# Question Paper

Exam Date & Time: 30-Apr-2024 (02:30 PM - 05:30 PM)

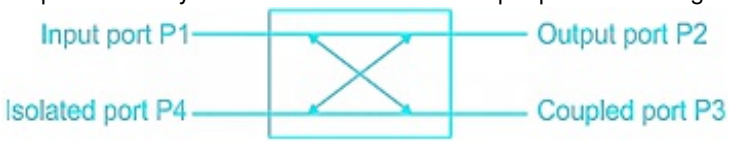
## MANIPAL ACADEMY OF HIGHER EDUCATION

**FOURTH SEMESTER B.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING) DEGREE EXAMINATIONS - APRIL / MAY 2024**
**SUBJECT: ECE 2224/ECE_2224 - MICROWAVE ENGINEERING**

**Marks: 50** **Duration: 180 mins.**

**Answer all the questions.**

1A) A four-port directional coupler has a 4:1 power splitting ratio and a dissipation loss of 3dB. The coupler directivity is 40 dB. What fraction of input power P1 will go to ports P2 and P3? (4)




1B) In an H-plane tee junction, 20mW power is applied to port 3, which perfectly matches the junction. Calculate the power delivered to the load 60Ω and 75Ω connected to ports 1 and 2. (4)

1C) In an isolator, the isolation is 30dB, and the insertion loss is 0.4 dB. Find its scattering parameter. (2)

2A) Define the coupling factor, directivity, isolation, and insertion loss in for the directional coupler. Determine the S-matrix for the directional coupler. (4)

2B) Show that the maximum directivity of infinitesimal dipole is 1.5. (4)

2C) Explain the limitation of conventional tubes at microwave frequencies. (2)

3A) The electric field of a linearly polarized electromagnetic wave given by $E_i = \widehat{a_x} E_0(x,y)e^{-jkz}$, is incident upon a linearly polarized antenna whose electric field polarization is expressed as $E_a \cong \left(\widehat{a_x} + \widehat{a_y}\right)E(r,\theta,\varphi)$. Find the polarization loss factor (PLF). (5)

3B) Derive the vector wave equation in terms of vector potential (F) and magnetic current density (M) and obtain the solution of it. (5)

4A) Explain the working and S-Matrix of a rat-race junction. (4)

4B) Derive the vector wave equation in terms of electric vector potential and obtain the solution of it. (4)

4C) Find the radiation resistance of an infinitesimal dipole whose overall length is L=λ/50. (2)

5A) With the necessary diagrams and equations, Explain the concepts of Fractal antenna and list their limitations. (4)

5B) With the necessary diagrams and equations, explain how the microstrip rectangular patch works. (4)

5C) Sketch the current distribution in the linear dipoles of length. (2)

(a) $l \ll \lambda$ (b) $l = \lambda/2$ (c) $\lambda/2 < l < \lambda$ (d) $\lambda < l < 3\lambda/2$

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