Department of Data Science
IIT Palakkad
DS5617 : Generative Artificial Intelligence

0800-0850 **Test 2 (18 Oct 2025)** **Marks : 15**

Instructions

1. Use Blue/ Black ink (red ink and pencils are not allowed). If your answer is not legible, you will not get any marks for that.
2. Be precise about notations, variables, parameters.

1. Consider the denoising diffusion probabilistic model, answer the following. (7)
   a. Describe the forward process. [2]
   b. Describe the reverse process. [2]
   c. What is the basic idea in training diffusion model considering the forward and the reverse process described above ? [3]

2. Flow Matching. Consider a Gaussian conditional probability path $p_t(.|x_1) = \mathbb{N}(\alpha_t x_1, \beta_t^2 \mathbb{I}_d)$, where $x_1 \sim p_{data}$ (actual data distribution). (8)
   a. Describe the trajectory of x_t for shifting from the simple parametric distribution to the target distribution. [2]
   b. Consider the conditional vector field:

$$u_t(x|x_1) = \left(\dot{\alpha}_t - \frac{\dot{\beta}}{\beta}\alpha_t\right)x_1 + \frac{\dot{\beta}_t}{\beta}x,$$

   state the training strategy for the flow matching model. [2]
   c. Considering $\alpha_t = t$ and $\beta_t = 1 - t$, simplify the learning objective and provide an intuitive explanation. [2+2]