COMPUTER SCIENCE S6
TEACHER'S GUIDE

FOREWORD

Dear teacher,

Rwanda Basic Education Board is honoured to present Senior 6 Computer Science teacher`s guide which serves as a guide to competence-based teaching and learning to ensure consistency and coherence in the learning of the Computer Science subject. The Rwandan educational philosophy is to ensure that learners achieve full potential at every level of education which will prepare them to be well integrated in society and exploit employment opportunities.

In line with efforts to improve the quality of education, the government of Rwanda emphasizes the importance of aligning teaching and learning materials with the syllabus to facilitate their learning process. Many factors influence what they learn, how well they learn and the competences they acquire. Those factors include the relevance of the specific content, the quality of teachers' pedagogical approaches, the assessment strategies and the instructional materials available. We paid special attention to the activities that facilitate the learning process in which learners can develop ideas and make new discoveries during concrete activities carried out individually or with peers. With the help of the teachers, learners will gain appropriate skills and be able to apply what they have learnt in real life situations. Hence, they will be able to develop certain values and attitudes allowing them to make a difference not only to their own life but also to the nation.

This is in contrast to traditional learning theories which view learning mainly as a process of acquiring knowledge from the more knowledgeable who is mostly the teacher. In competence-based curriculum, learning is considered as a process of active building and developing of knowledge and understanding, skills and values and attitude by the learner where concepts are mainly introduced by an activity, situation or scenario that helps the learner to construct knowledge, develop skills and acquire positive attitudes and values.

In addition, such active learning engages learners in doing things and thinking about the things they are doing and they are encouraged to bring their own real experiences and knowledge into the learning processes. In view of this, your role is to:

- Plan your lessons and prepare appropriate teaching materials.

- Organize group discussions for learners considering the importance of social constructivism suggesting that learning occurs more effectively when the learner works collaboratively with more knowledgeable and experienced people.

- Engage learners through active learning methods such as inquiry methods, group discussions, research, investigative activities and group and individual work activities.

- Provide supervised opportunities for learners to develop different competences by giving tasks which enhance critical thinking, problem solving, research, creativity and innovation, communication and cooperation.

- Support and facilitate the learning process by valuing learners' contributions in the class activities.

- Guide learners towards the harmonization of their findings.

- Encourage individual, peer and group evaluation of the work done in the classroom and use appropriate competence-based assessment approaches and methods.

- To facilitate you in your teaching activities, the content of this teacher`s guide is self-explanatory so that you can easily use it. It is divided in 3 parts:

The part 1: Explains the structure of this book and gives you the methodological guidance;

The part 2: Gives the sample lesson plans as reference for your lesson planning process;

The part 3: Provides details the teaching guidance for each concept given in the student book.

Even though this teacher`s guide contains the answers for all activities given in the learner's book, you are requested to work through each question and activity before judging learner's findings.

I wish to sincerely appreciate all people who contributed towards the development of this teacher`s guide, particularly REB staff who organized the whole process from its inception. Special gratitude goes to the University of Rwanda which provided experts in design and layout services, illustrations and image anti-plagiarism, lecturers and teachers who diligently worked to successful completion of this book. Any comment or contribution would be welcome for the improvement of this textbook for the next edition.

Dr. MBARUSHIMANA Nelson

Director General, REB

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Joan Murungi,
Head of CTLR

Contents

PART A: GENERAL INTRODUCTION

A.o. About the teacher's guide

This book is a teacher's guide for computer science Senior six in advanced level. It is designed to accompany senior four student's book and intends to help teachers in the implementation of competence based curriculum specifically computer science syllabus.

As the name says, it is a guide that teachers can refer to when preparing their lessons. Teachers may prefer to adopt the guidance provided but they are also expected to be more creative and consider their specific classes' contexts and prepare accordingly.

The structure of the guide

This section presents the overall structure, the unit and sub-heading structure to help teachers to understand the different sections of this guide and what they will find in each section.

Overall structure

The whole guide has three main parts as follows:

- **Part I: General Introduction**.

    This part provides general guidance on how to develop the generic competences, how to integrate cross cutting issues, how to cater for learners with special educational needs, active methods and techniques of teaching computer science and guidance on assessment.

- **Part II: Sample lesson plan**

    This part provides a sample lesson plan, developed and designed to help the teacher develop their own lesson plans.

- **Part III: Unit development**

    This is the core part of the guide. Each unit is developed following the structure below. The guide ends with references.

Each unit is made of the following sections:

- **Unit title:** from the syllabus
- **Key unit competence:** from the syllabus
- **Prerequisites** (knowledge, skills, attitudes and values)

    This section indicates knowledge, skills and attitudes required for the success of the unit. The competence-based approach calls for connections between

units/topics within a subject and interconnections between different subjects. The teacher will find an indication of those prerequisites and guidance on how to establish connections.

– **Cross-cutting issues to be addressed**

This section suggests cross cutting issues that can be integrated depending on the unit content. It provides guidance on how to come up with the integration of the issue. Note that the issue indicated is a suggestion; teachers are free to take another cross-cutting issue taking into consideration the learning environment.

– **Guidance on the introductory activity**

Each unit starts with an introductory activity in the learner's book. This section of the teacher's guide provides guidance on how to conduct this activity and related answers. Note that learners may not be able to find the right solution but they are invited to predict possible solutions or answers. Solutions are provided by learners gradually through discovery activities organized at the beginning of lessons or during the lesson.

– **List of lessons/sub-heading**

This section presents in a table suggestion on the list of lessons, lesson objectives copied or adapted from the syllabus and duration for each lesson. Each lesson /subheading is then developed.

– **End of each unit**

At the end of each unit the teacher's guide provides the following sections:

- Summary of the unit which provides the key points of content developed in the student's book.

- Additional information which provides additional content compared to the student's book for the teacher to have a deeper understanding of the topic.

- End unit assessment which provides the answers to questions of end unit assessment in the textbook and suggests additional questions and related answers to assess the key unit competence.

- Additional activities: remedial, consolidation and extended activities). The purpose of these activities is to accommodate each learner (slow, average and gifted) based onend unit assessment results.

Structure of each sub heading

Each lesson/sub-heading is made of the following sections:

Lesson Sub heading title 1: ....

– **Prerequisites/Revision/Introduction:**

This section gives a clear instruction to teacher on how to start the lesson

– **Teaching resources**

This section suggests the teaching aids or other resources needed in line with the activities to achieve the learning objectives. Teachers are encouraged to replace the suggested teaching aids by the available ones in their respective schools and based on learning environment.

- **Learning activities**

This section provides a short description of the methodology and any important aspect to consider. It provides also answers to learning activities with cross reference to text book:

- **Exercises/application activities**

This provides questions and answers for exercises/ application activities/

A. 1. Methodological guidance

A.1.1.Developing competences

Since 2015 Rwanda shifted from a knowledge based to a competency based curriculum for pre-primary, primary and general secondary education. This called for changing the way of learning by shifting from teacher centered to a learner centered approach. Teachers are not only responsible for knowledge transfer but also for fostering student's learning achievement, and creating safe and supportive learning environment. It implies also that a learner has to demonstrate what he/she is able to do using the knowledge, skills, values and attitude acquired in a new or different or given situation.

The competence-based curriculum employs an approach of teaching and learning based on discrete skills rather than dwelling on only knowledge or the cognitive domain of learning. It focuses on what learner can do rather than what learners know. Learners develop basic competences through specific subject unit competences with specific learning objectives broken down into knowledge, skills and attitudes. These competences are developed through learning activities disseminated in learner-centered rather than the traditional didactic approach. The student is evaluated against set standards to achieve before moving on.

In addition to specific subject competences, learners also develop generic competences which are transferable throughout a range of learning areas and situations in life. Below are examples of how generic competences can be developed in Computer Science:

Generic competence	Examples of activities that develop generic competences
Critical thinking	Compare the protected computer to the computer exposed to various security threats
	Demonstrate advantage of a computer network, having a database in a school or an institution.

Research and Problem solving	Research using internet or books from the library
	Build a computer network by responding the initial request.
	Design and develop a database for his/her school or institution.
	Demonstrate strategies that can be used to disinfect the computer or network attacked by threats.
Innovation and creativity	Translate the algorithms in a computing program
	Identify local computing problems and ways to resolve them.
Cooperation, Personal and Interpersonal management and life skills	Sharing resources on the network, emails
	Protecting his/her own data and school or institution data to.
	Work in Pairs
	Small group work
	Large group work
Communication	Organise and present in writing and verbally a complete and clear report of their computing activities
	Develop accurate diagrams for networks topology, model
	Design with talking diagram a database of the school.
	Select and use appropriate formats and presentations, such as tables, graphs and diagrams.
Lifelong learning	Exploit all opportunities available to improve on knowledge and skills. Use open source technologies and other digital materials to keep informed.

Among the changes in the competence based curriculum is the integration of cross cutting issues as an integral part of the teaching learning process-as they relate to and must be considered within all subjects to be appropriately addressed. The eight cross cutting issues identified in the national curriculum framework are: genocide studies, environment and sustainability, gender, Comprehensive Sexuality Education (CSE), Peace and Values Education, Financial Education, standardization Culture and Inclusive Education.

Some cross cutting issues may seem specific to particular learning areas or subjects but the teacher need to address all of them whenever an opportunity arises. In addition, learners should always be given an opportunity during the learning process to address these cross cutting issues both within and out of the classroom so as to progressively develop related attitudes and values.

Below are examples on how crosscutting issues can be addressed in Computer Science:

Cross-cutting issue	Examples on how to integrate the cross-cutting issue
Inclusive education	Involve all learners in all activities without any bias. Eg: – allow a learner with physical disability (using wheelchair) to take notes or lead the team during computer lab activities. – Student without arms can learn computer science using their toes. – Sign language can be used to address the need of students with hearing impairments.
Gender	– Involve both girls and boys in all activities: No activity is reserved only to girls or boys. – Teachers should ensure equal participation of both girls and boys during computing activities as well as during cleaning and tidying up related activities after computer lab activities.
Peace and Values Education	– During group activities, debates and presentations, the teacher will encourage learners to help each other and to respect opinions of colleagues. – Students must be warned about cyber security crimes and enabled to prevent hacking and stealing one's data or prevent unauthorised access of data of a person or institution. – Student must develop values of browsing relevant content on the internet(students should not spend their time browsing irrelevant and harmful content website.
Standardization culture	– Students should be familiar with standards used in network technologies in their daily interaction with different tools used in networking. – For tasks involving calculations, they have to always present accurate results.
Financial Education	– Student should develop this by comparing the use of digital technologies with the traditional paper based practices. – Eg. Compare the cost of sharing a 100 pages document on the network of 50 users and printing 50 copies of 100 pages on individual copy. – Different technologies used in networking should be an opportunity to study cost implication of individual technology. – Students do analysis of financial benefits of having a database. – Students must be aware of loss that can be caused by lacking security in computing.

A.1.2.Attention to special educational needs specific to each subject

In classroom, students learn in different way depending to their learning pace, needs or any other special problem they might have. However, the teacher have the responsibility to know how to adopt his/her methodologies and approaches in order to meet the learning needs of each student in the classroom. Also teachers need to understand that student with special needs, have to be taught differently or need some accommodations to enhance the learning environment. This will be done depending to the subject and the nature of the lesson.

In order to create a well-rounded learning atmosphere, teachers need to:

- Remember that students learn in different ways so they have to offer a variety of activities (e.g. role-play, music and singing, word games and quizzes, and outdoor activities)

- Maintain an organized classroom and limits distraction. This will help students with special needs to stay on track during lesson and follow instruction easily.

- Vary the pace of teaching to meet the needs of each students. Some students process information and learn more slowly than others;

- Break down instructions into smaller, manageable tasks. Students with special needs often have difficulty understanding long-winded or several instructions at once. It is better to use simple, concrete sentences in order to facilitate them understand what you are asking;

- Use clear consistent language to explain the meaning (and demonstrate or show pictures) if you introduce new words or concepts;

- Make full use of facial expressions, gestures and body language;

- Pair a student who has a disability with a friend. Let them do things together and learn from each other. Make sure the friend is not over protective. Both students will benefit from this strategy;

- Use multi-sensory strategies. As all students learn in different ways, it is important to make every lesson as multi-sensory as possible. Learners with learning disabilities might have difficulty in one area, while they might excel in another. For example, use both visual and auditory cues.

Below are general strategies related to each main category of disabilities and how to deal with every situation that may arise in the classroom. However, the list is not exhaustive because each student is unique with different needs and that should be handled differently.

Strategy to help a learner with developmental impairment:

- Use simple words and sentences when giving instructions.

- Use real objects that students can feel and handle. Rather than just working abstractly with pen and paper.

- Break a task down into small steps or learning objectives. The student should start with an activity that s/he can do already before moving on to something that is more difficult.

- Gradually give the student less help.

- Let the student work in the same group with those without disability.

Strategy to help a student with visual impairment:

- Help students to use their other senses (hearing, touch, smell and taste) to play and carry out activities that will promote their learning and development.

- Use simple, clear and consistent language.

- Use tactile objects to help explain a concept.

- If the student has some sight, ask him/her what he/she can see.

- Make sure the student has a group of friends who are helpful and who allow him/her to be as independent as possible.

- Plan activities so that students work in pairs or groups whenever possible

Strategies to help a student with hearing disabilities or communication difficulties:

- Always get the student's attention before you begin to speak.

- Encourage the student to look at your face.

- Use gestures, body language and facial expressions.

- Use pictures and objects as much as possible.

- Keep background noise to a minimum.

Strategies to help a student with physical disabilities or mobility difficulties:

- Adapt activities so that students who use wheelchairs or other mobility aids, can participate.

- Ask parents/caregivers to assist with adapting furniture e.g. The height of a table may need to be changed to make it easier for a student to reach it or fit their legs or wheelchair under.

- Get advice from parents or a health professional about assistive devices.

A.1.3. Guidance on assessment

Each unit in the teacher's guide provides additional activities to help learners achieve the key unit competence. Results from assessment inform the teacher which learner needs remedial, consolidation or extension activities. These activities are designed to cater for the needs of all categories of learners; slow, average and gifted learners respectively.

Assessment is an integral part of teaching and learning process. The main purpose

of assessment is for improvement. Assessment for learning/ Continuous/ formative assessment intends to improve learners' learning and teacher's teaching whereas assessment of learning/summative assessment intends to improve the entire school's performance and education system in general.

Continuous/ formative assessment

It is an ongoing process that arises out of interaction during teaching and learning process. It includes lesson evaluation and end of sub unit assessment. This formative assessment should plays a big role in teaching and learning process. The teacher should encourage individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods.

In Senior six computer science textbook, formative assessment principle is applied through checking up activities that are planned in each lesson to ensure that lesson objectives are achieved before moving on. At the end of each unit, the end unit assessment is formative when it is done to give information on the progress of students and from there decide what adjustments need to be done. Assessment standards are taken into consideration when setting tasks.

Summative assessment

The assessment done at the end of the term, end of year, is considered as summative. The teacher, school and parents are informed on the achievement of educational objectives and think of improvement strategies. There is also end of level/ cycle assessment in form of national examinations.

A.1.5. Students' learning styles and strategies to conduct teaching and learning process

There are different teaching styles and techniques that should be catered for. The selection of teaching method should be done with the greatest care and some of the factors to be considered are: the uniqueness of subjects; the type of lessons; the particular learning objectives to be achieved; the allocated time to achieve the objective; instructional available materials; the physical/sitting arrangement of the classroom, individual students' needs, abilities and learning styles.

There are mainly four different learning styles as explained below:

a) Active and reflective learners

Active learnerstend to retain and understand information best by doing something active with it, discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.

b) Sensing and intuitive learners

Sensing learners tend to like learning facts; intuitive learners often prefer discovering possibilities and relationships. Sensors often like solving problems by well-established methods and dislike complications and surprises; intuitive learners like innovation and

dislike repetition.

c) Visual and verbal learners

Visual learners remember best what they see—pictures, diagrams, flow charts, time lines, films, demonstrations, etc.; verbal learners get more out of words—written and spoken explanations.

d) Sequential and global learners

Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it."

A.1.5. Teaching methods and techniques that promote the active learning

The different student learning styles mentioned above can be catered for, if the teacher uses active learning whereby learners are really engaged in the learning process.

What is Active learning?

Active learning is a pedagogical approach that engages students in doing things and thinking about the things they are doing. In active learning, learners are encouraged to bring their own experience and knowledge into the learning process.

The role of the teacher in active learning

- The teacher engages learners through active learning methods such as inquiry methods, group discussions, research, investigative activities and group and individual work activities.

- He/she encourages individual, peer and group evaluation of the work done in the classroom and uses appropriate competence-based assessment approaches and methods.

- He provides supervised opportunities for learners to develop different competences by giving tasks which enhance critical thinking, problem solving, research, creativity and innovation, communication and cooperation.

- Teacher supports and facilitates the learning process by valuing learners' contributions in the class activities.

The role of learners in active learning

Learners are key in the active learning process. They are not empty vessels to fill but people with ideas, capacity and skills to build on for effective learning. A learner engaged in active learning:

- Communicates and shares relevant information with other learners through presentations, discussions, group work and other learner-centred activities (role play, case studies, project work, research and investigation)

- Actively participates and takes responsibility for their own learning

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- Develops knowledge and skills in active ways
- Carries out research/investigation by consulting print/online documents and resourceful people, and presents their findings
- Ensures the effective contribution of each group member in assigned tasks through clear explanation and arguments, critical thinking, responsibility and confidence in public speaking
- Draws conclusions based on the findings from the learning activities.

