DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE
SPRING SEMESTER 2021-2022 Mid-Term Examination Online mode

CSN312 PRINCIPLES OF PROGRAMMING LANGUAGES Full Marks: 25
Duration: 1hour 4.3.2022

Write your name and enrolment no. on the top of all pages. Each page should include your signature at the bottom. All the answers MUST be hand written in BLUE pen; otherwise zero mark will be given. Calculators are not allowed.

Answer all the questions. Answer for each question should begin on a new page.

Note:

Zero mark would be given for correct answers with no steps/unjustified steps/ incorrect justifications.

For each question, the final answer should be explicitly stated as: Final Answer : ... .

1. For the term given below, construct an equivalent term (without any shortcut notation) with as few parentheses as possible. All the steps should be clearly justified. [6]

(((w (λx. (λy. (λz. ((x z)(y z)))))) u) v)

2. Find the set of free variables, using the rules, for each of the following terms. [6]

(a) (λx. x y) λz. w λw. w z y x

(b) x λz. x λw. w z y

All the steps should be clearly justified.

3. Find the normal form of the term

((λf. ((λg. ((f f) g)) (λh. (k h))))(λx. (λy. y))) [6]

All the steps should be clearly justified.

4. Find the Principal Type (PT) of (λx.λy.λz. x y z z) using the PT algorithm, if any. All the steps should be clearly justified in any case. [7]

END