

THE INSTITUTE OF COMMERCIAL MANAGEMENT

SUBJECT SYLLABUS



Number and Logic

Unit code: NL-0908

Level: Diploma

Credits: 20

Unit leader: PY

Pre-requisites:

Main Aims of the Unit:

This unit provides an overview of the numeric processes that computers perform and also some of the numerical methods that are commonly solved by computers. The conversion of values from one number system to another will be introduced and students will be able to perform arithmetic operations totally in both binary and in hexadecimal. Other approaches to handling numbers are also considered including iterative methods, number progressions and basic statistical methods.

Main Topics of Study:

A Number systems

1. Definition of a general number system. The common rules of decimal, binary, octal and hexadecimal. From these, formulate the general rules for a number system with base N.
2. Definition of bit, byte, character, word as basic storage units.
3. Methods to convert between decimal, binary, octal and hexadecimal integers.
4. Methods to convert between decimal, binary, octal and hexadecimal fractions.
5. The special relationship between binary and octal and hexadecimal.

B Arithmetic operations

1. Addition, subtraction, multiplication and division performed TOTALLY within with binary, octal or hexadecimal systems.
2. Given that 10 is approximately 2 to the power $3 \frac{1}{3}$, work out how many binary places are equivalent to a given number of decimal places.

C Use of memory

1. Representing binary numbers in bytes and words. Normally only 8 or 16 bit-words will be used in numeric questions to reduce the working.
2. 2's complement method of holding negative numbers. The ACTUAL NUMERIC VALUE of the sign bit in a 2's complement number.
3. Representing fractional values in memory. Floating point numbers. Normalisation of floating point numbers. Determine how a decimal number would be held in binary in float point form including negative numbers. Determine the decimal value of a floating-point binary number.
4. Fixed point representation of mixed integer and fractional numbers – normally the mid-point will be the implied binary point.
5. How memory holds non-numeric data. ASCII. Binary Coded Decimal. Methods of holding variable length string data.
6. Format of an instruction in a binary word. A simplified form is normally tested which includes (i) operation code, (ii) register number and (iii) single address.

D Matrix notation

1. How a 2-D matrix is held in 1-D memory.
2. Basic rules for adding, subtraction and multiplying matrices.
3. Develop an algorithm for adding, subtracting or multiplying two matrices.
4. Determine the inverse of a 2x2 or 3x3 matrix.
5. Matrix method of solving simultaneous equations.

E Iterative methods

1. Iteration as the idea of “homing-in” to provide an accurate answer as required. Understand how far to go to determine an answer to the required number of figures/decimal places.
2. Understand that an iterative equation could converge to an answer or diverge away from it. Means of determining whether a particular iterative equation will converge for a given problem. e.g. An equation may have two solutions (near $x=2$ and $x=4$). To solve for the solution near $x=2$, one particular iterative equation might converge near $x=2$ but another might diverge or home in on the solution near $x=4$.
3. Practical applications of iteration such as:
 - i Newton-Raphson method to determine the square root of a number.
 - ii Determine the reciprocal of a number ($1/N$).
 - iii Solve an equation up to degree four by an iterative method.
 - iv Solve simultaneous equations by an iterative method.

F Other Numerical methods

1. Graphical method of finding the “best fit” (linear programming). Determine inequalities in a linear programming problem. Plot suitable lines graphically to represent the built-in restrictions. Plot a suitable line to maximise or minimise (e.g. minimum costs or maximum profit). Alternatively, candidates can use the Simplex method to solve a problem.
2. Venn diagrams. Application to real problems.
3. Apply a given process to determine the best fit. The method will be defined on the examination papers. e.g. best route to take between different points.

G Financial

1. Arithmetic and geometric series. Determine the n^{th} term and sum of n terms for each.
2. Application to financial situations – discount and depreciation. Inflation.
3. Interest – simple and compound.
4. Economic order quantity (EOQ).