Some active techniques that can be used in computer Science

The teaching methods strongly emphasised in the competence Based Curriculum (CBC) are active methods.

When a teacher is planning his/her lesson, he/she should establish criteria for performance and behaviour changes at the beginning of a unit. Then at the of end of every unit, the teacher should ensure that all the learners have mastered the stated key unit competences basing on the criteria stated, before going to the next unit. The teacher will assess how well each learner masters both the subject and the generic competences described in the syllabus and from this, the teacher will gain a picture of the all-round progress of the learner. The teacher will use one or a combination of the following: : a) Manipulation, (b)Computer and task/practice (c) observation, (d) pen and paper, and (e) oral questioning

A. Computing activities

Many of the activities suggested in the computer science curriculum as well as in the student's book are practical activities and projects.

Practical activities is mandatory in learning computer science; this method gives the learner the opportunity to implement a series of activities and leads to the development of both cognitive and hands-on skills.

A practical lesson is done in following stages:

Preparation: Checking materials, computers and install required programs to ensure they are available and at good state; try the activity before the lesson; think of safety rules and give instructions to lab technician if you have any.

- **Performance:** arrangement of students and hand-on of individual student. Preparing the next generation of experts in the field of computer science require student to experience what they are learning; Let the students perform and facilitate accordingly.
- **Debugging:** in computer Science student may not arrive at the desired output, inspire him/her to debug from his/her own work without starting from scratch where applicable.
- **Discussion:** student should discuss what they are doing and challenges they are facing. they should discuss also the implications of the results of their activities.

In some cases, demonstration by the teacher is recommended when for example the activity requires the use of sophisticated materials or very expensive materials or when safety is a major factor like disassembling a laptop in laboratory and it needs specific skills to be learnt first.

In case your school does not have enough computers, activities and projects can be done in groups but make sure every student participates.

B. Research work

Each learner or group of learners is given a research topic. They have to gather information from internet, available books in the library or ask experienced people and then the results are presented in verbal or written form and discussed in class.

C. Computer Based project

Computer science teachers are encouraged to sample and prepare project works and engage their students in, as many as possible. Learners in groups or individually, are engaged in a self-directed work for an extended period of time to investigate and respond to a complex question, problem, or challenge. The work can be presented to classmates or other people beyond the school. Projects are based on real-world problems that capture learners' interest. This technique develops higher order thinking as the learners acquire and apply new knowledge in a problem-solving context.

There are project proposed in different topic area programming, database and network that students must perform to show what they learnt can be put into real life situations.

D. Field trip

One of the main aims of teaching Computer science in Rwanda is to apply its knowledge for development. Students may visit an computer related work or equipments in an institution around the school to satisfy their inquiries and curiosity.

Main steps for a lesson in active learning approach

All the principles and characteristics of the active learning process highlighted above are reflected in steps of a lesson as displayed below. Generally the lesson is divided into three main parts whereby each one is divided into smaller steps to make sure that learners are involved in the learning process. Below are those main part and their small steps:

1) Introduction

Introduction is a part where the teacher makes connection between the current and previous lesson through appropriate technique. The teacher opens short discussions to encourage learners to think about the previous learning experience and connect it with the current instructional objective. The teacher reviews the prior knowledge, skills and attitudes which have a link with the new concepts to create good foundation and logical sequencings.

2) Development of the new lesson

The development of a lesson that introduces a new concept will go through the following small steps: discovery activities, presentation of learners' findings, exploitation, synthesis/summary and exercises/application activities, explained below:

- **Discovery activity**

Step 1

- − The teacher discusses convincingly with students to take responsibility of their learning
- − He/she distributes the task/activity and gives instructions related to the tasks (working in groups, pairs, or individual to instigate collaborative learning, to discover knowledge to be learned)

Step 2

- − The teacher let the students work collaboratively on the task.
- − During this period the teacher refrains to intervene directly on the knowledge
- − He/she then monitors how the students are progressing towards the knowledge to be learned and boost those who are still behind (but without communicating to them the knowledge).

- **Presentation of learners' productions**

  - − In this episode, the teacher invites representatives of groups to presents the students' productions/findings.
  - − After three/four or an acceptable number of presentations, the teacher decides to engage the class into exploitation of the students' productions.

- **Exploitation of learner's productions**

- − The teacher asks the students to evaluate the productions: which ones are correct, incomplete or false
- − Then the teacher judges the logic of the students' products, corrects those which are false, completes those which are incomplete, and confirms those which correct.

- **Institutionalization (summary/conclusion/ and examples)**

  - − The teacher summarises the learned knowledge and gives examples which illustrate the learned content.

- **Exercises/Application activities**

  - − Exercises of applying processes and products/objects related to learned unit/sub-unit
  - − Exercises in real life contexts
  - − Teacher guides learners to make the connection of what they learnt to real life

situations. At this level, the role of teacher is to monitor the fixation of process and product/object being learned.

3) Assessment

In this step the teacher asks some questions to assess achievement of instructional objective. During assessment activity, learners work individually on the task/activity. The teacher avoids intervening directly. In fact, results from this assessment inform the teacher on next steps for the whole class and individuals. In some cases the teacher can end with a homework assignment.

PART B: SAMPLE LESSON PLANS

The teacher's guide provides more than one lesson plan taking into consideration the type of lesson in the subject (E.g.: one per main topic/theme) using the CBC format.

School Name:..Teacher's name: ....……………

Term	Date	Subject	Class	Unit No	Lesson No	Duration	Class size
Term 1	21/02/ 2018	Computer Science	S6	1	1 of 9	80 minutes	30
Type of Special Educational Needs to be catered for in this lesson and number of learners in each category			1 learner with partial hearing impairment				
Unit title	COMPUTER SECURITY						
Key Unit Competence:	To be able to enumerate various security threats and ensure security of computer.						
Title of the lesson	Why computer security						
Instructional Objective	After observing a computer protected, students will be able to describe and list the importance of computer security						
Plan for this Class (location: in / outside)	This class will be held in computer lab and students will be organize in small groups						
Learning Materials (for ALL learners)	computers						
References	Internet and textbooks to facilitate research						

Timing for each step	Description of teaching and learning activity		Generic competences and cross cutting issues to be addressed + a short explanation
	Questions and answers technique is used to facilitate students, group activities and presentation of findings is used for learners to describe the importance of computer security.		
	Teacher activities	Learner activities	
Introduction

15 Minutes | *Teachers facilitates students to visit the school computer lab.

*Students observe how computer are protected.

 * The teacher helps learners to discover the topic of the lesson | Learners will respond to the asked questions by giving different ways of securing computer system | Communication

Cooperation

Interpersonal management

Gender through mixing boys and girls to do activity

Inclusive education, by encouraging students to speak loudly so that the one with hearing impairment can hear what have been said. |

Development of the lesson (Harmonization and summary) 50 minutes (task 1: 20 minutes , task 2: 20 minutes, task 3:10 minutes)	Form groups of two learners on 1 computer The teacher monitors the group work keeps focus on learner with understanding the importance of securing computer and data protection The teacher asks learners to present their findings and give additional comments to the learners 'work	* In groups, learners observe and discuss on how computers are secured *Learners ask questions for clarification while discussing in groups *Learners present their findings	Communication through presentations and discussing in groups. Cooperation when working together in groups Cross cutting issues: Gender ,peace and value education and inclusive education Inclusive education: during group work encourage peers to speak loudly and if possible use total communication to help the one with hearing impairment to participate in the group.
Conclusion: (Assessment) 15 minutes	The teacher concludes the lesson by asking questions to the learners, to know the achievement of the objective	Learners write individually on a sheet of a paper three importance of securing a computer. Importance of computer security is: …….	Critical thinking and interpersonal cooperation
Teacher self-evaluation	To be completed by the teacher after the lesson		

UNIT 1: COMPUTER SECURITY

1

1.1 Key unit competence:

To be able to enumerate various security threats and ensure security of computer.

1.2. Prerequisite knowledge and skills:

Students should have some knowledge and skills related to computer hardware and computer software installation in.

1.3. Cross-cutting issues to be addressed:

- **Financial Education:** To be covered when the students cost implication in using different computer storage devices and software anti-virus
- **Standardization Culture:** Students must be familiar with anti-virus installation and other measures computer security.
- **Gender education:** Mixing boys and girls in groups when they do practice activity
- **Peace and Values Education:** Students must be aware of using computer without permission. They must also not steal computer and its different components. They must be aware of any computer damage and attack.

1.4 Guidance on the introductory activity

Instruction to do the introductory activity

- This activity takes place in the computer lab where each student must log into a computer where it is possible. Teacher instructs students to go to page where figure 1.1 is in textbook.
- The teacher asks students to do the introductory activity in their respective groups.
- The teacher lets the students work independently on the activity.
- The teacher moves around to see how students are working.
- The teacher may ask some questions to boost the students.
- Guide students to list the risks of not securing a computer
- Guide students to list all possible ways that make data protected

Here are five simple ways to protect data in computer:

- Install Firewall.

- − Install Antivirus Software.

- − Install Anti-Spyware Software.

- − Use Complex and Secure Passwords.

- − Check on the Security Settings of the Browser.

The teacher tells the students that in the coming lessons they will have complete answers.

1.5. List of lessons (including assessment)

#	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes):	Number of periods
1	WHY COMPUTER SECURITY	• Describe various security mechanism and tools	2
2	COMPUTER THREATS	• Describe physical and logical security	2
3	COMPUTER ATTACK	• Describe various kinds of attacks and security threats • Identify and distinguish among various security threats such as virus, spyware, shoulder surfing, denial of service attack, eavesdropping, social engineering	2
4	SOURCE OF VIRUS AND OTHER ATTACKS	• Show concern on computer threats prevention and develop awareness on hardware and software security	2
5	DAMAGE CAUSED BY THREATS	• Show concern on computer threats prevention and develop awareness on hardware and software security	2
6	THREATS PROTECTION AND PRECAUTION	• Describe various security mechanisms and tools • Apply computer security mechanisms against computer threats and configure them properly	2

LESSON 1: WHY COMPUTER SECURITY

(2 Periods: 80 minutes)

a) Prerequisites/Revision/Introduction:

Learning activity 1.1 is used to introduce the lesson. Students visit the school computer lab and observe how computers are arranged and protected. The teacher asks students to take notes of what they observed and to reply the questions in the activity. By using technical explanations teacher helps students to understand the importance of computer security.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students in pairs in order to do learning activity.
- Learners observe computers in computer lab. They find that some computers are damaged by humidity and other computers are mal arranged.
- Teacher walks around and sees if students are doing activity.
- Students share their answers in presentation.
- Students react on the finding answers from others
- Teacher corrects false answers and completes the incomplete answers
- Teacher summarizes the contents (Note in students book)
- Teacher gives the instructions on how to do Application activity 1.1
- Students do Application activity 1.1

Answers of activity 1.1

1. In the computer lab, some computers are secured with password other are not.

2. Simple measures can be taken are following: installing anti-virus in all computers

   Protect all computers with password

d) Answers of application activity 1.1

1. Computer security refers to techniques developed to safeguard information and systems stored on computers.

2. Computer security is important in the following ways:

   - Computer security helps to keep safely data and equipment functioning and provide access only to appropriate people.

- Computer security is important, because of keeping information protected. It's also important for the computer's overall health, helping to prevent viruses and malware and helping programs run more smoothly.
- Computer and data stored can be protected from potential outside problems.
- Computer security is important for helping programs to run more smoothly
- Computer security is important for preventing theft of data, software, services and equipment

3. A group of people hacked the website of university of Kibungo.
    - In one bank, unknown people stole the identity of customer bank and get the money without permission.

LESSON 2: COMPUTER THREATS

2 periods: 80minutes

a) Prerequisites/Revision/Introduction:

Learning activity 1.2 is used to introduce the lesson. Let students connect the external hard disk to a broken computer system case. By using technical explanations teacher helps students to understand computer threats and the difference between them.

b) Teaching resources:

- Computer lab and external hard disk
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students in pairs in order to do learning activity
- Learners observe computers in computer lab. They find that some computer case are broken
- Students in pairs, discuss the reasons of mal functioning of the computer
- Teacher walks around and sees if students are doing activity
- Students share their answers in presentation
- Students react on the finding answers from others
- Teacher corrects false answers and completes the incomplete answers
- Teacher summarizes the contents (Note in students book)
- Teacher gives the instructions on how to do Application activity 1.2
- Students do Application activity 1.2

    ### Answers of activity 1.2

1. That computer is not functioning correctly because some ports have been

damaged. For example a port where a hard disk is connected

2. The solution can to take is to take care of physical parts of computers

3. No. It is a work for both.

d) Answers of application activity 1.2

1. **Answer:** Physical threats are digital storage media and hardware that can damage or destroy the computer system. Example: *Humidity, water*

   While logical threats areevents or attacks that remove, corrupt, deny access, or steal information. Example: *viruses and spyware*

2. Hardware failure is a malfunction within the electronic circuits or electromechanical components (disks, tapes) of a computer system while software failure is the inability of a program to continue processing due to erroneous.

3. A computer user can cause the errors to information system by using the wrong information.

4. If RAM is removed inside the computer case, the computer will do not work properly

5. In the computer lab:
   – The computers are not covered, and they can be damaged by dirty.
   – The computers are not protected the electrical problem by UPS(Uninterruptible power supply)
   – Some computers are infected by virus

LESSON 3: COMPUTER ATTACKS

2periods: 80minutes

a) Prerequisites/Revision/Introduction:

Learning activity 1.3 introduces the lesson. Teacher ask students what they have learnt in previous lessons 1 and 2. From answers given by students, teacher introduce the activity, the objective of the activity is to help the students to understand different computer attacks.

b) Teaching resources:

- Computer lab and flash disk
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher asks students to form groups and to do the Learning Activity 1.3
- Students elect the group leader who connect a flash disk to the computer and other group members help him to do the activity

- The teacher lets the students work independently on the activity.
- Teacher walks around and sees if students are doing activity in their respective group.
- The teacher may ask some questions to boost the students.
- Teacher summarizes the contents (Note in students book) and explain to students other kind of computer attacks
- Teacher gives the instructions on how to do Application activities 1.3

Answers of activity 1.3

Let students do the activity and guide them to describe what happen to the computers after doing the activity. Let students discuss the measure that can be taken.

d) Answers of application activity 1.3 a

1. - A computer attack is any attempt to expose, alter, disable, destroy, steal or gain unauthorized access to or make unauthorized use of an asset.

 - An active attack attempts to alter system resources or affect their operation while a passive attack attempts to learn or make use of information from the system but does not affect system resources

2. Worms are computer programs that infect networks by replicating themselves and transmitting their multiple copies to all the nodes connected on the network while trojan are used by hackers to gain access into a machine without the permission of the user.

A trojan may appear to be something interesting and harmless, such as a game, but when it runs it may have harmful effects.

3. Some viruses work by hiding on the first sector of a disk and loaded into memory. Other viruses insert themselves onto program files that start applications. Last category of virus are viruses which infect programs that contain powerful macro languages like programming languages.

Answers of application activity 1.3b

1. Types of computers attacks that had happened in a school computer lab may be **referred to student book.**

2. You can know that a new document is virus infected by its extension **.exe** or **.com**

3. In computer security a social engineer is a person who is able to gain access to equipment or a network by tricking people into providing the necessary access information

4.In computer security, **shoulder surfing** is a type of social engineerwho obtain information such as personal identification number, password and other confidential data by looking over the owner of information while as **Social Engineering** is a technique/method used by someone by trying to socialize with someone else with the purpose of

picking/getting his/her credentials or user name and password with intention to use them during his/her absence.

5. Cybercrime types

- **Cyberbullying** is bullying that takes place using electronic technology
- **Sexting** is the sending and receiving of text, photo or video messages of children and young people that are inappropriate and sexually explicit.
- **"Grooming"** is the way sexual predators get from bad intentions to sexual exploitation. Basically, grooming is manipulation. It's the process pedophiles use to get children they target online to meet with them offline, the simple goal being sex.

LESSON 4: SOURCES OF VIRUS AND OTHER ATTACKS

2 periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Introduce the lesson using what students have seen in lesson 3. By using the learning 1.4, facilitate students to understand different sources of virus and other attacks.

b) Teaching resources:

- Computer lab, flash disk or CD
- Internet

c) Learning activities

Guidance

- Teacher organize students to form groups of two and to do the learning activity 1.4
- In computer lab, teacher guide students to use flash disk and MS Word where it is possible.
- In pairs, students discuss what happen to computers after activity.
- Teacher walks around and sees if students are doing activity in their respective group.
- The teacher may ask some questions to boost the students.
- Teacher summarizes the contents (Note in student's book) and explain to students that there are other virus sources like portable devices and Bluetooth.
- Teacher gives the instructions on how to do Application activities 1.4

Answer of learning activity 1.4

Let students do the activity and help them to know the cause of data loss. The different sources of computer threats are discussed in Students Book.

d) Application activity 1.4

1. The easiest and quickest means of spreading Computer Virus is through the internet. Basically through downloaded files and documents.
   - When the source of an email attachment is not known and trusted it should not be opened especially the messages of "get rich quickly". Some of them are Scam and coded virus.
2. CD and portable devices can be protected from virus:
   - by installing anti-virus and anti-spyware in computers where those devices can be inserted.
   - by download files and documents from known sources.

