Unit 4.System Development

Introduction

A system is a group of things, components, elements or parts working together as a single entity to achieve some specific objective(s), for example, a computer and an organisation.
A system therefore identifies with the following:
a) Must fulfill a pre-determined objective(s).
b) Has two or more components present in it.
c) The system components are interlinked, interrelated and interdependent.

Description of a system

i) **Hard systems:** Those whose goals and objectives are clearly defined and are predictable. One can tell the outcome when given the inputs; for example Point of Sale (POS) in retail outlets.
ii) Soft systems: Those whose behaviour and objectives cannot be clearly defined as they are unpredictable, fluid and keep on changing; for example stock exchange, political system among others.

Characteristics of a system

a) Inputs and outputs: Inputs are the raw materials entered for processing while outputs are the end result of processing that have value to its users and exit the system.
b) Process: The actual transformation of input (data) into output (information).
c) Control: Is a decision-making component, governing input, output and the actual processing thus making a system to change or adapt as per the environment variation.
d) Boundary and environment: Boundary is the dividing line between the system and its environment, where the system is located and operates from, while environment is any entity outside the boundary which the system interacts with, for example, customers.
e) Purpose: Is the task or objective to be achieved by the system developed.
f) Subsystems: The parts or elements or units which make the whole larger system.
g) Holistic thinking: The whole system is seen to be more than the sum of individual parts that make the system.
h) Open and closed systems: Open systems interact with their environment and either inputs or outputs move freely within the boundary. Closed systems do not receive inputs from the environment nor send outputs and vice versa.
i) Entropy: A state of decay in a system meaning all systems get obsolete and useless after some period of time possibly because of change in technology.

Information system (IS)

An information system is a set of interrelated components that collect, manipulate, process and transform data into information and provide feedback to meet specified objectives. For example, Inventory Control Information System, Student Management Information System and Payroll System among others.

Reasons for new and computerised information systems

• New opportunities, for example, exploiting the use of mobile banking to assist customers in transactions.
• Problems such as constant errors and high failure rates.
• Directives from the management or government policies.

The above reasons are supported because of:

• Complaints from the customers, for example, long queues in a banking hall.
• Decline in the profit levels.
• Government policies such as the introduction of the National Integrated Identity Management System (NIIMS) - Huduma Number.
• Slow processing and being unable to beat deadlines, for example, a secretary using a type writer instead of computerised word processor.
• High cost of maintenance.
• System vulnerability to threats and security issues.
• Fierce competition in the market.

Purpose and Components of an information system

• Process data in an organisation.
• Improving decision making process by providing timely information.
• Means of communication and flow of information.
• Improving quality of production through feedback mechanism.

Components of of an information system

• **Data**- The raw facts which can be converted to information.
• **People or personnel** - systems analysts, programmer, network managers among others who interact with the system.
• **Hardware** – The tangible parts of a computer for example printers, storage media among others.
• **Software** – Programs or commands governing hardware operations.
• **Procedures** – Documented manuals acting as a guide.
• **Computer networks** - An interconnection of computers for the purpose of sharing devices and data.

System analyst as an agent of change

A computer specialist, who translates user problems, needs and requirements to produce information system requirements.

Functions of a system analyst

• Acts as a liaison between the information systems department and the rest of the organisation.
• An agent of change during system development since he advises when there is need for change.
• Designs the proposed system and oversees construction.
• Implements and trains the end users.

Project management

It is the process of defining, planning, directing, monitoring, and controlling the development of an acceptable system at a minimum cost within a specified time frame.

Theories of system development

There are three main theories or methods used in system development.

a) **Traditional approach**: Relies heavily on the skills and experience of the expertise within the project team. There is no formal documentation of work done.

b) **Rapid Application Development (RAD)**: The project team relies on information technology tools like computers and powerful software, to develop systems using small but specialised teams but developing them faster. RAD is made possible because of the following tools:

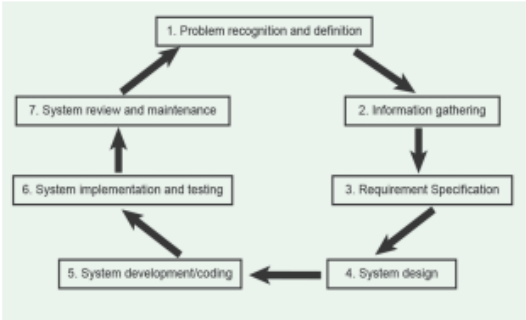
- Prototyping.
- Small teams with advanced tools (SWAT).
- Joint application development (JAD).
- Fourth generation languages (4GLS).

