

## ELL 705 MINOR TEST 1

Duration: 1 hour

Total Marks: 300

### Instructions

1. Show all relevant steps clearly and briefly.
  2. If needed, make suitable assumptions. But, state them clearly.
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**Question 1.** (300 marks) Consider a process,

$$y(t) = a + bt + \epsilon(t),$$

where  $y(t)$  is output at time  $t$  and  $\epsilon(t)$  is the noise. Denote data collected at  $t = 1, 2, \dots, N$  as  $y(1), y(2), \dots, y(N)$ . Both  $a$  and  $b$  are unknown parameters, but may be estimated from this data. Using the method of least squares, obtain estimates of  $a$  and  $b$ . Denoting the estimates obtained above as  $\hat{a}$  and  $\hat{b}$ , respectively, find  $E\{(\hat{a} - a)\}$ ,  $E\{(\hat{b} - b)\}$ ,  $E\{(\hat{a} - a)^2\}$ ,  $E\{(\hat{a} - a)(\hat{b} - b)\}$ , and  $E\{(\hat{b} - b)^2\}$  if  $\epsilon(t) = w(t)$ , where  $w(t)$  is a zero mean white noise process with unit variance.