LESSON 5: DAMAGE CAUSED BY THREATS

2 periods: 80minutes

a) Prerequisites/Revision/Introduction:

Introduce the lesson using what students have seen in lesson 3 and 4. Take students in the computer lab. By using the answers of activity 1.5, teacher ask the students the other consequences of virus to the computer system.

b) Teaching resources:

- Computer lab, CD, flash disk
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students in groups in order to do learning activity.
- Students in groups, discuss probable damages that threats could cause in a computer
- Teacher walks around and sees if students are doing activity.
- Students share their answers in presentation.
- Students react on the finding answers from others
- Teacher corrects false answers and completes the half correctly
- Teacher summarizes the contents (Note in students book)
- Teacher gives the instructions on how to do Application activity 1.5

Answer of learning activity 1.5

Computer attacks can cause the following damages:

-Theft of data and software   -software damage

-website harking

d) Answers of application activity 1.5

1. The virus can cause many damages like inoperable computers and system networks, hardware failure, data loss and data theft

2. Damages caused by threats for home users:

   - **Infection of your computer** if you click on an infected banner file

   - **Harvest your data** (system information, email addresses in your agenda, etc.) and send it to cybercriminal servers to use it in future attacks;

   - **Destroy your data**

   - **Hide from being detected by antivirus** products

   - Performance dropped when you are not doing anything heavy.

3. Other damages caused by virus:

   – Computers work slowly

   – The portable devices infected by virus cannot function anymore

4. Example: If in a bank, some computers are attacked by virus and all computers work in same network. This means if some documents are shared through different ways, other computers in network can be affected, and this can cause the loss of important information.

LESSON 6: THREATS PROTECTION AND PRECAUTIONS

2 periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Learning activity 1.6 is used to introduce the lesson. Students visit the school computer lab where some computers are protected with password to login. Students observe how computers are secured and they respond to the questions in the activity. From them teacher explain students and introduce the lesson using technical explanations. Teacher focus on password creation and anti-virus installation in computers.

b) Teaching resources:

- Computer lab, CD of Kaspersky anti-virus
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students in pairs in order to do learning activity.
- Students in pairs, discuss the security measures can be taken to protect data stored in computer
- Teacher walks around and sees if students are doing activity.
- Students share their answers in presentation.

- Students react on the finding answers from others and list other security measures
- Teacher corrects false answers, completes the incomplete answers and explain other security measures and threat precautions
- Teacher summarizes the contents (Note in student's book)
- Teacher gives the instructions on how to do Application activity 1.6

Answer of learning activity 1.6

1. Importance of computer password login is that the computer is used by only someone who have that password, this means that the computer is used by appropriate users.

2. To protect a computer some security measures can be taken. Here are the following:

   * To install Antivirus Software
   *To install Firewall.
   *To install Anti-Spyware Software.
   *To use Complex and Secure Passwords

3. Data stored in computer can be protected from damage different ways:

   1. Prevent the installation or execution of unauthorized software or content

   2. Secure your passwords

   3. Encrypt all confidential data whenever possible

   4. Implement anti-virus, anti-spam, and anti-spyware tools on the gateway and/or at the host-level

   5. Define and enforce security domains

d) Answers of application activity 1.6

1. The comparisons between access control and parental control

   - Access control is a security technique that can be used to regulate who or what can view or use resources in a computing environment while the Parental Controls feature is a valuable tool for controlling the amount of time your children spend on the computer and the programs they're using.

   - The access control model used by some operating system ensures authorized use of its objects by security principals while Parental controls can filter the web, blocking inadvertent access to inappropriate websites.

2. a. The type of security used here is **authorization**

   b. It is important because authorization give someone permission to do or have something. In this example, if your identity is not verified you can't access to bank account, this means no one else can't access to your account without your permission.

3. The purpose of creating different computer users is to give different user permissions or   access to different computer resources.

4. After installation of an anti-virus, the CD or CD box should be kept in a safe place because it cab used later when an anti-virus is removed by due to a problem that can cause a computer to be formatted or by some other problems of mal function of a computer.

   – If the CD or CD box is no longer needed, it can be kept in reserved place for unused materials.

5. The way an anti-virus may be used in any institution or a company will depend the number of licenses bought.

   – If the license key has been stolen by someone else, the number of users for that license in that institution will reduce due the lost license key. The remaining user will work in unsecure way due to the absence of the anti-virus license.

   – It is better to key the anti-virus license in a safe place so that it cannot be stolen.

1.6 Summary of the unit:

Computer security refers to techniques developed to safeguard information and systems stored on computers. Computer security helps to keep safely data and equipment functioning and provide access only to appropriate people.

In computer security, a network used in any area must be also secured from cyber criminals, hackers, and identity thieves because this can cause real and dangerous threats to any online computer system.

Computer is secured from any threat. A threat as anything that has the potential to cause serious harm to a computer system can be physic (humidity, dirty, water….) or logic (virus, worms, spyware…).

Threats to information systems can cause software failure, hardware failure, electrical problems, user errors, program changes and theft of data, software, services and equipment.

The computer threat or attack most people have heard of are:

A virus is a self-duplicating computer program or piece of code that is loaded onto a computer without the user's knowledge and runs against his wishes. Common virus are

A worm is a computer program that sits in the computer memory, duplicates itself continuously until the system runs out of memory and crashes.

A Trojan may appear to be something interesting and harmless, such as a game, but when it runs it may have harmful effects.

Denial Of Service: when a denial of service (DoS) attack occurs, a computer or a network user is unable to access resources like e-mail and the Internet

Spyware: just like virus, Spyware also comes under that category of malware attacks, which means that it is a code or program written for doing some damage to the computer.

Social engineer: a social engineer is a person who is able to gain access to equipment or a network by tricking people into providing the necessary access information

Eavesdropping: eavesdropping refers to the unauthorized monitoring of other people's communications.

Cybercrimes: cybercrime, also called computer crime, is any illegal activity that involves ICT tools such as a computer or network-connected device, such as a mobile phone.

Virus is common computer attack, and it can attack a computer from different sources. Below are the common sources of computer virus attack:

- **Internet:** There can be no denying the fact that internet is one of the common sources of virus infection. This fact is not a real surprise and there is no point to stop accessing internet henceforth

- **Downloadable programs:** one of the possible sources of virus attacks is downloadable programs from the web. Unreliable sources and internet newsgroups are one of the main sources of computer virus attacks.

- **Cracked Software** proves to be yet another source of virus attacks. Most people who download cracked and illegal versions of software online are unaware about the reality that they may contain virus sources as well.

- **Unknown CD;** One of the other sources of virus attacks is perhaps through an unknown CD. Most computer users believe that one of the most common ways of virus infection is through Data CD.

- **USB flash**: due to its portability and auto run capacity, USB flash drive can easily get infected by virus. You must have known the harm which virus can lead to.

- **Bluetooth;** viruses can be contacted through a transfer of documents via a Bluetooth, once one of the Computers is infected with a Virus or the document so transferred.

If a computer is attacked by viruses or other listed threats, it can become damaged. So, some measures to prevent can be taken to protect data, computer hardware and computer network.

Security measures can be taken are; anti-virus installation, anti-spyware, computer password creation, giving limited access to different computer users and to make data backup frequently.

1.7 Answers of End unit assessment

1. Computer security refers to techniques developed to safeguard information and systems stored on computers.

Computer security is important because it prevent computer system from hardware failure, software failure, user errors, and theft of data, software, services, equipment.

2. You can protect a computer from physical threats by keeping it in appropriate place, without humidity, dirty or water.

Example in computer lab, all computers must be electrically protected by using appropriate devices.

3. C**leartext (Mulisa) ciphertext (Ndoli).**

- Transformed message in encryption it is called **ciphertext**
- The original message, before being transformed is called **Plaintext**

4. Finger scanning, the digital version of the ink-and-paper fingerprinting process, and works with details in the pattern of raised areas and branches in a human finger image while Finger vein ID is based on the unique vascular pattern in an individual's finger.

5. Authorization policies define what an individual identity or group may access. *Access controls or permissions/ privileges* are the methods we use to enforce such policies.

For example, imagine a database that contains both customer purchases and a customer's personal and credit card information. A merchant could create an authorization policy for this database to allow a marketing group access to all customer purchases but prevent access to all customer personal and credit card information, so that the marketing group could identify popular products to promote or put on sale.

6. Denial of service

7. A social engineer is a person who is able to gain access to equipment or a network by tricking people into providing the necessary access information

8. The answer will be referred to unit 3(Safe and ethical use of computer) of s4 computer science.

9. 1.c   2.b   3.a   4.d   5.f   6.e

1.8 Additional activities

1.8.1. Consolidation activities and answers

1.   What is the difference between anti-virus and anti-spyware?

Answer: Antivirus software are computer programs that attempt to identify, neutralize or eliminate virus while **Anti-spyware** is a type of program designed to prevent and detect unwanted spyware program installations and to remove those programs if installed

2.   Explain how Biometric authentication techniques can be applied to any institution

Answer: this can be applied for example if access in office request to put your fingers on a device to detect if is appropriate person.

3.   How a user can protect physical equipment of a computer

Answer: a)use physical equipment against fire, b)use metallic doors and windows against theft, c)use security camera, security guard and alarms to detect theft d)use UPS to protect system failure and data loos due to the power failure

4. What is social engineering?

Answer: is a method used by hackers to gain access to computer system by exploiting human behavior.

1.8.2. REMEDIAL ACTIVITIES AND ANSWERS

1. What is computer security? Give the advantages of computer security to computer system

Answer: Computer security refers to techniques developed to safeguard information and systems stored on computers.

The protection of data (**information security**) is important. It reduces the probability of hardware and software problems and it increases the security of data stored in computers

2. Define a computer threat. Differentiate physical threat to logical threat.

Answer: A threat is an activity/ attack/ situation that may happen, with the potential to cause serious damage.

Physical threats are digital storage media and hardware that can damage or destroy the computer system while logical threats areevents or attacks that remove, corrupt, deny access, or steal information.

3. What is an anti-virus? Give its importance to computer system

Answer: Antivirus software are computer programs that attempt to identify, neutralize or eliminate harmful software. It is important because it is used to prevent threats; including worms, phishing attacks, Trojan and other malware.

4. Why is it necessary to login to computer with a password?

Answer: It is important to login to computer with password because the computer must be used with someone who know the password.

5. How a Bluetooth is a source of virus?

Answer: Viruses can be contacted through a transfer of documents via a Bluetooth, once one of the Computers is infected with a Virus or the document so transferred.

1.8.3.Extended activities answers

i. Distinguish between the term security and threat

Answer: A state of feeling safe and protected while a threat, in the context of computer

security, refers to anything that has the potential to cause serious harm to a computer system

ii. Suggest solutions that can be used to safeguard a computer network

Answer: Computer network need to be safeguard with anti-virus and firewall solutions. Good computer networks must meet performance levels expected. It should also be reliable, consistent, and meet recovery procedures and security criteria to maintain smooth flow of data in organization.

iii. Explain the difference between a spyware and spam. Identify risks involved when your computer is infected with spyware

Answer: Spam is any message sent electronically that is unsolicited and bulk while spyware is a software codes installed on a computer without user' s knowledge to monitor or supervise user activities

iv. Identify the kind of information that should be encrypted in your school

Answer: For example the information about salary of employees

v. What is the importance of encryption?

Answer: - Encryption protects data in transit example via computer networks like internet, E-commerce, mobile phones and Bluetooth

1.9 Structure of a lesson

Sample lesson plan

School Name: GS BUBAZI   **Teacher's name:** MUGABE

Term	Date	Subject	Class	Unit No	Lesson No	Duration	Class size
Term 1	21/02/ 2018	Computer Science	S6	1	1 of 9	80 minutes	30
Type of Special Educational Needs to be catered for in this lesson and number of learners in each category			1 learner with partial hearing impairment				
Unit title	COMPUTER SECURITY						
Key Unit Competence:	To be able to enumerate various security threats and ensure security of computer.						
Title of the lesson	Why computer security						
Instructional Objective	After observing a computer protected, students will be able to describe and list the importance of computer security						

Plan for this Class (location: in / outside)	This class will be held in computer lab and students will be organize in small groups
Learning Materials (for ALL learners)	computers
References	Internet and textbooks to facilitate research

Timing for each step	Description of teaching and learning activity		Generic competences and cross cutting issues to be addressed + a short explanation
	Questions and answers technique is used to facilitate students, group activities and presentation of findings is used for learners to describe the importance of computer security.		
	Teacher activities	Learner activities	
Introduction Minutes	*Teachers facilitates students to visit the school computer lab. *Students observe how computer are protected. * The teacher helps learners to discover the topic of the lesson	Learners will respond to the asked questions by giving different ways of securing computer system	Communication Cooperation Interpersonal management Gender through mixing boys and girls to do activity

Development of the lesson **(Harmonization and summary)** **50 minutes (task 1: 20 minutes , task 2: 20 minutes, task 3:10 minutes)**	Form groups of two learners on 1 computer The teacher monitors the group work keeps focus on learner with understanding the importance of securing computer and data protection The teacher asks learners to present their findings and give additional comments to the learners 'work	* In groups, learners observe and discuss on how computers are secured *Learners ask questions for clarification while discussing in groups *Learners present their findings	Communication through presentations and discussing in groups. Cooperation when working together in groups Cross cutting issues: Gender ,peace and value education and inclusive education
Conclusion: **(Assessment)** **15 minutes**	The teacher concludes the lesson by asking questions to the learners, to know the achievement of the objective	Learners write individually on a sheet of a paper three importance of securing a computer. Importance of computer security is: ……	Critical thinking and interpersonal cooperation
Teacher self-evaluation	To be completed by the teacher after the lesson		

UNIT 2: LAN architecture, Network protocols and models

2

2.1 Key Unit Competency

To be able to identify computer network models, protocols and configure network devices

2.2 Prerequisite knowledge and skills

Students should have knowledge and skills related to principles, standards and purposes of computer network learnt in Senior 5 in the unit of introduction to computer network.

2.3 Cross-cutting issues to be addressed:

- **Peace and value education**: Students must be aware of crimes that use computer networks or devices.

- **Financial education:** Students must be aware that network planning take into consideration available financial means.

- **Environment and sustainability:** Students should be informed about the refurbishment of perished materials.

- **Standardization culture:** To be covered through the rationalization of protocols and standards in the growth of computing area and to avoid actions that are against Rwandan culture such as pornography...

2.4 Guidance on the introductory activity

(with cross referencing to the Student book + answers)

Instruction to do the introductory activity:

1. The teacher instructs students to go to page where figure 2.1 is in textbook.

2. The teacher organizes students into groups

3. The teacher asks students to do the introductory activity in their respective groups.

4. The teacher finds a seat in the corner and let the students work independently on the activity.

5. The teacher moves around to see how students are working.

6. The teacher may ask some questions to boost the students.

   a. What are the different types of computer networks?

b. What is the role of a switch within a network?

7. The teacher invites representatives of groups to presents their findings (3 or 4 groups).

8. The teacher ask students to evaluate findings.

9. The teacher tells the students that in the coming lessons they will have complete answers.

2.5 List of lessons (including assessment)

#	Lesson title	Learning objectives	Number of periods
1	LAN architecture	• Explain Ethernet LAN architectures, • Explain IEEE 802.3 and carrier sense multiple access with collision detection, • Appreciate the role of LAN architecture	2
2	Ethernet standard	• Describe and differentiate among various cable Ethernet standard • Identify and differentiate among various wireless Ethernet standard • Explain token ring architecture • Able to describe multi - station access unit	3
3	Fiber Distributed Data Interface	• Explain Fiber Distributed Data Distributed Data architecture • Able to describe Fiber Distributed Data Distributed Data architecture	2
4A	Network devices Part I	• Explain steps to install and configure wireless NIC, connect it to access point • Able to install wireless NIC and configure it	2
4B	Network devices Part II	• Able to install and configure router and connect a switch/hub to a router with Physical router or in Network Simulator software • Able to install and configure multi-function device and connect computers to it • Explain steps to install and configure access point and set up security • Able to connect a host /computer to access point	3

5	Computer Network protocols	• Explain different computer network models and protocols • Identify network layers, differentiate various protocols and devices used on each layer • Able to configure email using POP,IMAP and SMTP and perform file transfer using FTP	3
6	OSI models	• Able to identify network model, use protocol and devices found in each layer	3
7	TCP/IP data models	• Describe different layers associated with each network model	3
8	Network Switching	• Differentiate packets switching and circuit switching	2
9	Assessment		1
Total			24

LESSON 1: LAN ARCHITECTURE

(Duration: 2 periods: 80 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to visit the school computer lab. Students observe how computers are connected together. The teacher asks students to take notes of what they observed.

b) Teaching resources:

- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do activity 2.1.
- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 2.1 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on findings / answers from other groups.
- Teacher corrects false answers and completes the half correctly answers.
- Teacher summarizes the contents or teacher refers to notes in students' book

and gives examples that should be done by students.

- Teacher requests students to do Application activity 2.1.
- Students do Application activity 2.1.

Answer of activity 2.1

1. Let students determine the LAN technology (between cable Ethernet and Wireless LAN) which is used to connect computers within the computer lab.

2. Students determine the physical topology (Star, Three, Bus, Ring and Mesh topologies) which is implemented in their computer lab, its advantages and disadvantages.

d) Answers of application activity 2.1

1. Students demonstrate that they are able to connect computers according to given physical topology using devices like router, switches, Ethernet cables and computers available in their computer lab. Some of the topologies which can be realized are Star, Three, Bus, Ring and Mesh topologies.