c) **Structured approach**: Project team identifies all the stages, after which, each stage is tackled on its own and documented accordingly, by the system analyst. This gives a breakdown that is easy to follow

Stages of system development

System development: It is a process that involves chronologically studying the entire activity of the current information system, detailing the physical layout and evaluating the activities based on the objectives, in order to determine the procedures of attaining them. The activities that comprise systems development are encompassed in the term systems analysis and design.

Stages of system development



a) Problem recognition and definition

What are the problems with the current information system in use? Naturally one must know, recognise and understand the problem before it can be solved.
The problems originate from:
i) Environment: The environment may take the form of a key change in government policy, pressure from vendors, customers, competitors, trade unions, labour laws, among others.
ii) Within the organisation: Employees, executive, shareholders, system analyst among others.
Problem definition: Examining whatever current information system in use is, any existing problems in the current system and suggesting some possible plans as alternatives to the present system. The request for a new system usually triggers off the feasibility study, a study to determine if the project should be carried out or not.
Types of feasibility
• **Technical feasibility**: This is the study to determine software, hardware, and the personnel to develop, purchase or install, operate the system and whether the technology in use can support it.
• **Economic feasibility**: Is a measure of the cost-effectiveness of a project or solution.
• **Legal feasibility**: Are there conflicts between the system under study and the organisation's ability to discharge legal duties
. • **Operational feasibility:** Will the system perform as required within the organisational environment with the current personnel and existing procedures. How do the end-users and management feel about the problem (solution)? Are they happy?
• **Social feasibility**: Concerned with the effect on employees and customers at the introduction of the new system. Will it result in redundancies, retraining or relocation of the workforce? Will the jobs be deskilling?
• **Schedule feasibility:** This is concerned with trying to find if the project can be completed on time without any constraints

b) Information gathering

The report is submitted to the management for approval after which a detailed survey is conducted on the existing system mostly to establish weaknesses and strengths of the system.
What to evaluate in order to justify the replacement
• When the volume of input and output is low, and inefficiencies in handling data.
• Poor methods of file maintenance and updating.
• What equipment are used and failure rates.
• The accuracy checks performed during processing.
• Time limitations, if any during processing and speed.
• The cost of the present system if it is viable.
• Redundant operations or duplications.
• Inefficiencies in data handling.

Information gathering techniques

i) **Observation:** This may take the form of inspection or visits to the area or department under study. The analyst is required to actually witness an operation and consequently draw the relevant conclusion about it.

Advantages of observation:

• Data gathered is highly reliable.

• The analyst can see what is being done clearly including the tasks which are difficult to explain clearly in writing or in words.

• Inaccuracy or inaccurately described tasks can easily be identified.

• It allows the analyst to easily compare gathered facts through other methods and what actually happened on the ground.

• Relatively cheap compared to other methods.

Disadvantages of observation:

• People feel uncomfortable when being observed and behave abnormally thus influence the analyst's conclusions.

• The exercise may take place at odd times thus inconveniencing those involved.

• The analyst may observe exceptional activities, leaving some critical areas. His patience and expertise play a great role.

• The tasks being observed may be interrupted and the analyst may gather wrong facts.

• Cannot be used when there are possibilities of risks.

• Expensive when visiting remote and distant areas.

ii) Interview

This is a live one to one activity between the system analyst (the interviewer) and users (interviewees) for the purpose of extracting facts without upsetting the other party.

Advantages of interview:

• The analyst can frame questions differently to individuals depending on their level of understanding.

• The analyst can observe non-verbal communication from the interviewees.

• The response rate tends to be high.

• Provides immediate response.

• The analyst can get detailed facts from each respondent.

Disadvantages of interview:

• Costly and time consuming when used on a large number of people.

• Success highly depends on the analyst human relation skills, expertise and experience.

• May not be practical due to location of respondent.

• May make the respondents to feel that they are being summoned or grilled by analyst.

iii) Record inspection or document review

This method involves perusing through literature or documents to gain a better understanding about the existing system. Examples of documents that are perused include sales orders, job descriptions, existing systems documentation, management reports, procedure manuals, organised structure charts, trade journals among others. This method is best used when:

- The analyst needs to have a quick overview of the existing system.
- The information required cannot be obtained through any other techniques.

