

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)

CLASS: M.TECH  
BRANCH: ECE

SEMESTER : I  
SESSION : MO/18

SUBJECT: EC505 ADVANCED ELECTROMAGNETIC ENGINEERING

TIME: 3 HOURS

FULL MARKS: 50

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) Find the expression of cut-off frequency for partially dielectric filled rectangular waveguide for TEx or TMx modes. [5]
- Q.1(b) Show that in a rectangular waveguide when many mode exist simultaneously, each mode transmits energy as if it is existed alone. [5]
- Q.2(a) Determine the expressions of cut-off frequencies and wave impedances for TE and TM mode in Circular waveguides. [5]
- Q.2(b) Illustrate that for parallel-plate radial waveguide the wave impedance,  $Z_{+\rho}^{TM}$ , is predominantly resistive when  $k\rho > n$  and predominantly reactive when  $k\rho < n$ . Also explain that the dominant mode  $TM_{00}$  for parallel-plate radial waveguide corresponds to the TEM to  $\rho$ . [5]
- Q.3(a) Determine the solutions of Helmholtz Equation in Spherical coordinate system and write the equations of various field components for TM to r and TE to r. [5]
- Q.3(b) Evaluate the expression of highest possible antenna gain using spherical waveguide modes of order  $n \leq N$ . [5]
- Q.4(a) Develop a general procedure for establishing stationary formulas using the concept of reaction. [5]
- Q.4(b) Show that, any increase in  $\epsilon$  and/or  $\mu$  within a cavity can only decrease the resonant frequency. Also find the quasi-static correction to the perturbational formula for the thin slab with E normal to it. [5]
- Q.5(a) Find the equivalent transmission models for waveguide TE and TM modes and define each element. [5]
- Q.5(b) Show that slope of the reactance or susceptance for a loss free one port network is always positive. [5]

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