H Statistics

1. Averages – definitions of Mean, Median, Mode, Range, Inter-quartile range, frequency.
2. Calculation of averages for a set of numbers including data held in a frequency table. Determine the best average to use in a given situation.
3. Calculation of averages for tabular data with class intervals.
4. Dispersion. Standard deviation. Skewness. Normal distribution. Correlation treated non-numerically.
5. Probability. Definition. Simple problems involving:
 - i Mutually exclusive events – the probability of either occurring.
 - ii Independent events. Probability of both occurring.
 - iii Conditional probability– probability of x given y has occurred = $P(x|y)$. Bayes theorem.
6. Expected value.
7. Permutations and combinations. Simple problems.

Learning Outcomes for the Unit:

At the end of this Unit, students will be able to:

1. Handle binary and other number systems related to computer usage
2. Describe how data is held in memory
3. Use iterative approaches to solve simple mathematical problems
4. Solve problems using techniques such as linear programming and Venn diagrams
5. Use basic statistics in the description and analysis of data

The numbers below show which of the above module learning outcomes are related to particular cognitive and key skills:

Knowledge & Understanding 1-5
Analysis 3, 4
Synthesis/Creativity -
Evaluation 4
Interactive & group Skills -
Self-appraisal/Reflection on Practice -
Planning and Management of Learning -
Problem Solving 3, 4, 5
Communication & Presentation 5
Other skills (please specify) -

Learning and teaching methods/strategies used to enable the achievement of learning outcomes:

Learning takes place on a number of levels through lectures, class discussion including problem review and analysis. Formal lectures provide a foundation of information on which the student builds through directed learning and self managed learning outside of the class. The students are actively encouraged to form study groups to discuss course material which fosters a greater depth learning experience.

Assessment methods weightings which enable students to demonstrate the learning outcomes of the Unit:

3 hour examination: 100%
(Answer 5 questions from 8, each question worth 20% of the marks)

Indicative Reading for this Unit:

Main text

Refer to the ICM website for learning materials

Alternative Texts & Further Reading:

Quantitative Techniques by T.Lucey (Thomson)
ISBN 1844801063 (Sixth Edition)

Computer Science for Advanced Level by R Bradley (Stanley Thornes)
ISBN 0 7487 4046 5 (Fourth edition).

Guideline for Teaching and Learning Time (10 hours per credit)

Lectures / Seminars / Tutorials / Workshops: 50 hours
Tutorial support includes feedback on assignments and may vary by college according to local needs and wishes.

Directed learning: 50 hours
Advance reading and preparation / Class preparation / Background reading / Group study / Portfolio / Diary etc

Self managed learning: 100 hours
Working through the course text and completing assignments as required will take up the bulk of the learning time. In addition students are expected to engage with the tutor and other students and to undertake further reading using the web and/or libraries.

Guidelines

- This syllabus is designed to provide a test of the numeric processes that computers perform and also test some of the numerical methods that are commonly solved by computers. It has been extensively revised from the former Computer Arithmetic and Logic module.
- Note that Boolean algebra has been moved to the Hardware and Operating System module to include technical aspects of logic circuits.
- Candidates should have had much practice in converting between number systems using a variety of different methods. In particular it is important that a FAST EFFICIENT METHOD can be chosen.
- Candidates must be able to perform arithmetic operations totally in both binary and in hexadecimal. Too many answers in the past have converted binary to decimal, performed decimal arithmetic and then converted back. Apart from the extra time this takes in the examination, the additional work inevitably produces more mistakes.
- Much time will be saved if candidates actually know, for instance, that the sign bit in a twos-complement has a particular negative value. Also, multiplying and dividing by powers of 2 is effectively the same process as in decimal where additional noughts or movement of the decimal point is all that is needed for powers of ten. Many past answers, normally wrong, have taken a page of calculations to divide a binary number by decimal 4 when in fact the answer can be written down in a few seconds by shifting the digits to places.
- Candidates must ensure that when questions particularly relate to numbers held in memory, (the word size will be given) that the answer shows ALL the bits including leading zeroes as it would be held in that memory. This is particular relevant where negative numbers are being held in twos-complement format.
- Candidates are only expected to be able to solve simple problems in statistics. Tutors should explain the meanings of the results of a statistical calculation.