GUIDELINES ON MATHEMATICAL MATERIALS

List of Symbols

A thesis should contain a list of symbols before the start of the first chapter. A list of symbols at the beginning of the thesis helps in ensuring that the same symbol is neither used for more than one purpose nor defined in more than one way. Furthermore, a reader of the thesis can refer to only one place to find the definition of a symbol.

The list of symbols should be arranged with Latin letters followed by Greek letters, each of them arranged alphabetically. Whenever applicable, the unit of measure should be given for each symbol.

Examples:

c: Velocity (km/h)

m: Mass (kg)

…

β: Regression coefficient (units/rupee)

η: Efficiency (1)

Note the use of colon rather than the equality sign.

Numbers

Consistency

Consistency should be maintained throughout the text. The following is an example of inconsistency in writing a number 5,000 in two places:

0.05×10^5 in one place and 0.5×10^4 in another

Standard Scientific Notation

Standard scientific notations are preferred to computer exponentials:

5.0×10^{-3} instead of 5.0 E−3

Decimal fractions should be preceded by zeros except in case of probabilities:

0.25 (but .25 when it refers to a probability value)

Use of the Symbol %

The symbol % is used with Arabic numbers, and the word “per cent” is used with the word version of the number:

5% and five per cent (not 5 per cent)

The symbol is not repeated with each number in a series or with each number in a range of values:

5, 10, and 15%; 5–10%

Location of a Number

A sentence does not start with a number:

25 persons were included. (Incorrect)

Twenty-five persons were included. (Correct)

Compound Numbers

A hyphen separates the individual numbers of a compound number and also the ordinal counterparts:

twenty-one, thirty-four, . . .

twenty-first, thirty-fourth, . . .

Numbers that are nine or less should be written in words in the text. If a series of numbers contain numbers both less and more than 10, then only Arabic numerals should be used:

There are 25 samples. Each sample has a size of five.

Marks secured by the five students are: 2, 5, 10, 15, and 18.

Thousand Operator

For very large and very small numbers, give a space in the thousand operator:

10 000 000 0.254 25

Symbols of Basic Arithmetic Operations

The signs for the basic arithmetic operations are the following:

Plus	+
Minus	−
Multiplication	×
Division	⁄ and ÷

Excepting for the plus symbol, no symbol is available on a keyboard normally available in the market. All other symbols are to be selected from the Symbols list.

We generally confuse the symbol of a hyphen (-) with a minus sign (−) (note the length, vertical location, and intensity of the two signs), and wrongly use the symbol of an asterisk (*) or the letter x for the symbol of multiplication (×). Similarly, we are not

right when we use the symbol of a solidus (/) available on a keyboard for division (⁄) (look at the inclination of the two lines).

ISO standards for scalars, vectors, and tensors are the following:

scalar:	lightface italics (*V, l, m,* ...)
vector:	boldface italics (***V, l, m,*** ...)
tensor:	lightface italics sans serif (*V, L,* ...)

The purpose of italicizing them is to distinguish them from the SI units that are always upright.

Variables and Constants

Symbols for variables, constants, and unknown quantities are to be italicized:

x, l, m

The subscripted variables follow different writing styles:

Subscripts are numbers:	x_1, x_2
Subscripts are variables:	x_i, x_{ij}
The variables indicate constant values:	$x_\mathrm{u}, x_\mathrm{l}$

In the third example, x_u indicates the upper limit of the variable x, and x_l its lower limit.

Greek letters (such as α, β, etc.) are always set in Roman.

Standard Functions

Abbreviations for standard functions, such as log, max, min, exp, sin, cost, tan, cosh, lim, avg, cov, diag, and ln, are set in Roman:

$\log x$

Series of Variables

Three ellipses (printed like periods and separated by spaces) are to be used to indicate a series of variables:

$x_1, x_2, \ldots, x_n$ (not $x_1, x_2 \ldots x_n$)

Notice the commas appearing before and after the three ellipses.