Advantages of this method are:

- It is comparatively cheap compared to other techniques.
- It is a faster method of fact finding especially when documents to be considered are few.

Disadvantages of this method are:

- Time consuming if the documents are many or if they are not within the same locality.
- Unavailability of relevant documents makes this method unreliable.
- Its success depends on the expertise of the analyst.
- Most of the documents or information obtained may be out-dated.

iv) Questionnaire

It is a list of prepared questions in a document from the system analysts to the respondents for the purpose of collecting facts from them.

Advantages of questionnaires

- They provide cheap means of gathering information or data from a large number of people.
- They encourage individuals to provide response without fear, intimidation or victimisation.
- The respondents can complete the questionnaire at their own convenience with minimal or limited interruption of their work.
- Questions are presented consistently to all without bias.

Disadvantages of questionnaires

- Response is often too slow since the respondents complete and return the form at their own convenience.
- They do not provide an opportunity for respondents to obtain clarification of questions which may appear vague or ambiguous.
- Does not provide an opportunity for the analyst to observe respondents' reactions.
- The design of the questionnaire requires an expert who may charge expensively.
- All forms may not be returned and also not all questions may be answered which leads to incomplete data for analysis.

v) Automated data capture

It makes use of electronic devices at the source areas with less intervention of users, for example, digital cameras recording traffic along the highway.

NB: A fact finding report is produced which must tackle:

- Title of the report.
- Table of contents (ToC).
- Statement of the problem.
- Summary of findings.
- Details of findings.
- Recommendation and conclusions.

c) Requirement specification

It involves the system analyst determining user Requirements; for example, task performed, output expected, proposed system development cycle and user goals. This is the systems analysis.

The importance of system analysis

- It helps the analyst or system developer to gain understanding of the existing system.
- It allows the analyst or system developer to record existing system information in a standard form to aid design of a new system.
- It also facilitates understanding of the system by the user staff.
- Enables the analyst or developer to define existing system procedure into a logical model.
- Helps the analyst to write or produce statement of requirements, which guides the development team throughout subsequent stages of the development life cycle.

Requirements specifications include:

i) **Output specification:** What emerges from the computer system for the user to act upon after processing whether hard or softcopy, for example, printouts, screen display, microfilm and speech output. It checks on the following output features.

- Type of output; hard or softcopy.
- Response time required.
- Content
- Volume statistics
- Format
- Sequence
- Location required
- Frequency; daily, weekly among others.

ii) **Input specification**: What goes into the computer for processing and may include:

- What data and how they are captured.
- The frequency of input and its timing.
- The necessary contents of each record.
- The medium and device to be used for a particular piece of input.
- Input forms to be used for accuracy purposes.
- Costs

iii) **Files**

After the relevant output and input specifications have been completed, the next step is to decide how the data is to be structured and stored on backing storage devices.

iv) **Hardware and software requirements**

Hardware requirements

The decision of hardware choice must consider many factors:

- **Future needs** - Can the equipment be upgraded?
- **Availability** -Is it only available overseas?
- **Capacity**-For example, is the hard disk big enough to hold all your data? Is it fast enough?
- **Reliability** - Can it be depended on?
- **Cost** - Initial costs, running costs, upgrade costs, repair costs and training costs.
- **Compatibility** - With your other equipment, and that of your partners and clients.
- **Warranty and support** - In case of failure or problems.
- **Ease of use and installation.**
- **Compliance with local conditions** - For example,power supplies must be 240V or compliant with telecommunication systems.

Software requirements

Factors influencing the choice of software include:

• **User requirement**s: The selected software or package should fit user requirements as closely as possible.

• **Processing time:** This involves the response time. For example, if it is slow, the user might consider the software or package as unsuccessful.

• **Documentation:** The software should be accompanied by manual, which is easy to understand by non-technical person. The manual should not contain technical jargon.

• **User friendliness:** The package should be easier to use with clear on-screen prompts, menu driven and extensive on-screen help facility.

• **Controls:** The software should have in-built controls which may include password options, validation checks, audit trails or trace facilities among others.

• **Up-to-date:** The software should be up-to-date; for example it should have changes or corrections in line with business procedures.

• **Modification**: One should consider whether the user could freely change the software without violating copyright.

