M.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING

FIRST YEAR SECOND SEMESTER EXAM 2017

ADAPTIVE AND SMART ANTENNA (MW)

Time: Three hours Full Marks:100

[***Question No. 1 is compulsory*** and ***answer any three*** from the rest.]

1. Answer any four questions:

i) "Wireless communication system, as opposed to their wire-line counterparts, pose some unique challenges." - explain by listing all major challenges. When do you call an antenna system 'smart'? How does a smart antenna system behave with SNOI and SOI. How such system detects DOA? [4+2+2+2]

ii) Using block diagram, explain the architecture of a smart antenna system. What are the main difficulties in designing a smart antenna system? [7+3]

iii) Discuss about switched beam antenna configurations. Using schematic diagram explain the beam steering technique using Butler matrix. [4+6]

iv) What is adaptive antenna? Compare performances of switched beam antenna with adaptive antenna. What are the main benefits and major disadvantages of adaptive arrays? [3+3+4]

v) Draw and explain the functional block diagram of an N-element adaptive array. Mention some practical difficulties for implementation of adaptive antenna systems inside a handset. [7+3]

2. a) What are the main advantages and disadvantages of antenna arrays over a single antenna. [2]

b) How can the directional pattern of an array of identical special elements be predicted? Calculate the uniform linear array beam patterns for 3-element and 4-element arrays with $d = 0.5 \lambda$ and compare the results. [3+7]

c) Describe Null Synthesis technique using the unit circle. Explain Null Synthesis using cancellation of beams. [5+3]

3. a) For an N-element adaptive array, find out the necessary conditions for minimizing the jamming interference from a particular direction. [10]

   b) Using mathematical derivations discuss about the nulling limitations due to miscellaneous array effects. [10]

4. Mention names of four gradient-based algorithm other than Least mean square (LMS) algorithm. Why are Gradient algorithms so popular? Describe LMS algorithm. [2+3+15]

5. What is reconfigurable antenna? Which types of switches are suitable for reconfigurable antennas? How can a rectangular microstrip patch antenna be switched to operate between two different frequencies? Using figures discuss on reconfigurable antennas for change polarizations. [2+2+8+8]

6. Write short notes on (any two): [2x10=20]

   a) Low side-lobe amplitude tapers and thinned arrays
   b) The MSE performance measure
   c) Optimum array processing techniques for narrow-band applications
   d) Narrow-band and broadband signal processing considerations