Three raised ellipses (centered dots) are to be used for a series of additions or multiplications of variables:

$x_1 + x_2 + \cdots + x_n$ (not $x_1 + x_2 + \ldots x_n$)

$x_1x_2 \cdots x_n$ (not $x_1x_2 \ldots x_n$)

Three ellipses are to be used to indicate the range of a variable:

x_i, $i = 1, 2, \ldots$ (not x_i, $i = 1, 2 \ldots$)

Notice the presence of a comma before the first ellipsis point.

Space Accompanying Mathematical Operators

One space should be provided on both sides of a mathematical operator:

$z = x + y$

$z = x - y$

$z = x \times y$

$z = x \div y$

No space appears, however, if a division is indicated by the symbol ⁄ and also when the multiplication is implied:

$z = x/y$

$z = xy$

$z = 25x$

A negative number should not have a space separating the sign and the number:

The number −2 (not − 2) is more than −3 (not − 3).

−3 < −2 (correct)

− 3 < − 2 (not correct)

Similarly, when a plus sign is used to indicate a positive number then no space appears between the sign and the number:

$-3 \leq x \leq +3$

No space appears between a variable and its subscripts (or superscripts) and between a variable and its power:

$x_i, \quad x_{ij}, \quad x^2$

Equations

Each equation should appear immediately after it is referenced in the text. To make it look distinct, it should be separated from the text (both preceding and following it) by a larger line spacing (compared to the one provided in the text) and should be set off from the left margin with an indentation.

All equations that are referred in the text of the thesis should be given equation numbers depending on the chapters where they appear and on the order of their appearance (same as for tables and figures). The equation numbers should be right justified and should be preceded by three raised ellipses.

It is a good practice to explain an equation in the text that precedes it, by defining the variables and their relationships that lead to the equation. An example follows:

> The number of students (z) in the class is given in eq. (4.2) as the sum of the number of male students (x) and the number of female students (y):
>
> $$z = x + y \qquad \cdots (4.2)$$

This equation is the second in order of appearance in Chapter 4.

A numbered equation should not appear in a line in the text. Thus the following is not correct:

> It thus comes out to be true that $x^2 + y = x + y^2 \qquad \cdots (4.3)$

Breaking Equations

Sometimes an equation could be so long that it does not fit in one line and needs one or more additional lines to be accommodated. Such an equation can be broken in either of the two ways:

- before a verb operator (such as =, ≠, <, >, ≤, ≥, δ, ε, η, □) or
- before a conjunction (such as +, !, ×, ə, ∀, 1, χ) that follows an aggregation (an aggregation is an expression within parentheses ( ), brackets [ ], or within curl brackets { }).

In the first case, the run-over lines are aligned on the verb operators. In the second case, the conjunction on the run-over line is lined up with the right of the verb in the line above.

Example:

$$\begin{aligned} z &= (x + y - ef + r) \\ &< 2y - ef + r \\ &\quad + e - f \end{aligned}$$

Notice that the symbol $<$ in the second line is vertically aligned with the symbol $=$ in the first line, and the plus sign in the third line is vertically aligned with the number 2 in the second line.

Heads and Texts for Definitions

Heads for definitions, theorems, propositions, corollaries, lemmas, assumptions, and rules are set in Roman capital and small capital, whereas the texts are in italic (except for numerals):

DEFINITION 1: *The graph . . .*

THEOREM 2:

LEMMA 4.5:

ASSUMPTION:

RULE:

Notice that the first letters of the heads are in bigger font compared to those of the succeeding letters.

Heads of proofs and solutions are in Roman capital and small capital, but the texts are in Roman, with only the variables in italic:

PROOF:

Let us assume that the variable x is . . .

Miscellaneous

When a mathematical expression forces one to create additional line spacing, write fractions and exponentiations as follows:

Examples: x/y and exp (xy)

Upper and lower limits should always be placed to the right of the integral sign, never above and below (e.g., $\int_a^b$).