• **Success in the market:** One should consider how many users are using the software and how long it has been in the market.

• **Compatibility of the software**: How the software integrates with other software; particularly the operating system and the user programs.

• **Portability:** One should consider how the software runs on the user computer and whether there will be need for the user to upgrade his hardware.

• **Cost:** The user company should consider its financial position to establish whether it can afford the software required for efficient operations rather than the least cost package software available.

d) System design

This entails the activities of transforming the requirement specifications into a logical view of the system that focuses on computer based solutions. Design is divided in broad categories namely:

i) Logical design.

ii) What data is captured, processed and output.

iii) Physical design.

iv) How data is captured, processed and output.

System design objectives

The designed system should meet the following criteria:

- User needs should be met at an affordable cost.
- One that is within the constraints laid down in the terms of reference.
- Produce correct outputs by processing data accurately and efficiently.
- Simple to operate or easy to use.
- One with sufficient built-in controls and provide feedback to its user.
- Should be reliable.
- Should be functional.

Design tools

System design uses several tools to assist designers in coming up with comprehensive and well worked out plans to successfully develop the required system.

Design tools include:

- Ststem flow charts
- Data Flow Diagrams (DFDs).
- Prototypes.
- Computer Aided Software engineering tools.

System flow charts

A system flowchart is a diagram which gives an overall view of a data processing system. It shows the following:

- The tasks carried out within a system, either by manual means or by the computer.
- The devices and media used to hold the files which enter and are output from the system.
- The following design questions should be borne in mind

i) The nature of the system.

ii) Frequency of output.

iii) The hit rate on the master file.

iv) File organisation.

v) File medium.

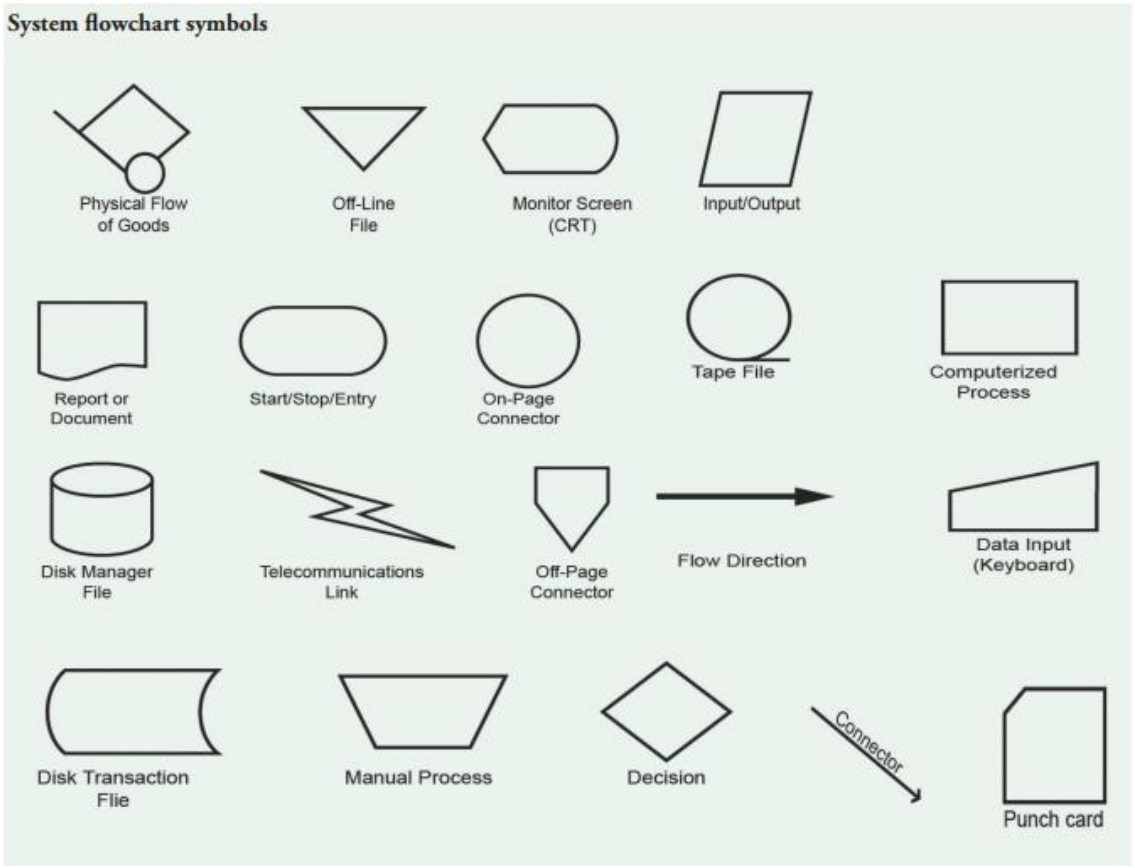
vi) Frequency of input.