2. Students describe the process of CSMA/CD "Carrier Sense Multiple Access with Collision Detection".

The following fact happens when a collision occurs on an Ethernet LAN:

- A jam signal informs all devices that a collision occurred.
- The collision invokes a random back off algorithm.
- Each device on the Ethernet segment stops transmitting for a short time until the timers expired.
- All hosts have equal priority to transmit after the timers have expired.

LESSON 2: CABLE ETHERNET STANDARD

(Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to look around the school computer lab. Students observe communication media used to connect computers. The teacher asks students to take notes of what they observed.

b) Teaching resources:

- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 2.2.
- Students elect the group leader and secretary.

- Teacher asks the students to work independently in groups on Activity 2.2 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half correctly answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 2.2.
- Students do Application activity 2.2.

Answer of activity 2.2

1. Students observe and write notes on different specifications indicated on network cables, wireless cards, wireless routers and access points. They must indicate LAN technologies such as Ethernet, Fast Ethernet/100Base-T, Gigabit Ethernet/GigE, 10 Gigabit Ethernet and / or wireless standards such as 802.11 Standard, 802.11b Standard, 802.11g Standard, 802.11n standard, 802.11ac standard.

d) Answer of application activity 2.2

1. Students may choose between LAN, Token ring and FDDI technologies.

2. The device can be placed in any building. Students demonstrate how the wireless device to be used can emit its signals to the whole school by indicating its coverage area. Student indicate their choice between 2.4 GHz (~90 meters) and 5 GHz (~28 meters) wireless routers.

3. Students demonstrate their ability to choose proper network cable between Ethernet, Fast Ethernet/100Base-T, Gigabit Ethernet/GigE and 10 Gigabit Ethernet taking into consideration the cost and the maximum distance which cannot exceed 100 meters in our case.

LESSON 3: FIBER DISTRIBUTED DATA INTERFACE

(Duration: 2 periods: 80 minutes)

a) Prerequisites/Revision/Introduction:

The teacher requests students to observe the figure on activity 2.3. The teacher asks students to take notes of what they observed.

b) Teaching resources:

- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 2.3.
- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 2.3 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half correctly answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher takes students to the place where they can observe the fiber optic cable.
- Teacher asks students to do Application activity 2.3.
- Students do Application activity 2.3.

Answer of activity 2.3

1. Students must show the following in their descriptions:
   - The presence of different Local Area networks dispatched at different levels of a building
   - The presence of three buildings which are linked by a cable
   - The presence of network devices which may be routers, switches or hubs

d) Answer of application activity 2.3

Advantages of FDDI

- FDDI supports transmission rates of 100 megabits per second on token-passing networks.
- FDDI provides high-speed network backbones that can be used to connect and extend LANs.
- Fiber-optic cable such as the cable used with Fiber Distributed Data Interface (FDDI) can support very large volumes of data over large distances.

Disadvantages

- Fiber Distributed Data Interface (FDDI) is an expensive technology to set up than twisted-pair cable.
- Because most Fiber Distributed Data Interface (FDDI) installations use a redundant second ring, more cabling is required.

Multimode optical fiber is the best answer because it works well over distances of a few kilometers or less. On the given figure, core and distribution layers are used to extend LANs in building.

LESSON 4 A: NETWORK DEVICES PART I

(Duration: 2 periods: 80 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to the computer lab. The teacher shows to students different network devices such as routers, Access Points, Switch, Hub, UTP cables, desktop, laptop and printers. The teacher requests students to brainstorm on the role of each device and how they can be used to create Local Area Network. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Network devices (routers, Access Points, Switch, Hub, UTP cables, desktop, laptop and printers)
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

Teacher organizes students in groups in order to do Activity 2.4. part I

- Students elect the group leader and secretary.
- Teacher distributes available network devices to groups.
- Teacher asks the students to work independently in groups on Activity 2.4 part I during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half correctly answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 2.4. part I
- Students do Application activity 2.4. part I

Answer of activity 2.4

1. Students describe the role of each device according to what they have learnt in

S5 in the unit of introduction to computer network (Refer to the textbook of S5)

2. Students prove their ability to determine complete set of devices which can make a functional network:

 – Switch, access point, UTP cable, printer and computers

 – Switch, UTP cable, printer and computers

 – Wireless router, access point, UTP cable and computers

 – Wireless router, access point, UTP cable, printer and computers

 – Answer of application activity 2.4

 – Students switch off their desktops, unplug all electrical cables, remove the CPU box cover, remove wireless adaptor from the extension slot, install the wireless adaptor and reassemble the CPU box.

 – Students check whether wireless drivers are available passing through the device manager.

LESSON 4 B: NETWORK DEVICES PART II

 (Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to the computer lab. The teacher gives routers and Access Points to students. The teacher requests students to brainstorm on the role of each device and how they can be used to create Local Area Network. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

 • Network devices (routers and / or Access Points, Switch, UTP cables, desktop, laptop)

 • Computer lab (any room which has networked computers)

 • Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

 • Teacher organizes students in groups in order to do Activity 2.4 part II

 • Students elect the group leader and secretary.

 • Teacher distributes available network devices to groups.

 • Teacher asks the students to work independently in groups on Activity 2.4 part II during some given time.

 • Teacher walks around and sees if students are doing activity in their respective groups.

 • Representatives of groups present their answer to the rest of class.

- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half correctly answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 2.4 part II.
- Students do Application activity 2.4 part II.

d) Answer of application activity 2.4 part II

1. Students must show their ability to select the Network icon in the notification area in order to display all available networks.

2. Students must prove their ability login and enter into the router's Basic Wireless Settings using the default IP, user name and password. Students must change the wireless name as indicated in the question and save changes.

3. Students must enter into the command prompt and run the ipconfig command.

4. The protection of wireless network with a password helps to prevent unauthorized access or damage such as downloading pirated movies or porn to computers using that wireless networks. It also guarantees the proper utilization of available bandwidth.

5.
   a. Students will go through the Tethering & portable hotspot → Put it on → Set up Wi-Fi hotspot → Configure the Network name and Security.
   b. The second step is to connect computers to the smartphone using its wireless signal, network name and password.
   c. The same process in (a) can be repeated by changing the network name and password.

LESSON 5: COMPUTER NETWORK PROTOCOLS

(Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to read the activity 2.5 and discuss on possibilities to share files on network. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 2.5.

- Students elect the group leader and secretary.

- Teacher asks the students to work independently in groups on Activity 2.5 during some given time.

- Teacher walks around and sees if students are doing activity in their respective groups.

- Representatives of groups present their answer to the rest of class.

- Students react on the findings / answers from other groups.

- Teacher corrects false answers and completes the half correctly answers.

- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.

- Teacher asks students to do Application activity 2.5.

- Students do Application activity 2.5.

Answer of activity 2.5

– Teacher will create a shared folder on his computer and sets it to full access through the network.

– The students will access the shared folder, copy and save those files to that shared folder.

– Transfer of files will be possible because of FTP (File transfer protocol) is used when the created folder is shared.

2. Each group will demonstrate their ability to apply the proposed solution.

d) Answer of application activity 2.5

1. A network protocol defines rules and conventions for communication between network devices. Network protocols include mechanisms for devices to identify and make connections with each other, as well as formatting rules that specify how data is packaged into messages sent and received.

2. Install FileZilla Server on to a Windows PC

– Download the setup of FileZilla Server from here and open the executable file.

– Agree to all and click "Next". You will see the "Choose components" window.

– Select the "Standard" from the drop-down menu and click "Next".

– In the "Startup settings" options select "Install as service, started with Windows (Default)" from the drop-down menu and in the port text box write "14147". Click "Next".

– In the next "Startup settings" window, select "Start if user logs on, apply to all users" from the drop-down menu and click "Next".

– Now the program will install and when it shows that the setup is completed you

may click "Close".

Configure FTP server

– Open the installed application.

– Click on "File" and then click on "Connect to server". A new window will open. Check whether the settings are same as in the image below and after that click on "Ok".

– Now click on "Edit" menu and click on "Settings"; a new window will appear. Make the settings same as image below. You may click on the images to see their larger versions.

– Now click on "Passive mode settings" and then click on "Use the following IP:" radio button and in the text box, enter your own IP address.

– You can find out your IP from whatismyip.com or by using Google or even natively in Windows 7. More on that here.

– Now click on "Ok" in the settings.

– You can enable auto-ban feature if you are making a public FTP server.

Add users and groups to FTP server

– In the FileZilla server user interface, click on "Edit" menu and then click on "Groups".

– Click on "Add" and name the group for e.g., I've added two groups.

– At the left size under the page select "Shared Folder" and add folders to the list and you can select different permissions for different groups. You may see image for proper understanding.

– Your groups are ready, click on "OK" and it will save your settings.

– Now under the "Edit" menu click on "Users".

– Add users by same method you did so for adding groups, for e.g. I've made three users.

Install FileZilla Client on to Windows PC

– Download FileZilla Client from here. Install it on your client's PC. Its installation is very easy.

– Now go to "File" menu and click on "Site Manager".

– In the host text box enter the IP address of server PC. And in port text box enter "21". Rest, all setting should be as same as in the image below. And username and password should be one of them that you entered in the users in the server interface. Click on connect.

– It would connect successfully. But if it doesn't, then go through the tutorial once again.

– Now at the left side you can see local site and at the right side you can see

remote site. You can upload or download any file from the server by right clicking the file.

LESSON 6: OSI MODELS

(Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to read and discuss on activity 2.6. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Projector
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 2.6.
- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 2.6 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half correctly answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 2.6.
- Students do Application activity 2.6.

Answer of activity 2.6

Description	Device
This device sends and receives information about the Network layer.	Router
This device uses hardware addresses to filter a network.	Bridge or switch
This device can measure the distance to a remote network.	Router

d) Answer of application activity 2.6

1. The Transport layer creates virtual circuits between hosts before transmitting any data.

2. The OSI model was created to help vendors create interoperable network devices and software in the form of protocols so that different vendor networks could work with each other. It divides the network communication process into smaller and simpler components, thus aiding component development, design, and troubleshooting; it allows various types of network hardware and software to communicate; and it prevents changes in one layer from affecting other layers.

3. Short description of OSI layers

   a. **Application:** To allow access to network users

   b. **Presentation:** To translate, encrypt and compress data

   c. **Session:** To establish, manage and terminate sessions. For example, once user/password verification is done, the remote host maintains this session for a while and does not ask for verification again in that time span.

   d. **Transport:** This layer is responsible for end-to-end delivery between hosts.

   e. **Network:** To move packets from source to destination to provide internetworking.

   f. **Data link:** To organize bits into frames; to provide hop-to-hop delivery

   g. **Physical:** To transmit bits over a medium; to provide mechanical and electrical specifications.

4. The Physical layer takes frames from the Data Link layer and encodes the 1s and 0s into a digital signal for transmission on the network medium.

5. The Network layer is responsible for routing, enabling connections and path selection between two end systems.

6. Presentation layer defines how data is formatted, presented, encoded, and converted for use by software at the Application layer.

7. The Session layer is responsible for creating, managing, and terminating sessions between applications and overseeing data exchange between presentation layer entities.

LESSON 7: TCP/IP DATA MODELS

(Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to read and discuss on activity 2.7. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)

- Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 2.7.
- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 2.7 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half correctly answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 2.7.
- Students do Application activity 2.7.

Answer of activity 2.7

1. Students may give the following answer: split the document into small files with less than 20MB

d) Answer of application activity 2.7

1. Layers in TCP/IP model are:

   a. Application

   b. Transport

   c. Internet

2. The layer of TCP/IP model which is equivalent to Transport layer in OSI model is "Host to Host or Transport" layer.

3.

Sr. No.	TCP/IP Reference Model	OSI Reference Model
1	Defined after the advent of Internet.	Defined before advent of internet.
2	Service interface and protocols were not clearly distinguished before	Service interface and protocols are clearly distinguished
3	TCP/IP offers support for connectionless communication within the network layer.	In the network layer, OSI supports both connectionless and connection-oriented communication.
4	TCP/IP supports Internet working	Internet working not supported
5	Loosely layered	Strict layering
6	Protocol Dependent standard	Protocol independent standard
7	More Credible	Less Credible
8	TCP reliably delivers packets, IP does not reliably deliver packets	All packets are reliably delivered

LESSON 8: NETWORK SWITCHING

(Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher requests students to observe figures A and B on activity 2.8. The teacher asks students to take notes of what they observed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 2.8.
- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 2.8 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half correctly answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 2.8.
- Students do Application activity 2.8.

Answer of activity 2.8

1. Students must indicate the following devices in their descriptions: route, switches, hub, computer / Server, token ring

2. The difference is that in figure B there is a switch which is not in figure A

d) Answer of application activity 2.8

1. In circuit switching a dedicated communication path in physical form between two stations within a network is established, maintained and terminated for each communication session. On the other side, message switching does not establish a dedicated path between the two communicating devices i.e. no direct link is established between sender and receiver. Each message is treated as an independent unit.

2. Packet switching can be done through the following technologies:

   a. Datagram networks

Packets are treated independently and may take different routes. Datagram is better if numbers of packets are not very large.

   b. Virtual circuit networks

In virtual circuit, a logical path is setup prior the transmission and therefore, no routing decision is to make which ensure that packet are forwarded more quickly than datagram.

2.6 Summary of the unit

This unit entitled "LAN Architecture, network models and protocols" is a complement to the unit of introduction to computer network. It provides skills and knowledge related to computer network models, protocols and the configuration of wireless network devices.

LAN architecture consists of three levels: Physical, Media Access Control (MAC) and Logical Link Control (LLC) and its major components are Hardware, Access methods, Topology and software.

Cable Ethernet standards are into the following categories: etherne, Fast Ethernet/100Base, Gigabit Ethernet/GigE, 10 Gigabit Ethernet

Wireless Ethernet standards are into the following categories: 802.11 Standard, 802.11b Standard, 802.11g Standard and 802.11ac standard

Token ring or IEEE 802.5 is a network where all computers are connected in a circular fashion. A Multistation access unit (MSAU) is a hub or concentrator that connects a group of computers to a token ring local area network.

Fiber Distributed Data Interface (FDDI) is a standard which allows the transmission of very large volumes of data over large distances. There are three types of fiber optic cable commonly used: single mode, multimode and plastic.

Technologies used in fiber optic cable are: 100Base-FX, 1000Base-SX, 1000Base-LX and 1000Base-CX

This unit indicates all steps to install and configure: Wireless NIC, Wireless router, Wireless access point and Default gateway

Network protocols include mechanisms for devices to identify and make connections with each other, as well as formatting rules that specify how data is packaged into messages sent and received. Some of the most used protocols are:

Simple Mail Transfer Protocol (SMTP), File Transfer Protocol (FTP), TErminaL NETwork (TELNET), Transmission Control Protocol /Internet Protocol (TCP/IP), User Datagram Protocol (UDP), Post Office Protocol version 3 (POP3), Internet Message Access Protocol (IMAP), Internet Message Access Protocol (IMAP), Dynamic Host Configuration Protocol (DHCP), Hypertext Transfer Protocol (HTTP), Hypertext Transfer Protocol Secure (HTTPS), Secure Shell (SSH)

There are seven layers in the OSI reference model and 4 layers in the TCP/IP model:

OSI model	TCP/IP model
Application	Application
Presentation	Transport
Session	
Transport	
Network	Internet
Data Link	Network Access
Physical	

Network switching falls into three categories:

1. Circuit-Switched Networks

2. Packet Switched Networks (Datagram networks and Virtual circuit networks)

3. Message switching

2.7 End unit Assessment

1. Your school has acquired 60 computers from the Rwanda Education Board (REB) and wishes to distribute them as follows:

- Administration: 3 computers

- Staff room: 7 computers

- Computer lab for students in Ordinary level: 30 computers

- Computer lab for students in Advanced level: 20 computers

a) List all materials needed to setup 2 wireless LANs within the school.

Answer: The following are possible alternatives:

- Two Wireless Routers, UTP cable, laptop or desktop

- One Wireless Router and one Access Point, UTP cable, laptop or desktop

b) Provide specifications for your materials and equipment.

Answer:

- It is better to use a 2.4 GHz 802.11n standard or 802.11ac standard wireless router / Access Point regardless of the model because it has greater range than 5GHz routers.

- UTP cat6 or cat7 can be used.

c) Is it possible to secure those wireless networks?

Answer: yes

d) Indicate the type of wireless security that will be used.

Answer: Students will choose between WEP, WPA and WPA2

2. Discuss the advantages of Fiber optic cables within a LAN.

Answer:

- The fiber opticprovides high-speed network that can be used to connect and extend LANs.
- Fiber optic cabling offers much larger transmission distance.
- Electromagnetic noise cannot affect fiber-optic cables.
- Resistance to corrosive materials.

3. Why routers and switches do not operate at the same OSI reference model layer?

Answer: Routers (layer 3 devices) use logical addressing and provide what is called packet switching. Routers use a routing table (map of the internetwork) to make path selections and to forward packets to remote networks. On the other side, switches (layer 2 devices) are not used to create internetworks because they do not break up broadcast domains by default; they are employed to add functionality to a network LAN. The main purpose of switches is to make a LAN work well and do not forward packets to other networks as routers do.

4. What are the common steps in configuring both wireless routers and access points?

Answer: Common steps may include but are not limited to:

- Entering into the device's configuration interface
- Defining the wireless name of SSID
- Setting wireless security mode and password

5. Is it possible to change the default gateway of your computer? Explain.

Answer: Yes. The default gateway can be configured manually and changed according to the user's needs. In addition, when you change the network, the default gateway will also change automatically.

