B. Derive the vector wave equation in terms of electric vector potential and also obtain the solution of it.

(5+5)

4A. Sketch the pattern of $E_n = \cos\theta$ and obtain the value of Directivity using exact formula

4B. A λ/2 dipole antenna, with a total loss resistance of 1Ω, is connected to a generator whose internal impedance is (50 + j25) Ω. Assuming the peak voltage of the generator is 2V and impedance of dipole excluding loss resistance, is (73 + j 42.5) Ω, Find the power:
(a) supplied by the source (real)
(b) Radiated by the Antenna
(c) Dissipated by Antenna

4C. Starting from fundamentals obtain the expression for Radiation Resistance for an N turn small circular loop of constant current.

(2+3+5)

5A. For an N element array of isotropic point sources, with uniform amplitude and spacing and with a progressive phase shift of β between the elements derive the expression of normalized array factor of far fields.

5B. Design a 3 element, Binomial array of isotropic point sources having same phase and with spacing between elements d = λ/4. Derive the Array Factor equation and obtain the value of amplitudes of current of the elements.

5C. Starting from the expression of Electric field, obtain the value of Directivity and radiation resistance of a half wavelength dipole.

(3+3+4)