Advantages of flowcharts

- Easier to understand.
- Can be easy to code from if properly constructed.
- Presents a clear picture of the activities to be performed.
- Identifies problem areas and opportunities for process improvement.
- Provides a way of training employees' relationships.
- It serves as documentation.

Disadvantages of flowcharts

- Time consuming.
- Space consuming.
- Requires template or special software.



e) System construction(coding)

This involves programming, testing, documenting and installation of the software. This activity involves translation of system specification into program code. A programmer should carry out the following roles during development:

- Writing the logical steps which have been established onto coding sheets.
- Construction of a source program from the design.
- Loading and compiling of the source program.
- Program testing for errors and debugging the errors.
- Integrating each fully tested application program into the system as a whole.
- System maintenance. Note: Appropriate programming language is used during coding.

Computer program errors

- **Syntax errors**: Misuse of the set rules and conventions in a programming language. They are also called grammatical errors. They are detected by translators.
- **Run-time errors:** Errors that stop the program from running making it to crush the process of translation; for example, use of wrong data type or dividing a number by zero.
- **Logical errors:** They do not stop the program from running; however they make the computer to give a wrong output. Trapping them is very hard and this is managed through a test data for example IF marks > 80% THEN Grade is "Fail".

f) System implementation and testing

It involves the practical work of putting the newly developed system into use. During implementation the following tasks are carried out:

- Acquisition and installation of hardware and software.
- Testing the system.
- Training the users.
- Documentation of the system.
- File conversion.
- System conversion or changeover.

In the systems implementation phase, the new information system is installed and people are trained to use it. There are four primary techniques to convert to a new system.

Types of conversion

a) Direct or straight approach

- Conversion is done by abandoning the old system and the new system takes effect immediately.
- It is less expensive and faster to implement.
- It is however a very risky way to do things and typically only used if it is the only alternative.
- It puts the company in a do or die situation since there is no reverting back.

b) Parallel approach

- The old and new systems are run side by side until the new one is proven to be reliable.
- It is a low risk approach to conversion and allows a company to compare returns from the two systems.
- It is however expensive to keep both systems running and it takes longer to implement.

c) Pilot approach

- The new system (whole) is implemented out, but only in one part (branch) of the organisation.
- Once it works smoothly in the pilot, it is rolled out to the rest of the remaining departments in the organisation.
- It is lower in cost than the parallel approach, but has more risk (especially for the pilot part of the organisation).

d) Phased approach

- The new system is implemented gradually in stages, in piece meal for a period of time, but in all departments.
- The entire process is broken down into steps, and once the first step works, the next is added.
- It is an expensive scheme, but low risk.
- In general, the pilot and phased approaches are preferred for their balance of cost and risk.
- Pilot works best when many different people do similar tasks in different locations.
- Phased approach works best when people are doing different operations

User training

It is important that the system users be trained to familiarise themselves with the hardware and the system before the actual changeover.

The aims of user training are:

- To reduce errors arising from learning through trial and error.
- To make the system to be more acceptable to the users.
- To improve security by reducing accidental destruction of data.
- To improve quality of operation and services to the users.
- To reduce the cost of maintenance by minimising accidental destruction of data or hardware.
- To ensure efficiency in system operation when it goes live.

g) System maintenance and review

i) **System maintenance**

The process of modifying and adjusting an information system to meet changing needs and make it adaptive is known as system maintenance.