6. When and how both public and private IP addresses are used within the same network?

Answer: Both public and private IP addresses are used within the same network when it has access to internet. In such a case, the network has only one single public IP address received from your ISP (Internet Service Provider) provides to identify your home network to the outside world. Private IP address provides unique identification for devices that are within your Local Area Network, such as your computer, your smartphones, and so on.

7. What are the advantages of using OSI layered model?

Answer:

- It prevents changes in one layer from affecting other layers.
- It describes what functions occur at each layer of the model that encourages industry standardization.
- It allows different types of network hardware and software to communicate.

8. Describe the purpose and basic operation of the protocols in the OSI and TCP models.

Answer:

Sr. No.	TCP/IP Reference Model	OSI Reference Model
1	Defined after the advent of Internet.	Defined before advent of internet.
2	Service interface and protocols were not clearly distinguished before	Service interface and protocols are clearly distinguished
3	TCP/IP offers support for connectionless communication within the network layer.	In the network layer, OSI supports both connectionless and connection-oriented communication.
4	TCP/IP supports Internet working	Internet working not supported
5	Loosely layered	Strict layering
6	Protocol Dependent standard	Protocol independent standard
7	More Credible	Less Credible
8	TCP reliably delivers packets, IP does not reliably deliver packets	All packets are reliably delivered

9. Discuss the importance of switches within a LAN.

Answer: Advantages of switches are:

- Switches increase available network bandwidth
- Switches reduce the workload on individual computers
- Switches increase network performance
- Networks that include switches experience fewer frame collisions because switches create collision domains for each connection (a process called micro segmentation)
- Switches connect directly to workstations

2.8 Additional activities

2.8.1 Consolidation activities

Suggestion of questions and answers for deep development of competences.

1. What is the relationship between the physical topology and the logical topology?

Answer: A logical topology is the signal path through a physical topology.

2. How can you measure the performance of a network?

Answer: One characteristic that measures network performance is bandwidth. The bandwidth reflects the range of frequencies we need. The term can be used in two different contexts with two different measuring values bandwidth in hertz which is the range of frequencies contained in a composite signal or the range of frequencies a channel can pass and bandwidth in bits per second which refers to the number of bits per second that a channel, a link, or even a network can transmit.

What is the difference between wireless router and wireless access point?

Answer: A wireless router is a device that performs the functions of a router and also includes the functions of a wireless access point. It is used to provide access to the Internet or a private computer network.

Wireless access points are networking devices that allow wireless Wi-Fi devices to connect to a wired network.

2.8.2 Remedial Activities

Suggestion of Questions and Answers for remedial activities for slow learners.

1. Describe each one of the major components of a Local Area Network?

Answer:
   - Hardware (Computers, Network Interface Card (NIC), Media or Cables, Hub, Switches, repeaters)
   - Access Methods: Rules that define how a computer puts data on and takes it from the network cable.
   - Network Topology: the logical or physical arrangement of network devices (nodes).
   - Software: Programs to access and / or to manage the network.

2. How does a collision occur in a network?

Answer: A data collision occurs when two or more computers send data at the same time. When this happens, each computer stops data transmission and waits to resend it when the cable is free.

3. What is the difference between 2.4 GHz and 5 GHz wireless routers?

Answer:

2.4 GHz	5 GHz
802.11b/g/n	802.11a/n/ac
Greater Range (~90 meters)	Lower Indoor Range (~28 meters)
Universal Compatibility	Limited Compatibility (a/n/ac devices only)
3 non-overlapping channels	24 non-overlapping channels
Congested with Wi-Fi	Little Wi-Fi congestion
Plagued by non-Wi-Fi interference	Very little non-Wi-Fi interference

4. Which one the following steps is not part of Wireless NIC card Driver installation process? Why?

Step 1: Shut down the PC.

Step 2: Right-click on Computer to select Manage.

Step 3: On the left, select Device Manager to bring it up on the right.

Step 4: Right click on the unknown adapter to Update Driver Software.

Step 5: Click to Search automatically for updated driver software.

Step 6: Wait until the download process is successfully completed.

Step 7: Click on Save Settings or OK to apply the change.

Answer: Step 1 is not necessary because we cannot install wireless NIC card driver when the computer is turned off.

2.8.3. Extended activities
 Suggestion of Questions and Answers for gifted and talented students.

1. Describe the role of Simple Mail Transfer Protocol (SMTP) for both email client software and servers.

Answer: The Simple Mail Transfer Protocol (SMTP) is used to only transfer electronic mail from one user to another. This task is done by means of email client software the user is using. Client software uses Internet Message Access Protocol (IMAP) or Post Office Protocol (POP) protocols to receive emails. Servers use SMTP to send as well as receive emails.

Configure an IMAP account in outlook using the manual setup option.

Answer: Required steps are as follows:

Step 1: Open your Outlook account and click *File*, then click *Add Account*.

Step 2: Select the option to do a *Manual Setup* or *Additional Server Types*, then click next.

Step 3: Select *IMAP* (recommended) or *POP*, then click *Next.*

Step 4: Enter the following details:

- Your Name: Enter the name you would like to appear on your emails.

- Email Address: Your full email address.

- Account Type: Use the dropdown menu to select POP3 or IMAP.

- Incoming mail server: For POP or IMAP accounts use pop.emailprovider.com (for example pop.gmail.com if you have a Gmail account).

- Outgoing mail server (SMTP): For POP or IMAP accounts use smtp.emailprovider.com (for example smtp.gmail.com if you have a Gmail account).

- User Name: Your email account user name.

- Password: Your email account password.

Step 5: Click on the *More Settings* button, then select the *Outgoing Server* tab. Ensure the box next to *My outgoing server (SMTP) requires authentication* is checked, as well as the option to *Use same settings as my incoming mail server.*

Step 6: Click the *Advanced tab.* The incoming mail server port number should be 143 for IMAP, or 110 for POP. The outgoing server (SMTP) can be either 1025, 25 or 587 depending on your Internet Service Provider. The encrypted connections type should be None. Click OK to proceed.

Step 7: Click *Next.* Outlook will test your current settings and determine if there is a connection to the server.

UNIT 3: NETWORKING PROJECT

3

3.1. Key unit competence:

To be able to Build a computer wired and wireless network

3.2 Prerequisite knowledge and skills:

Students should ideally have some knowledge and skills related to the introduction to computer network.

3.3. Cross-cutting issues to be addressed:

Financial Education: To be covered when the students cost implication in building networking cables, sharing resources from one computer to another and building P2P/Client-Server networks.

- **Standardization Culture:** Students must be familiar with the standards of network devices, building different forms of network connections.

- **Inclusive Education:**

- **Peace and Values Education:** Students must be aware of internet based crimes like hacking and prevent accessing people's data without permission.

3.4 Guidance on the introductory activity

Instruction to do the introductory activity

- Take students in the computer lab where it is possible.

- Each computer in the lab should be connected to the Internet where it is possible.

- Share students in different groups, by using two laptops, try to pair laptops using Bluetooth and sharing a file from one computer to another. One group will serve as sender, and another group will be receiver. After sending and receiving files from one machine guide them to state different steps they follow to share file.

- Guide students to identify devices and transmission medium used to facilitate sharing the files.

- By observing the figure 3.1 in student book guide, guide them to list all needed materials to build computer network.

- Guide students to discuss how they can build their own network. Peer to Peer network or Client to server network.

3.5. List of lessons (including assessment)

#	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes):	Number of periods
1	**Building P2P Network** **Project I:** Preparing cables and devices	• Discuss the tools required to build P2P Network • Preparing materials and devices needed to build P2P network • Share folder on the created network • Connecting computers and central devices	2
2	**Building P2P Network** **Project II:** Static IP address configuration	• assigning each computer a static IP address • test connectivity between computers	2
3	**Building P2P Network** **Project II:**Sharing folder	• Creating a working group • Sharing folder, files, printer and internet to the same P2P network	2
4	**Wireless router configuration** **Project I:** TP-Link connection and Setting	• explain different steps to configure Wireless access point • connecting wireless router to TP-Link using Ethernet cable • Setting an SSID to the TP-Link router	2
5	**Wireless Router configuration** **Project II:** wireless security configuration	• Configuring the wireless security • Set DHCP settings	2
6	**Building Client server network** **Project I:** Creating and setting an FTP folder	• Explain different steps to build wireless access point configuration. • Creating an FTP folder • Configuring IP address • Creating an FTP server and FTP extensibility	2

7	**Building Client server network** **Project II:** Creating and setting an FTP site	Creating an FTP site Giving name to a created FTP site Creating an Information Service Site (IIS)	2
8	**Building Client server network** **Project III:** Creating rules and share folder	Enabling FTP server port to be access from the LAN Selecting proper management Adding new user to the security settings of the FTP folder	2
10	Assessment		

PART 1: BUILD PEER TO PEER NETWORK

LESSON 1: PREPARING CABLES AND DEVICES

2 Periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Activity 3.1 is used to introduce the lesson "Build peer to peer network". The teacher invites students to visit the school computer lab. Students observe how computers are connected together. The teacher asks students to imitate the connection seen in the computer lab and build P2P network following different steps learned in S5. Using technical explanations teacher helps students to recall different steps to build P2P network.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students into groups of 4 students in order to do project
- Students elect the group leader and secretary
- Teacher asks the students to work collectively in groups on project 3.1.A during some given time
- Teacher walks around and sees if students are doing activity in their respective groups and guide them
- Teacher asks groups Secretaries to take note when building P2P network
- Guidance on assessment before the lesson, during the lesson and after the lesson
- Questions and answers from application activities

P2P Project 3.1. A

The project will depend on infrastructure available in the school computer lab.

Students demonstrate that they are able to build computers according to given physical devices, CAT6 UTP Cables, RG-45, Switch/hub available in their computer lab and teacher provide IP address to be used.

Step 1: Make sure all computers are turned off, organized and arranged.

In this practice we need to arrange 10 computers which is the maximum number of computer allowed in P2P network.

Using packet tracer or physical connection help learners to prepare all devices

Step 2: Install central devices (Switch or hub).

Step 3: Connect each end of the UTP CAT 6 straight through cables to connect computers to Switch/ Hub

When connecting devices, UTP CAT 6 straight through cable is required to connect the same devices (Computer to computer) and UTP CAT 6 crossover cable to connect different devices (Switch to computer), depending on number of devices we have in our practice, more Ethernet cables are need. There are some tools which are needed to make Ethernet cables and different steps learned in the previous school **(S5, Unit 3 Introduction to networking)** are needed.

After making Ethernet cable we need to make them tested using cable tester

Using packet tracer, we can connect devices using different cables not only packet tracer which can be used but also real computers depending on the resources/ computer **(Figure 3.1.6).**

LESSON 2: STATIC IP ADDRESS CONFIGURATION

2 Periods: 80 minutes

a) Prerequisites/Revision/Introduction:

- Project 3.2 is used to introduce the lesson "Static IP address configuration". The teacher invites students to visit the school computer lab. Students observe how computers are communicating together. The teacher asks students to configure Static IP address following different steps learned in S5. Using technical explanations teacher helps students to recall different steps to configure static IP address network.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students into groups of 4 students in order to do project.

- Students elect the group leader and secretary.

- Teacher asks the students to work collectively in groups on project 3.1.B during some given time.

- Teacher walks around and sees if students are doing activity in their respective groups and guide them.

- Teacher asks groups Secretaries to take note when configuring static IP address

Project 3.1.B

Project will depend on infrastructure available in the school computer lab.

Listing IP addresses that will be used to different computers is an important step that will be helpful to define the same working group for being able to share files, folder, printers and network.

In this project, we use maximum 10 computers which are allowed to build P2P network, the IP addresses given to the PCs can be in the same network for being in the same work group to share resources such as folder, printer, files and network.

The following are IP addresses we will use in this practice: PC1: 192.168.0.1; PC2: 192.168.0.2; PC3: 192.168.0.3; PC4: 192.168.0.4; PC5: 192.168.0.5; PC6: 192.168.0.6; PC7: 192.168.0.6; PC8: 192.168.0.8; PC9: 192.168.0.9; PC10: 192.168.0.10

Step 4: Configure static IP address for each computer.

Process 1: In windows 10, go to search and type in Control panel and click ok.

Process 2: Click the link "View network status and tasks" under the Network and Internet heading.

Process 3: Click the link on the left of the window labeled Change adapter settings.

Process 4: You might have more than one internet connections listed in this window. If this is the case you will need to determine which one is your connection to the internet. Once you have found it, right click on your network adapter and choose properties to open up the properties window of this Internet connection.

Process 5: Find the option of Internet Protocol Version 4 (TCP/IPv4) and click on it. Then choose the option under that titled Properties.

Process 6: Select "Use the following IP address" and enter the IP address, Subnet Mask, Default Gateway and DNS server. Click OK and close the Local Area Connection properties window.

When choosing "Use the following IP address" the IP must be configured as Static

Procces7: As an example, assign one PC1 an IP address of 192.168.0.1 and use the subnet mask 255.255.255.0.

For PC1

Procces 8: As an example, assign one PC2 an IP address of 192.168.0.2 and use the subnet mask 255.255.255.0.

For PC2

Process 9: Do the same for other 8 PCs

Step 5: Ping each computer to verify if they are connected

Process 1: In windows 10, go search and type in CMD then press Enter

Process 2: Type Ping 192.162.0.1 (if you use a computer assigned with 192.168.0.2 type in: ping 192.168.0.2) then press Enter button.

Step 6: do the same as what you did on step 5 to all PCs

Note: if you receive timeout message when attempting to ping your selected IP address, it is possible that the internet connection firewall is interfering, unplugged cables, mistake on IP configuration, etc

How to allow internet connection through the firewall?

- – Right click on *My Network places*, then select properties.
- – Right click local Area connection and select properties once again,
- – Click the advanced tab. Uncheck the box titled: Protect my computer from the Internet.
- – Click OK. Now, type the selected IP address again.

Once you get two computers to communicate successfully together, you can now enjoy the benefit of files, printer, internet sharing.

LESSON 3: SHARING FOLDER

2 Periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Project 3.3 is used to introduce the the project "Sharing folder". The teacher invites students to visit the school computer lab. Students observe how computers are communicating together. The teacher asks students to create the same work group and, printer, files and internet following different steps learned in the previous lesson. Using technical explanations teacher helps students to recall different steps to share folder, printer, files and network on the same network.

b) Teaching resources:

- • Computer lab
- • Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students into small groups of students in order to do project.
- Students elect the group leader and secretary.
- Teacher asks the students to work collectively in groups on project 3.1.C during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups and guide them.
- Teacher asks groups Secretaries to take note when configuring static IP address

P2P Project 3.1.C

Project will depend on infrastructure available in the school. Teacher will guide step to share folder where learners fails.

To share folder requires creating a home group/ workgroup, for the topic discussed in S5, creating home group/ work group is discussed, here we need to change a home group/ work group to be able to share files, folder, printer and network.

The following are the steps to change the home group/ workgroup in Windows 10

Step1: With the right mouse button click the Start icon and choose System. If you have a touch enabled device, click and hold the start button, then tap the System button.

Step2: Under "Computer name, domain, and workgroup settings" click on **Change Settings**

Step3: Under the tab "Computer Name" find the **Change...** button and click it.

Step4: Under "Member Of" change the Workgroup name.

Step 5: Change the name from WORKGROUP to S6A

Step 6: Then click on **OK,** the system will prompted to **reboot**

After rebooting the system, the new folder/files/printer or network will be added to the existing Home group following the steps below.

Step 1: Use the **Windows key + E** keyboard shortcut to open File Explorer.

Step 2: On the left pane, expand your computer's libraries on Home Group.

Step 3: Right-click **Documents.**

Step 4: Click **Properties.**

Step 5: Click **Add.**

Step 6: Select the folder you want to share and click **Include folder.**

Step 7: Click **Apply.**

Step 8: Click **OK.**

Now the folder will be accessible by anyone joined in the Home Group when they browse the Documents folder

PART 2: WIRELESS router connection and setting

PROJECT I (lesson 1): WIRELESS ROUTER CONNECTION AND SETTING

2 periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Using the project 3.2facilitate students to recall ideas on wireless communication from the previous lessons and setting wireless router.

b) Teaching resources:

- Computer lab, browser , Ethernet cables
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Help learners to know the materials needed to configure wireless router.
- Guide students/learners in recalling different steps to configure wireless router.
- Guide learners in configuring Wireless router.

PROJECT I: WIRELESS ROUTER SECURITY CONFIGURATION

2 periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Using the project 3.2facilitate students to recall ideas on wireless communication from the previous lessons and setting wireless router security configuration.

b) Teaching resources:

- Computer lab, browser , Ethernet cables
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Facilitate learners to know the materials needed to configure wireless Access point
- Facilitate students/learners to recall different steps to configure wireless Access point.
- Facilitate learners to configure Wireless access point.

Answers to Project 3.2.A

d) Project 3.2.B

The answers to this project can be found by referring to content under Project II: Wireless security configuration

PART 3: CLIENT/ SERVER CONFIGURATION

PROJECT I: CREATING AND SETTING AN FTP FOLDER

2 periods: 80 minutes

a) Prerequisites/Revision/Introduction:

- Introduce the lesson by asking students what they have learnt in previous lessons 1 and 2 by recalling them materials to build client to server network
- Using the learning activity facilitate students to understand and to do practice of on how to build an FTP client/server network.

b) Teaching resources:

- Computer lab, an FTP Folder , IP address, Ping command
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Facilitate learners/ students to list different materials needed to build an FTP client/server network
- Explain students/learners clearly different steps to build an FTP client/server network.
- Facilitate learners to understand WEP, WPA, and WPA2 wireless security protocols and why security is important.

