COMPUTER SCIENCE TRIPOS Part IA – 2017 – Paper 2

10 Discrete Mathematics (IML)

For each of the following languages over the alphabet $\{a, b\}$, state with justification whether the language is regular or not. m and n are natural numbers.

(*a*) L_1 is the set of all strings with the number of a's in each being divisible by 3 and the number of b's being divisible by 7. [4 marks]

(*b*) $L_2 = \{a, b\}$ [4 marks]

(*c*) $L_3 = \{a^m b^n \mid m \neq n\}$ [4 marks]

(*d*) $L_4 = \{uww^R v$ for nonempty strings $u, w, v \in \{a, b\}^*\}$

w^R is the string obtained by reversing the string w. [4 marks]

(*e*) $L_5 = \{a^n \mid$ where there are twin primes $p, p + 2,$ with $p > n\}$

Twin primes are pairs of primes which differ by 2, such as 5 and 7, or 17 and 19. It has been conjectured – but never proven – that there are infinitely many twin primes. [4 marks]