Types of maintenance

- **Adaptive maintenance:** All systems will need to adjust to changing needs within the company.
- **Corrective maintenance:** Fixing of bugs (errors/ problems) that show up during system use.
- **Emergency maintenance:** Directed towards solving system malfunctions. It is an urgent call requiring urgent attention.
- **Perfective maintenance:** Creates room for improvement, for example, database queries may be very slow and change in the program may be able to improve response time.
- **Routine maintenance:** Designed to keep the systems performance operational.

ii) **Post-implementation review**: The post-implementation review is a critical examination of the system for three to six months after it has been put into production. This waiting period allows several factors to stabilise: the resistance to change, the anxieties associated with change, and the learning curve. It also allows time for unanticipated problems to surface. The post-implementation review focuses on the following:

- A comparison of the system's actual performance versus the anticipated performance objectives.
- An assessment of each side of the system with respect to pre-set criteria.
- Mistakes made during system development.
- Unexpected benefits and problems.

Post-implementation activities

- Just like a new automobile will need some bolts tightened after a few hundred miles on the road, an information system will need some fine-tuning just after implementation.

System documentation

Documentation: This is the description of software in written form after its development also called a manual.
The importance of documentation include:
• It guides the development team at various stages of the development life cycle.
• Can be used as a system back up copy should something happen to its implementation.
• It aids or assists during system maintenance since it guides in identification of system modules to be changed.
• Effectively provides a check list of items to be covered during subsequent system audit and maintenance.
• Guides against loss of system understanding particularly when the author leaves the company or dies.
Documentation is generally classified into two major types:
• **User or operator documentation** is a complete description of the system from the users' point of view detailing how to use or operate the system. It also includes the major error messages likely to be encountered by the users.
• **System documentation** contains the details of system design, programs, their coding, system flow, data dictionary, process description, among others. This helps to understand the system and permit changes to be made in the existing system to satisfy new user needs.
Other types of documentation may include:

• **Program documentation**: Is a written report or manual which explains how the program was developed and instructions on how to use the program or manage the use of the program.
• **Technical or programmer oriented documentation or manual:** Is the written instructions on how the program was developed including the code and design.
• **User manual:** This is a manual provided for an end user to enable him or her use the program.
• **Reference guide**: Is used by someone who already knows how to use the program but needs to be reminded about a particular point. •**Quick reference guide:** This is a small sheet or card, which the user may keep handy for help with common tasks carried out with the program.

Contents of System Documentation Report

• Title
• Table of Contents (ToC)
• Introduction
• Problem definition
• Problem analysis
• System design
• System testing
• System implementation
• Recommendation and conclusion.

KCSE Sample Questions

1. Give **four** reasons why a firm may decide to computerise its operations. (4 marks) **(KCSE 2002).**
2. i) What is an information system? (1 mark)
ii) State two roles of an information system. (2 marks) **(KCSE 2012).**
3. A manager wishes to replace the current manual system with a computerised one. Describe three main areas that must be evaluated to justify the replacement. (6 marks) **(KCSE 2007).**
4. State **two** instances where observation is not a viable method of gathering information during system analysis stage. (2 marks) **(KCSE 2010).**
5. List the **three** areas that would be considered in the requirement specifications. (3 marks) **(KCSE 2012).**
6. Various considerations should be made during input design and output design. State two considerations for each case. (4 marks) **(KCSE 2010).**
i) Input design
ii) Output design
6. State **two** roles of a programmer in system development life cycle. (2 marks) **(KCSE 2012).**
7. State and explain **three** ways that can be followed to replace the current system. (6 marks) **(KCSE 2007).**
8. An organisation intends to replace an existing system by carrying out the process in stages.
a) Name this implementation strategy; (1 mark)
b) Give two reasons why the organisation is opting to use the implementation strategy in (a) above. (2 marks)
c) A manager wishes to replace the current manual system with a computerised one. Describe **three** main areas that must be evaluated to justify the replacement. (6 marks) **(KCSE 2016).**
9. State two instances where observation is not a viable method of gathering data during system analysis stage. (2 marks) **(KCSE 2016).**
10. The following are some of the phases in the systems development life cycle (SDLC): system analysis, system design, system implementation, system review and maintenance. State four activities that are carried out during the system implementation phase. (4 marks) **(KCSE 2010).**
11. a) Name four approaches that may be used to replace a computerised information system. (2 marks)
b) Which of the approaches named in (a) above is appropriate for critical systems? Explain. (2 marks) **(KCSE 2009).**

12. Briefly explain the purpose of the following types of program documentation: **(KCSE 2003)**
a) User manual: same as user documentation above
b) Reference guide c) Quick reference guide
13. State two types of documentation in program development and give the purpose of each. (4 marks) **(KCSE 2002).**