Project 3.3.A

Step 1: Create a folder that your FTP users will be accessing on C: drive.

Step2: Press the "Windows key + R" on your keyboard to open the Run window, and type CMD, click OK to open the command prompt window.

Step3: Here type "ipconfig" and press enter, write down the IP address and the default gateway IP, because we are going to use it in the next steps. Here the following IP addresses will be used: 10.0.0.17 and 10.0.0.1

Step4: Then go to Control Panel -> Programs and Features.

Step5: Navigate to Turn Windows features on or off on the top left.

Step 6: Select the check box, next to "Internet Information Services" also collapse it to check mark "FTP Server" and "FTP Extensibility", then click the OK button and wait for the features to be added.

PROJECT II: CREATING AND SETTING AN FTP SITE

2 periods: 80 minutes

a) Prerequisites/Revision/Introduction:

- Introduce the lesson by asking to students what they have learnt in previous lessons recalling them steps needed to create and set an FTP site
- Using the learning activity help students understand and do practice on how to build an FTP site.

c) Teaching resources:

- Computer lab, an FTP Folder, IP address.
- Internet and textbooks to facilitate research

d) Learning activities:

Guidance

- Facilitate learners/students to list different materials needed to build an FTP client/server network
- Explain to students/learners clearly different steps to build an FTP client/server network.
- Facilitate learners to understand WEP, WPA, and WPA2 wireless security protocols and why security is important.

Answers to Project 3.3.B

Step 7: Go to Control panel, Administrative tools,

Step 8: Internet Information Services (IIS) Manager,

Step 9: Expand the root and right click on Sites to create a new FTP Site, click on "add FTP Site…"

Step 10: Give your FTP site a name, such as "AvoidErrors", and browse for the folder we created initially. This will be the default location where files will be accessible on the server via FTP.

Step 11: On the Binding and SSL Settings page, click on the drop down to select the IP Address of the computer, Select "No SSL". If you do have an SSL certificate, you can choose either "Require SSL" or "Allow SSL".

Note: Be sure to require SSL if you intend to make this FTP server accessible via the Internet.

On the Authentication and Authorization Information screen, change "Authentication" option to "Basic" (require's that the FTP users specify a login ID and password).

Step 12: Authorization section, select "Specified Users", and Read & Write permissions. Alternatively, you can choose specific user accounts or a group, and limit permission to only Read or Write. Click Finish.

Step 13: Now your new IIS Site is properly created.

Step14: Create a local user account, and give it permission on the FTP content directory:
*If you prefer to use an already existing local computer user account instead of creating one you can skip the create user step and skip to open windows firewall ports.

To allow additional users you must:

1. Create a Windows 10 User.

2. Create a new IIS Rule for the new user.

3. Add the new User to the security settings of the FTP folder.

Open firewall ports for FTP:

Open Control Panel… (View by: "Small icons" recommended)… Windows Firewall… Select "Allow an app or feature through Windows Firewall" -> Change Settings button

Select the checkbox next to "FTP Server" and at least one of the networks, and then click on OK.

PROJECT III: CREATING RULES AND SHARING FOLDERS

2 periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Introduce the lesson by asking students what they have learnt in previous lessons recalling them steps needed to create and set an FTP site

b) Teaching resources:

- Computer lab, an FTP Folder , IP address.
- Internet and textbooks to facilitate research

c) Learning activities:

- Facilitate learners/ students to list different materials needed to build an FTP client/server network
- Explain students/learners clearly different steps to build an FTP client/server network.
- Guide students in discovering how to create rules

Project 3.3.C

To add the new user to the security settings of the FTP folder:

The following steps are a follow up of the steps in project 3.3.B aimed at creating an FTP site. After those phases continue with the steps below:

Process 1: Locate the folder that your FTP users will be accessing (example: C:\FTP-Folder), right click the folder... select Properties -> Security tab... and add the user that was created in the previous step with appropriate permissions.

Step15: Once you have tested the FTP over the LAN than we are ready to access it via WAN. To allow FTP connection you must enable Port 21 in your router's firewall to allow incoming connection via FTP port 21.

Process 2: Select the proper Site in IIS Manager and on the right, navigate to FTP Authorization Rule.

Process 3: Right click an empty space and select Add Allow Rule...

Process 4: Here check mark specified users and write the user name. Make sure is first created in windows 10 and click OK.

To add the new user to the security settings of the FTP folder:

Process 5: Locate the folder that your FTP users will be accessing (example: C:\FTP-Folder), right click the folder... select Properties -> Security tab... and add the user that was created in the previous step with appropriate permissions.

3.6 Summary of the unit.

Computers are connected together to share services and resources. Computers are connected on the network using cables as guided media and radio waves as unguided media. Computer networks are build depending on the owner needs, ability of IT technician, geographical infrastructure and financial means. The advantages of having any types of network are to share folders, printers, files and internet at to the clients or peer. In this regard, the following are three types to build network: **P2P Network, Wireless Access point, Client/ Server network**

Building P2P network is not easy but only requires the maximum of 10 computers, UTP CAT6 cables build as Crossover cables to connect different devices such as hub to hub, computer to computer, switch to switch etc., and straight through cables to connect the same devices such as Computer to switch, computer to hub etc. Switch/hub is needed as central devices where we use a star topology to build P2P network with the following steps.

Step 1: Make sure all computers are turned off, organized and arranged.

Step 2: install central devices (Switch or hub).

Step3: Connect each end of the UTP CAT 6 straight through cables to connect computers to Switch/ Hub

Step 4: configure static IP address for each computer.

Step 5: Ping each computer to verify if they are connected

Wireless access point only takes a few simple steps but also need a configured router, when router is going to be used at the first time, it has a default configuration. A wireless

router, computer/laptop with wireless capability, a modem/SIM card and two Ethernet cables are needed for Wireless access point configuration. When configuring Wireless Access point many wireless security protocol is needed, security protocols are listed from the best to the worst namely WPA2+AES, WPA+AES, WPA+TKIP/AES, WPA+TKIP, WEP and the last one which is not advisable is Open network with no security. Different step are stated for Wireless access point configuration **(see student book Unit 3)**

Another type of network is **Client/servernetwork.** At this level, an FTP client/server network is needed to upload and download files from anywhere to PC as well as to cloud storage without limitations. Setting up a File transfer protocol (FTP) server may sound complicated, but it is actually quite easy to set up specially if using Windows 10, the following are steps to create an FTP client/server network

Step 1: Create a folder that your FTP users will be accessing on C: drive.

Step2: Press the "Windows key + R" on your keyboard to open the Run window, and type CMD, click OK to open the command prompt window.

Step3: Configure IP address to be used

Step4: Selecting program features

Step5: Navigate to Turn Windows features on or off on the top left.

Step6: Navigate to Internet Information Services

Step 7: Go to Control panel, Administrative tools,

Step 8: Internet Information Services (IIS) Manager,

Step 9: Expanding the root

Step10: Give your FTP site a name

Step11: On the Binding and SSL Settings page

Step12: Authorization section

Step13: creating IIS site

Step14: Create a local user account

Step15: enabling Port 21 in your router's firewall to allow incoming connection via FTP port 21

3.7 End unit assessment

This part provides the answers of end unit assessment activities designed in integrative approach to assess the key unit competence with cross reference to the textbook.

The teacher's guide suggests additional questions and answers to assess the key unit competence.

1. Lab activity: a given 5 computers with the following IP addresses: 198.162.0.117, 198.162.0.114, 198.162.0.118, 198.162.0.119, 198.162.0.116, the subnet mask is 255.255.255.0 assigned to all computers

a. Create a P2P network

b. Add a home group and share folders, music and files to all computers.

Answers: in this project follow the same steps to create P2P network, Wireless router configuration and Client/server network **(Unity 3 in student book)**

3.8. Consolidation, Remedial and extended activities

3.8.1 Consolidation activities

Consolidation activities: Suggestion of questions and answers for deep development of competences.

Project1: Computers,Given UTP CAT 6 Ethernet cable, RG45, Crimping tools, Scissor, Cable tester

a) Create Crossover and Strait through cables.

b) Assign each computer a static IP address

c) Create an FTP site

Answers:

a) Steps to build an Ethernet cable

Step 1: Cut into the plastic sheath about 1 inch (2.5 cm) from the end of the cut cable. The crimping tool has a razor blade that will do the trick with practice.
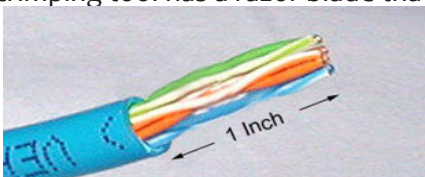
Figure 1) Cutting plastic sheath

Step 2: Unwind and pair the similar colors.
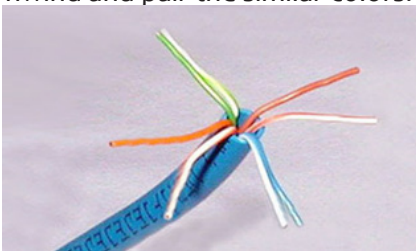
Figure 2) Pairing similar wires

Step 3: Pinch the wires between your fingers and straighten them out as shown. The color order is important to get correct.
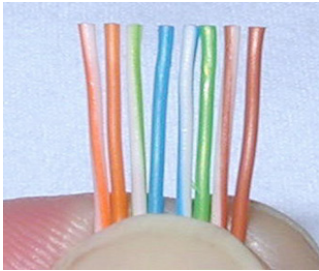
Figure 3) Pinching wire between fingers

Step 4: Use scissors to make a straight cut across the 8 wires to shorten them to 1/2 Inch (1.3 cm) from the cut sleeve to the end of the wires.

Step 5: Carefully push all 8 unstripped colored wires into the connector. Note the position of the blue plastic sleeve. Also note how the wires go all the way to the end.

Figure 4) pushing cable into the connector

Step 6: Crimping the cable carefully place the connector into the Ethernet Crimper and cinch down on the handles tightly. The copper splicing tabs on the connector will pierce into each of the eight wires. There is also a locking tab that holds the blue plastic sleeve in place for a tight compression fit. When you remove the cable from the crimper, that end is ready to use.

Figure 5 Crimping cable

Note: For a standard "Straight Through" cables, repeat all steps and wire color order on the other end of cable. For a cross-over cable, the other end will have a different color order.

Step 7: Make sure to test the cables before installing them. An inexpensive Ethernet cable tester does this quite well.

Figure 6) cables Testing

a) Follow the steps in the student book to P2P building, **(Project II)**

b) Follow the steps in the student book to configure an FTP Client/server network **(Project I and II)**

3.8.2 Remedial activities

Suggestion of Questions and Answers for remedial activities for slow learners.

Q1. State different steps to build peer to peer network

Answer:

Step 1: Make sure all computers are turned off, organized and arranged.

Step 2: Install central devices (Switch or hub).

Step 3: Connect each end of the UTP CAT 6 straight through cables to connect computers to Switch/ Hub.

Step 4: Define IP address scheme

Step 5: Configure static IP address for each computer.

Step 6: Ping each computer to verify if they are connected

Step 7: do the same as what you did on step 5 to all PCs

Q2: State different steps to configure wireless router

Answer:

Step 1: Prepare router and switch on it.

Step2: Connect router to the Laptop/PC with wireless capability

Step3: Access Dashboard using default IP address and Password

Step4: Configure internet using information from the ISP

Step5: Configure LAN and IP using DHCP

Step 5: DHCP Settings and select **disable the DHCP Server.**

Step 6: Set the IP from ISP and go to the System Tools and Reboot the device.

Q3. What are advantages of Client/server network?

Answer: Centralization, Proper Management, Back-up and Recovery possible, Upgradation and Scalability in Client-server set-up, Accessibility, Security.

Servers can play different roles for different clients.

3.8.3 Extended activities

Suggestion of Questions and Answers for gifted and talented students.

Project 1: A given three PCs, Ethernet cable, IP addresses: PC0: 192.168.0.112; PC1: 192.168.0.113; PC2: 192.168.0.114

a) Build an FTP client/server network

b) Consider IP address of PC2, configure wireless router connection

c) Consider PC0 and PC2; build a peer to peer network.

d) What makes your authentication password strong? What measure can you take to avoid an authorized user of your network?

Answers:

a) Follow the steps in the student book to build an FTP client/server network (Project 1, 2 and 3)

b) Follow the steps in the student book to configure wireless router connection (Project 1and 2)

c) Follow the steps in the student book to build a P2P network (Project 1, 2 and 3)

Note: here we use only two PCs, we don't need Crossover cables and central devices (Switch/Hub)

UNIT 4: SQL AND DATABASE PROJECT

4

4.1. Key unit competence:

To be able to apply Structured Query Language in RDBMS and create a short database project

4.2. Prerequisite knowledge and skills:

Students should ideally have some knowledge and skills related to introduction to database and database design

4.3. Cross-cutting issues to be addressed:

- **Financial Education:** Practical exercises that involve business issues
- **Standardization culture:** While developing a database, a customer gives system requirements to developer. It is a good practice to initiate a learner to meet customer's expectation while developing databases and meet all agreements as signed in contract.
- **Inclusive education:** All students must get involved in class activities regardless of any kind of disability they may present.
- **Gender education:** All students must get involved in class activities regardless of gender.

4.4 Guidance on the introductory activity

- The introductory activity is done in the form of a survey
- The teacher divides the class into groups of four to do the introductory activity
- The teacher gives guidance on how the activity is going to be done by specifying the objectives and the expected outcomes
- Groups exchange their work and one group present their finding in front of the class, other students may ask questions which may be answered by the members of the group presenting or any student. The teacher completes them where necessary.
- For questions whose answers can not immediately be found due to lack of required knowledge on the side of students, the teacher explains that they will be able to answer to those questions at the end of the lesson

4.5 List of lessons (including assessment)

#	Lesson title	Number of Periods
1	Unary operations	1
2	Binary operations	2
3	Data Definition Language (DDL) : create, use, drop	3
4	Data Definition Language (DDL) : alter	3
5	Data Manipulation Language (DML) : insert, delete	3
6	Data Manipulation Language (DML):select (select all, set criteria such as OR, AND, BETWEEN, LIKE, HAVING, TOP, GROUP BY, ORDER, etc)	3
7	Data Manipulation Language (DML): select (sub queries)	2
8	Aggregate functions	2
9	String Expressions	2
10	SQL Joins (introduction and basic statements)	3
11	SQL Joins (advanced concepts)	3
12	Data Control Language (DCL)	2
13	Database security concept	2
14	Database threats	1
15	Database protection	1
16	Database planning, designing and Management	2
17	End unit assessment	1
		36

Guidance on different lessons outlined above

LESSON 1: UNARY OPERATIONS

Periods: 1

a. Prerequisites/Revision/Introduction:

Teacher will guide the student to recall operators as learnt in senior four, unit 11. He / She will focus on arithmetic operators that they used in C++. In this lesson, teacher will rotate around incrementation and decrementation as they are unary operators.

b. Teaching resources:

Library, student books, digital content

Teaching technics and methods:

- Learning activities can be done in groups (form group considering available resources, space and class size).

- Application activities should be done individually

- Teacher should ask flash questions to check if learners understand

c. Learning activities:

In group, learners will discuss **Learning activity 4.1** thereafter, groups will exchange the findings.

Answers to learning activity 4.1:

1) Kabeza Company Ltd is running a business and wishes to manage transactions in computerized way. The database of business contains various entities including "Customers" (id, names, age, address, salary) and orders (id, date, customer_id, amount) which are given here below. Help your school to find a solution to get the following:

i. The highly paid employee

Select max(salary) as Highly_paid_employee from customers;

ii. The least paid employee

Select min(salary) as Least_paid_employee from customers;

iii. The oldest employee

Select max(age) as oldest from customers;

iv. The youngest employee

Select min (age) as youngest from customers;

v. To generate total amount of income at a given day.

Select sum(amount) as total_income from orders;

vi. To retrieve only the names and age of all employees

Select names,age from customers;

vii. To retrieve the average income at a given day.

Select avg(amount) as average from orders;

Learners will do individually Learning activity 4.2 under teacher's guidance and facilitation.

d) Application activity

i. σsalary>2000("Customers")

d. Application activity

- Application activity 4.1, will be done individually to assess if learners are understanding the concept of selection operation.

```
+----+-----------+-----+-----------+--------+
| id | name      | age | address   | salary |
+----+-----------+-----+-----------+--------+
|  4 | mugisha   |  25 | nyamagabe |   6500 |
|  5 | nyampundu |  27 | gasabo    |   2125 |
|  6 | uwera     |  22 | nyagatare |   4500 |
|  7 | mutoni    |  24 | Ngororero |  10000 |
+----+-----------+-----+-----------+--------+
```

ii. σage>=23 AND address≠ kigali("Customers")

```
+----+-------------+------+-----------+---------
| id | name        | age  | address   | salary
+----+-------------+------+-----------+---------
| 1  | keza        | 32   | kigali    | 2000
```

Application activity 4.2, will be done individually to assess if learners are understanding the concept of projection operation.

The resulting relation will look like this:

i.

```
+----+-----------+
| id | address   |
+----+-----------+
| 1  | kigali    |
| 2  | muhanga   |
| 3  | huye      |
| 4  | nyamagabe |
| 5  | gasabo    |
| 6  | nyagatare |
| 7  | Ngororero |
+----+-----------+
```

ii.

```
+----------+--------+
| name     | salary |
+----------+--------+
| mugisha  | 6500   |
| mutoni   | 10000  |
+----------+--------+
```

LESSON 2: BINARY OPERATIONS

Periods: 2

a. Prerequisites/Revision/Introduction:

Teacher will guide the student to recall operators as learnt in senior four, unit 11. He / She will focus on arithmetic operators that they used in C++. In this lesson, teacher will rotate around addition, subtraction, division, multiplication as they are binary operators.

b. Teaching resources:

Library, student books, digital content

Teaching technics and methods:

- **Some** Learning activities can be done in groups (form group considering available resources, space and class size).

- Application activities should be done individually
- Teacher should ask flash questions to check if learners understand

c. Learning activities:

- Under teacher's facilitation, learner will do learning activity 4.3, for internalizing Cartesian product.
- Learning activity 4.4, will help a learner to understand union operation

    Answer to activity 4.4:

    The operation used is union

- **Learning activity 4.5,** is here to help a learner to use difference operation

    Answer to activity 4.5:

    The operation used is difference

d. Application activity

1) Application activity 4.3, will be done individually and will help learners to fetch information from different relations and put them together according to required criteria:

Expected results:

XxY

A	B	C	D
1	2	6	7
1	2	8	9
3	4	6	7
3	4	8	9

2) Application activity 4.4, will help a learner to internalize and apply learnt concepts:

XUY

A	B
1	2
3	4
6	7
8	9

3)Application activity 4.5, will be done individually and will help learners to fetch information from different relations and put them together according to required criteria:

a)

Name
Mukama
Cyiza

b)

Id	Name	Age	Gender	OccupationId	CityId
3	Victor	31	Male	2	5
4	Jane	27	Female	1	3

c)

Id	Name	Age	Gender	Occupa-tionId	CityId	Occupa-tionId	Occupation-Name
1	Mukamana	25	Male	1	3	1	Software Engineer
2	Gakuru	20	Female	3	4	3	Pharmacist
3	Mukamana	31	Male	2	5	2	Accountant
4	Cyiza	27	Female	1	3	1	Software Engineer

d)

Name	Gender
Mukamana	Male

1. By definition unary operators are operators that use only one operand (relation). In Relational algebra, the unary operators are s**electionand projection** WHEREAS Binary operators are operators that use two operands (relations). In Relational algebra, the   binary operators are Cartesian product, Union operator, Set Difference, Intersection

2. Selection is a unary operation that selects records which satisfy a given predicate (criteria). It selects a subset of records.

Given the Customers table:

```
+----+-----------+-----+----------+--------+
| id | name      | age | address  | salary |
+----+-----------+-----+----------+--------+
|  1 | keza      | 32  | kigali   | 2000   |
|  2 | muhirwa   | 25  | muhanga  | 1500   |
|  3 | kabandana | 23  | huye     | 2000   |
|  4 | mugisha   | 25  | nyamagabe| 6500   |
|  5 | nyampundu | 27  | gasabo   | 8500   |
|  6 | uwera     | 22  | nyagatare| 4500   |
|  7 | mutoni    | 24  | rusizi   | 10000  |
+----+-----------+-----+----------+--------+
```

Using the selection operation you can display all data of Customers table where value in name column is mugisha, you should write:

σ name='Mugisha' ("Customers")

output

```
+----+----------+-----+------------+---------+
| id | name     | age | address    | salary  |
+----+----------+-----+------------+---------+
|  4 | mugisha  |  25 | nyamagabe  |   6500  |
+----+----------+-----+------------+---------+
```

WHEREAS, the PROJECTION operation is another unary operationagain that returns a set of tuples containing a subset of the attributes in the original relation.It retrieves some columns in the table.

Example:

$$\prod_{DISTRICT}(Student)$$

Student

Id	Name	DISTRICT
1108	BUSHAKE	BURERA
3936	KALIZA	HUYE
8507	YOHANI	NYANZA
8452	SHYAKA	GASABO

Result

DISTRICT
BURERA
HUYE
NYANZA
GASABO

4.
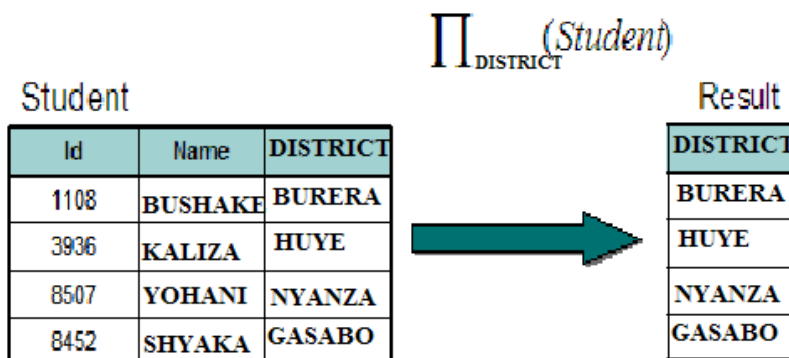
- Π number,surname(δcustomer=Rwanda("Represantative"))
- Π number,surname ("Represantative")

Notes:

- For remaining questions, teacher should summarize what were learnt and should come up with another solutions for binary and unary operations
- The teacher should summarize what was learnt and should come up with another solutions for selection and projection operations.

LESSON 3: DATA DEFINITION LANGUAGE (DDL): CREATE, USE, DROP

Periods: 3

a. Prerequisites/Revision/Introduction:

Database design, S5: unit 5

b. Teaching resources: Books, Computers, RDBMS Software, Projector

Teaching technics and methods: Individual work, Group work, assignment

c. Learning activities:

Learning activity 4.6:

1.   Consider the following relational schema of HIJK database;

Departments (Dept_Code (integer), name (text) , Budget (number))

Employees (SSN (integer), first_name (text), last_name (text), Dept_Code (integer, foreign key)

Write SQL query to:

i.   Create the above relations (tables)

```
mysql> create table Employees (SSN integer, first_name text,last_name text, Dept_Code integer);
```

ii.   Add at least ten records

```
mysql> insert into Departments values(1,'computer science', 150000000);
```

iii.   Select the last name of all employees, without duplicates.

```
mysql> select distinct last_name from employees;
```

iv.   Select all the data of employees whose first name is "Peter" or "Diane".

```
mysql> select * from employees where first_name="peter" or first_name="Diane";

+------+------------+--------------+-----------+
| SSN  | first_name | last_name    | Dept_Code |
+------+------------+--------------+-----------+
|    1 | peter      | turabumukiza |         2 |
|    2 | Diane      | Muhoracyeye  |         7 |
|    6 | Diane      | Uwayezu      |         7 |
+------+------------+--------------+-----------+
```

v.   Retrieve the sum of all the departments' budgets.

```
mysql> select sum(budget) as Total_Budget from departments;
+--------------+
| Total_Budget |
+--------------+
|    207000000 |
+--------------+
```

vi. Retrieve all the data of employees whose last name begins with letter "U".

```
mysql> select * from employees where last_name like 'u%';
+------+------------+-----------+-----------+
| SSN  | first_name | last_name | Dept_Code |
+------+------------+-----------+-----------+
|    3 | Prosper    | Uwayezu   |         4 |
|    5 | Aline      | Umutoni   |         6 |
|    6 | Diane      | Uwayezu   |         7 |
+------+------------+-----------+-----------+
```

vii Show the number of employees in each department (you only need to show the department code and the number of employees).:SELECT Dept_Code,COUNT(SSN) as EMPLOYEE_NO FROM Departments,   Emlpoyees;

viii. Select the first name and last name of employees working for departments with a budget greater than 6,000,000 (currency: Rwf) : SELECT first_name,last_name FROM Employees, Departmenst WHERE Bugdet>Dep6 000 000 ;

ix Show the departments with a budget larger than the average budget of all the departments: SELECT name FROM Departments HAVING Budget > AVG(Budget);

Notes:

− For remaining questions, teacher should summarize what were learnt and should come up with another solutions.

− The teacher should summarize what was learnt and should come up with another solutions.

x. Add a new department called "Quality Assurance", with a budget of 4,000,000 (currency: Rwf) and departmental code 11. Add an employee called "" in that department, with SSN 847-21-9811.

xi. Reduce the budget of all departments by 10%.

xi. Delete from the table all employees in the IT department (code 14).

LESSON 4: DATA DEFINITION LANGUAGE (DDL): CREATE, ALTER AND DROP

Periods: 3

a. Prerequisites/Revision/Introduction:

Teacher will do a revision on create statement and focus on asking learner what should be done if a mistake was made while creating a relation. Simply, some changes must be done. The challenge will be how these changes can be made! The solution to this challenge, will be alter.

b. Teaching resources:

Books, digital content, internet, computers, RDBMS

Teaching technics and methods:

• Some learning activities can be done in group while others can be done individually.

- All application activities must be done individually.

c. Learning activities:

Always database name should be unique within the RDBMS.

Learning activity 4.7:

Create the database XYZLtd

```
mysql> create database XYZLtd;
```

```
DOS MySQL 5.7 Command Line Client - Unicode
mysql> use xyzltd;
Database changed
mysql> create table customers(
    ->    id           int                  not null,
    ->    name         varchar (20)      not null,
    ->    age          Int                   not null,
    ->    address      char (25) ,
    ->    salary       Int,
    ->    primary    key (id)
    -> );
Query OK, 0 rows affected (0.48 sec)

mysql>
```

Activity 4.8:

Consider "Customers" relation, perform the following tasks;

i. Add new column "sex"

```
mysql> alter table customers add sex varchar(30);
```

ii. Change the datatype of salary to decimals

```
mysql> alter table customers modify salary decimal;
```

iii. Add "Not null" constraint to age field (column)

```
mysql> alter table customers modify age integer not null;
```

iv. Remove the column "sex"

```
mysql> alter table customers drop sex;
```

v. Drop "not null" constraint from age field.

```
mysql> alter table customers modify age int not null;
```

Activity 4.9:

Create/ insert six records in "Customers" table (relation). Use two possible ways to insert records (tuples) in a table:

First method:

```
Query OK, 1 row affected (0.16 sec)

mysql> insert into customers (id,name,age,address,salary)
    -> values (2, 'muhirwa', 25, 'muhanga', 1500 );
Query OK, 1 row affected (0.01 sec)

mysql>
mysql> insert into customers (id,name,age,address,salary)
    -> values (3, 'kabandana', 23, 'huye', 2000 );
Query OK, 1 row affected (0.06 sec)

mysql>
mysql> insert into customers (id,name,age,address,salary)
    -> values (4, 'mugisha', 25, 'nyamagabe', 6500 );
Query OK, 1 row affected (0.05 sec)

mysql> insert into customers (id,name,age,address,salary)
    -> values (5, 'nyampundu', 27, 'gasabo', 8500 );
Query OK, 1 row affected (0.06 sec)

mysql>
mysql> insert into customers (id,name,age,address,salary)
    -> values (6, 'uwera', 22, 'nyagatare', 4500 );
Query OK, 1 row affected (0.06 sec)
```

Second method:

```
mysql> insert into customers
    -> values (7, 'mutoni', 24, 'rusizi', 10000 );
Query OK, 1 row affected (0.09 sec)
```

All the above statements would produce the following records in "Customers" table:

```
mysql> insert into customers
    -> values (7, 'mutoni', 24, 'rusizi', 10000 );
Query OK, 1 row affected (0.09 sec)

mysql> select * from customers;
+----+-----------+-----+-----------+--------+
| id | name      | age | address   | salary |
+----+-----------+-----+-----------+--------+
|  1 | keza      |  32 | kigali    |   2000 |
|  2 | muhirwa   |  25 | muhanga   |   1500 |
|  3 | kabandana |  23 | huye      |   2000 |
|  4 | mugisha   |  25 | nyamagabe |   6500 |
|  5 | nyampundu |  27 | gasabo    |   8500 |
|  6 | uwera     |  22 | nyagatare |   4500 |
|  7 | mutoni    |  24 | rusizi    |  10000 |
+----+-----------+-----+-----------+--------+
7 rows in set (0.00 sec)                    New record

mysql>
```

Assessment:

Consider "Customers" relation, perform the following tasks;

i.   Add new column "sex"

```
mysql> alter table customers add sex varchar(30);
```

ii.   Change the datatype of salary to decimals

```
mysql> alter table customers modify salary decimal;
```

iii. Add "Not null" constraint to age field (column)

```
mysql> alter table customers modify age integer not null;
```

iv. Remove the column "sex"

```
mysql> alter table customers drop se
```

v. Drop "not null" constraint from age field.

```
mysql> alter table customers modify age int not null;
```

LESSON 5: DATA MANIPULATION LANGUAGE (DML): INSERT, DELETE

Periods: 3

a. Prerequisites/Revision/Introduction:

Revision can be done on creating table. Thereafter, teacher will guide learners to recall the role of table in database. Learner will find that a table is used to store records. Then, the challenge will be to ask how these records get into table!! The solution of this challenge will "insert" statement.

b. Teaching resources:

Books, digital content, internet, computers,

Teaching technics and methods: Individual activities and Oral questions on insert syntax

c. Learning activities:

See learning activity 4.11 in student book, it has a guidance to solution

Assessment:

d. Application activity 4.5:

To create library database:

```
mysql> create database library;
```

To create table book:

```
mysql> create table book(ISBN varchar(30) primary key,title varchar(30),author
varchar(30),pages integer, price integer);
```

To check if the table was successfully created:

```
mysql> desc book;
+---------+-------------+------+-----+---------+-------+
| Field   | Type        | Null | Key | Default | Extra |
+---------+-------------+------+-----+---------+-------+
| ISBN    | varchar(30) | NO   | PRI | NULL    |       |
mysql> insert into book values('45050166-30','big data','Nyiranamajimana',77,4
000);
| pages
| price   | int(11)     | YES  |     | NULL    |       |
+---------+-------------+------+-----+---------+-------+
```

LESSON 6: DATA MANIPULATION LANGUAGE (DML): SELECT

(select all, set criteria such as or, and, between, like, having, top, group by, order, etc)

Periods: 3

a. Prerequisites/Revision/Introduction:

Teacher can introduce this topic by asking students how reports are done. Normally, reports are built upon setting criteria and select records that meet such criteria. This is to mean that for example in a school, we may produce a report of girls learning in Senior 6. To achieve this, learner will need to practice statements that implement criteria.

b. Teaching resources:

Books, digital content, internet, computers, RDBMS

Teaching technics and methods: Group work, individual works, small projects

c. Learning activities:

Learning activities are done under teacher's facilitation as they are in student's book

d. Application activity

Application activity 4.6:

You are given a flat database named "Library", with a relation Book (ISBN (Text, primary key), title (text), author (text), pages (integer), and price (integer)). Create this database and relation, then insert at least five records.

Database creation and inserting record are covered in previous topic, learners just apply

Retrieve ISBN and price of books written by "Bigirumwami"

```
mysql> select ISBN,price from book where author='Bigirumwami';
+-------------+-------+
| ISBN        | price |
+-------------+-------+
| 47050167-40 | 40000 |
+-------------+-------+
```

Retrieve books whose price is between 30,000 and 200,000 Rwf

```
mysql> select * from book where price between 30000 and 200000 ;
+-------------+----------+-------------+-------+-------+
| ISBN        | title    | author      | pages | price |
+-------------+----------+-------------+-------+-------+
| 47050167-40 | Imigenzo | Bigirumwami |   787 | 40000 |
+-------------+----------+-------------+-------+-------+
```

Select title and pages of all books

```
mysql> select title,pages from book;
+------------+-------+
| title      | pages |
+------------+-------+
| C++        |    70 |
| C          |   710 |
| networking |   552 |
| Database   |   552 |
| Java       |   300 |
| big data   |    77 |
| Imigenzo   |   787 |
+------------+-------+
```

Show the books that have more than 300 pages or books that cost more than 4,000 Rwf

Retrieve books written by authors whose name is started by A, B or C.

```
mysql> select * from book where pages>300 or price>4000;
+-------------+------------+-------------+-------+-------+
| ISBN        | title      | author      | pages | price |
+-------------+------------+-------------+-------+-------+
| 34445645-20 | C          | Umwari      |   710 |  2123 |
| 35050115-20 | networking | Kaneza      |   552 |  2211 |
| 35050115-30 | Database   | Mahoro      |   552 |  2211 |
| 35050116-30 | Java       | Ruberanziza |   300 |  4500 |
| 47050167-40 | Imigenzo   | Bigirumwami |   787 | 40000 |
+-------------+------------+-------------+-------+-------+
```

Order the books 'titles' from A to Z.

Retrieve top three books.

Delete books which have less than 50 pages

```
mysql> delete from book where pages<50;
```

Delete books written by "Kagame".

```
mysql> delete from book where author='Kagame';
```

LESSON 7: DATA MANIPULATION LANGUAGE (DML): SELECT

Periods: 2

a. Prerequisites/Revision/Introduction:

Revision will be done on covered concepts of "select" statement.

b. Teaching resources:

Books, digital content, internet, computers, RDBMS

Teaching technics and methods: Group work, individual works, small projects

c. Learning activities:

Learning activities are done under teacher's facilitation as they are in student's book

d. Application activity:

Teacher will use activities vi, vii,viii from activity 4.6

LESSON 8: AGGREGATE FUNCTIONS

Periods: 2

a. Prerequisites/Revision/Introduction:

Revision will rotate on select statements that have been discussed in class. This is because aggregate functions use much select statement

b. Teaching resources:

Books, digital content, internet, computers, RDBMS

Teaching technics and methods: Group work, individual works, small projects, homework

c. Learning activities:

They are facilitated by teacher to guide a learner as the expected answers are given in screenshots in learner's book

d. Application activity

Application activity 4.7:

You are given a flat database named "Library", with a relation Book (ISBN (Text, primary key), title (text), author (text), pages (integer), and price (integer))

Create this database and relation, then insert at least five records.

Covered in previous topics, just a learner will apply

Retrieve the amount to get when all books are sold.

```
mysql> select sum(price) as Total_amount from book;
+--------------+
| Total_amount |
+--------------+
|        55268 |
+--------------+
```

Retrieve the most expensive book.

```
mysql> select title,max(price) as Most_Expensive from book;
+-------+----------------+
| title | Most_Expensive |
+-------+----------------+
| C++   |          40000 |
+-------+----------------+
```

Select the least expensive book

```
mysql> select min(price) as cheap_book from book;
+------------+
| cheap_book |
+------------+
|        223 |
+------------+
```

Show the total number of the books in book relation.

```
mysql> select count(ISBN) as total_number_of_books from book;
+-----------------------+
| total_number_of_books |
+-----------------------+
|                     7 |
+-----------------------+
```

Find the average price of the books

```
mysql> select avg(price) as Average_price from book;
+---------------+
| Average_price |
+---------------+
|     7895.4286 |
+---------------+
```

LESSON 9: STRING EXPRESSIONS

Periods: 2

a. Prerequisites/Revision/Introduction:

Revision can be done on string functions as learnt in C++, S4 Unit 14

b. Teaching resources:

Books, digital content, internet, computers, RDBMS

Teaching technics and methods: Group work, individual works, small projects, homework, Oral questions

c. Learning activities:

They are facilitated by teacher to guide a learner as the expected answers are given in screenshots in learner's book

d. Application activity

Application activity 4.8:

You are given a flat database named "Library", with a relation Book (ISBN (Text, primary key), title (text), author (text), pages (integer), and price (integer))

Find the length of the title of the book which has 35050115-30 as ISBN

```
mysql> select ISBN,title,length(title) as Lenght_of_database_word from book where ISBN='35050115-30';
+-------------+----------+--------------------------+
| ISBN        | title    | Lenght_of_database_word  |
+-------------+----------+--------------------------+
| 35050115-30 | Database |                        8 |
+-------------+----------+--------------------------+
```

Reverse the name of the author who wrote the book "Imigenzo".

```
mysql> select author,reverse(author) as reversed_name from book where title='
+-------------+--------------+
| author      | reversed_name |
+-------------+--------------+
| Bigirumwami | imawmurigiB  |
+-------------+--------------+
```

Compare the names "Aloys" and "Alexis".

```
mysql> select strcmp('aloys','alex')
+----------------------+
| strcmp('aloys','alex') |
+----------------------+
|                    1 |
```

Change "Ndi umunyarwanda" in upper case.

```
mysql> select upper('Ndi umunyarwanda');
+--------------------------+
| upper('Ndi umunyarwanda') |
+--------------------------+
| NDI UMUNYARWANDA         |
+--------------------------+
```

Change "HELP EACH OTHER" in lower case

```
mysql> select lower('HELP EACH OTHER');
+-------------------------+
| lower('HELP EACH OTHER') |
+-------------------------+
| help each other         |
+-------------------------+
```

LESSON 10: SQL JOINS

(introduction and basic statements)

Periods: 3

a. Prerequisites/Revision/Introduction:

Here revision can be most fitting. Teacher can recall commonly used select statements as they will be highly used while manipulating joins

b. Teaching resources:

Books, digital content, internet, computers, RDBMS

Teaching technics and methods: Group work, individual works, small projects, homework, Oral questions

c. Learning activities:

They are facilitated by teacher to guide a learner as the expected answers are given in screenshots in learner's book

d. Application activity

Assessment for join statements will be done in form of projects selected in End unit assessment. This is to mean that the time to start joins, teacher will give learner project to develop where they will apply join statement.

LESSON 11: SQL JOINS

(advanced concepts)

Periods: 3

a. Prerequisites/Revision/Introduction:

Revision should be carried out on basic join concepts

b. Teaching resources:

Books, digital content, internet, computers, RDBMS

Teaching technics and methods: Group work, individual works, small projects, homework, Oral questions

c. Learning activities:

They are facilitated by teacher to guide a learner as the expected answers are given in screenshots in learner's book

d. Application activity

Assessment for advanced join statements will be done in form of projects selected in End unit assessment. This is to mean that the time to start joins, teacher will give learner project to develop where they will apply advanced join statement especially nested queries, etc.

LESSON 12: DATA CONTROL LANGUAGE (DCL)

Periods: 2

a. Prerequisites/Revision/Introduction:

Teacher can introduce this course using S6, unit 1: computer security and highlight the role of data security.

b. Teaching resources:

Books, digital content, internet, computers, RDBMS

Teaching technics and methods:

Group work, individual works, small projects, homework, Oral questions

c. Learning activities:

They are facilitated by teacher to guide a learner as the expected answers are given in screenshots in learner's book

d. Application activities:

Application activity 4.9:

Students answer questions of application activity as a home work. The teacher selects some students who explain the results they found.

Application activity 4.10:

ANSWERS:

1. For this activity, learners will do it in group. Teacher will allow the research time and discussion. They must rotate on problems that occur when unauthorized access happen.

2.Learners in their groups and after conducting a research should discuss the role of granting privileges and present to the whole class

LESSON 13: DATABASE SECURITY CONCEPT

Periods: 2

a. Prerequisites/Revision/Introduction:

Teacher can introduce this course using S6, unit 1: computer security and highlight the role of data security.

b. Teaching resources:

Books, digital content, internet, computers

Teaching technics and methods: Group work, individual works, small projects, homework, Oral questions

c. Learning activities:

Learning activity 4.10:

These questions, are theory oriented and picked from student book notes so teacher will use the student's book for guiding them instead of recopying them here again.

d. Application activities:

Application activity 4.11:

These questions, are theory oriented and picked from student book notes so teacher will use the student's book for guiding them instead of recopying them here again.

LESSON 14: DATABASE THREATS

Periods: 1

a. Prerequisites/Revision/Introduction:

Revision can be done on previous lesson (Database security concepts).

b. Teaching resources:

Books, digital content, internet, computers

Teaching technics and methods:

- Group work, individual works, small projects, homework, Oral questions

c. Learning activities:

Learning activities will be oral questions and conversation which engage discussions about this topic

d. Application activities:

Learning activity 4.11:

The questions of this activity are theory oriented and picked from student book notes so teacher will use the student's book for guiding them instead of recopying them here again.

LESSON 15: DATABASE PROTECTION

Periods: 1

a. Prerequisites/Revision/Introduction:

Revision can be done on previous lesson (Database threats).

b. Teaching resources:

Books, digital content, internet, computers

Teaching technics and methods: Group work, individual works, small projects, homework, Oral questions

c. Learning activities:

Learning activities will be oral questions and conversation which engage discussions about this topic

Assessment:

Application activity 4.12:

To answer this question, students will refer themselves to the content of the student book in the related section. The task of the teacher here is to guide students.

LESSON 16: DATABASE PLANNING, DESIGNING AND MANAGEMENT

Periods: 3

a. Prerequisites/Revision/Introduction:

Revision can be done on Database design, S5, Unit 5.

b. Teaching resources:

Books, digital content, internet, computers

Teaching technics and methods: Group work, individual works, small projects, homework, Oral questions

c. Learning activities:

Learning activities will be oral questions and conversation which engage discussions about this topic

Learning activity 4.12:

These questions, are theory oriented and picked from student book notes so teacher will use the student's book for guiding them instead of recopying them here again.

Application activity:

The assessment will be evaluated in progressive project development as given in end unit assessment.

REMEDIAL ACTIVITIES

XYZ high school's database has the following information:

- Professors have an SSN, a name, an age, a rank, and a research specialty. Projects have a project number, a sponsor name (e.g., USAID), a starting date, an ending date, and a budget.

- Graduate students have an SSN, a name, an age, and a degree program (e.g., Bachelor's or Masters..).

- Each project is managed by one professor (known as the project's principal investigator).

- Each project is worked on by one or more professors (known as the project's co-investigators).

- Professors can manage and/or work on multiple projects.

- Each project is worked on by one or more graduate students (known as the project's research assistants).

- When graduate students work on a project, a professor must supervise their work on the project.

- Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for each one.

- Departments have a department number, a department name, and a main office.

- Departments have a professor (known as the chairman) who runs the department.

- Professors work in one or more departments, and for each department that they work in, a time percentage is associated with their job.

Graduate students have one major department in which they are working on their degree. Each graduate student has another, more senior graduate student (known as a student advisor) who advises him or her on what courses to take.

i. Design and draw an ERD that captures the information about the XYZ High school. Use only the basic ER model here; that is, entities, relationships, and attributes. Be sure to indicate any key and participation constraints.

ii. Use SQL statement to computerize the above ERD.

iii. Use your favorite programming language and design front end to interact with your back end (database).

NB: This activity will be conducted as a project along the course when they start learning about joins.

END UNIT ASSESSMENT

Guidelines to database projects (Part II)

1. Consider the following relations:

Student (*snum: integer*, *sname*: string, *major*: string, *level*: string, *age*: integer)

Class (*name: string*, *meets_at:* string, room: string, *fid*: integer)

Enrolled (*snum:* integer, cname: string)

Faculty (*fid: integer*, fname: string, *deptid:* integer)

a) CREATE TABLE STUDENT

(SNUM	INTEGER	NOT NULL,
SNAME	VARCHAR (15),	
MAJOR	VARCHAR (10),	
SLEVEL	CHAR (2)	NOT NULL,
AGE	NUMBER (3),	

PRIMARY KEY (SNUM));

b) CREATE TABLE FACULTY
```
(FID           INTEGER        NOT NULL,
 FNAME         VARCHAR (12) NOT NULL,
 DEPTID        NUMBER (3),
 PRIMARY KEY (FID));
```

c) CREATE TABLE CLASS
```
(NAME VARCHAR (12)  NOT NULL,
 MEETS_AT      VARCHAR (10),
 ROOM          VARCHAR (5),
 FID           INTEGER,
 PRIMARY KEY (NAME),
 FOREIGN KEY (FID) REFERENCES FACULTY (FID));
```

d) CREATE TABLE ENROLLED
```
(SNUM          INTEGER        NOT NULL,
 CNAME         VARCHAR (12) NOT NULL,
 PRIMARY KEY (SNUM, CNAME),
 FOREIGN KEY (SNUM) REFERENCES STUDENT (SNUM),
 FOREIGN KEY (CNAME) REFERENCES CLASS (NAME));
 INSERT INTO STUDENT VALUES (&SNUM, '&SNAME', '&MAJOR', '&SLEVEL', &AGE);
```

INSERT INTO FACULTY VALUES (&FID, '&FNAME', &DEPTID);

INSERT INTO CLASS VALUES ('&CNAME', '&MEETS_AT', '&ROOM', &FID);
INSERT INTO ENROLLED VALUES (&SNUM, '&CNAME');

Write the following queries in SQL. No duplicates should be printed in any of the answers.

i) Find the names of all Juniors (level = A LEVEL) who are enrolled in a class taught by Prof. Harshith

SELECT DISTINCT S.SNAME
FROM STUDENT S, CLASS C, ENROLLED E, FACULTY F
WHERE S.SNUM = E.SNUM AND E.CNAME = C.NAME AND C.FID = F.FID AND
        F.FNAME = 'Prof. Kwizera' AND S.LEVEL = 'A LEVEL';

ii) Find the names of all classes that either meet in room R128 or have five or more Students enrolled.

SELECT C.NAME
FROM CLASS C
WHERE C.ROOM = 'R128'
        OR C.NAME IN (SELECT E.CNAME
                        FROM ENROLLED E
                        GROUP BY E.CNAME
                        HAVING COUNT (*) >= 5);

iii) Find the names of all students who are enrolled in two classes that meet at the same time.

SELECT DISTINCT S.SNAME
FROM   STUDENT S
WHERE S.SNUM IN (SELECT E1.SNUM
                FROM   ENROLLED E1, ENROLLED E2, CLASS C1, CLASS C2
                WHERE E1.SNUM = E2.SNUM AND E1.CNAME <> E2.CNAME
                AND E1.CNAME = C1.NAME
                        AND E2.CNAME = C2.NAME AND C1.MEETS_AT = C2.MEETS_AT);

iv) Find the names of faculty members who teach in every room in which some class is taught.

SELECT DISTINCT F.FNAME
FROM FACULTY F
WHERE NOT EXISTS ((SELECT *
                        FROM   CLASS C
                        EXCEPT
                        (SELECT C1.ROOM
                        FROM   CLASS C1
                        WHERE C1.FID = F.FID));

v) Find the names of faculty members for whom the combined enrollment of the courses that they teach is less than five.

```
SELECT        DISTINCT F.FNAME
FROM          FACULTY F
WHERE         5 > (SELECT  COUNT (E.SNUM)
                  FROM      CLASS C, ENROLLED E
                  WHERE  C.CNAME = E.CNAME
                  AND        C.FID = F.FID);
```

2. The following relations keep track of airline flight information:

Flights (*flno: integer*, *from*: string, to: string, distance: integer, Departs: time, arrives: time, price: real)

Aircraft (*aid: integer*, aname: string, cruisingrange: integer)

Certified (*eid: integer, aid:* integer)

Employees (*eid:* integer, ename: string, salary: integer)

Note that the Employees relation describes pilots and other kinds of employees as well; Every pilot is certified for some aircraft, and only pilots are certified to fly.

CREATE TABLE FLIGHTS	
(FLNO INTEGER	PRIMARY KEY,
FFROM VARCHAR(15)	NOT NULL,
TTO VARCHAR(15)	NOT NULL,
DISTANCE INTEGER,	
DEPARTS TIMESTAMP,	
ARRIVES TIMESTAMP,	
PRICE NUMBER(10,2));	
CREATE TABLE AIRCRAFT	
(AID INTEGER	PRIMARY KEY,

```
ANAME              VARCHAR(10),

CRUISINGRANGE      INTEGER);


CREATE TABLE EMPLOYEES

(EID          INTEGER      PRIMARY KEY,
```

ENAME   VARCHAR(15),

SALARY   NUMBER(10,2));

CREATE TABLE CERTIFIED

(EID   INTEGER NOT NULL,

AID   INTEGER NOT NULL,

PRIMARY KEY (EID, AID),

FOREIGN KEY (EID) REFERENCES EMPLOYEES (EID),

FOREIGN KEY (AID) REFERENCES AIRCRAFT (AID));

INSERT INTO FLIGHTS VALUES (&FLNO, '&FFROM', '&TTO', &DISTANCE, '&DEPARTS', '&ARRIVES', &PRICE);
INSERT INTO AIRCRAFT VALUES (&AID, '&ANAME', &CRUISRANGE);
INSERT INTO EMPLOYEES VALUES (&EID, '&ENAME', &SALARY);
INSERT INTO CERTIFIED VALUES (&EID, &AID);

Write each of the following queries in SQL:

i) Find the names of aircraft such that all pilots certified to operate them have salaries more than Rs.80,000.

SELECT	DISTINCT A.ANAME	
FROM	AIRCRAFT A	
WHERE	A.AID IN (SELECT	C.AID
	FROM	CERTIFIED C, EMPLOYEES E
	WHERE	C.EID = E.EID AND

NOT EXISTS (SELECT   *

FROM   EMPLOYEES E1

WHERE   E1.EID = E.EID AND

E1.SALARY < 80000));

ii) For each pilot who is certified for more than three aircrafts, find the eid and the maximum cruisingrange of the aircraft for which she or he is certified.

SELECT	C.EID, MAX (A.CRUISINGRANGE)
FROM	CERTIFIED C, AIRCRAFT A
WHERE	C.AID = A.AID
GROUP BY	C.EID
HAVING	COUNT (*) > 3;

iii) Find the names of pilots whose salary is less than the price of the cheapest route from Kigali to Nairobi.

SELECT	DISTINCT E.ANAME
FROM	EMPLOYEE E
WHERE	E.SALARY < (SELECT MIN (F.PRICE)
	FROM FLIGHTS F
	WHERE F.FFROM = 'Kigali' AND F.TTO = 'Nairobi');

iv) For all aircraft with cruisingrange over 1000 Kms,. Find the name of the aircraft and the average salary of all pilots certified for this aircraft.

Observe that aid is the key for Aircraft, but the question asks for aircraft names; we deal with this complication by using an intermediate relation Temp;

SELECT	TEMP.NAME, TEMP.AVGSALARY
FROM	(SELECT A.AID, A.ANAME AS NAME,
	AVG (E.SALARY) AS AVGSALARY
	FROM AIRCRAFT A, CERTIFIED C, EMPLOYEES E
	WHERE A.AID = C.AID AND
	C.EID = E.EID AND A.CRUISINGRANGE > 1000
	GROUP BY A.AID, A.ANAME) AS TEMP;

v) Find the names of pilots certified for some Boeing aircraft.

SELECT	DISTINCT E.ENAME
FROM	EMPLOYEES E, CERTIFIED C, AIRCRAFT A
WHERE	E.EID = C.EID AND
	C.AID = A.AID AND
	A.ANAME = 'Boeing';

vi) Find the aids of all aircraft that can be used on routes from Rusizi to Kigali.

SELECT A.AID
FROM   AIRCRAFT A
WHERE A.CRUISINGRANGE   >   (SELECT MIN (F.DISTANCE)
                FROM   FLIGHTS F
              WHERE F.FFROM = 'Rusizi' AND F.TTO = 'Kigali');

3. Consider the following database of student enrollment in courses & books adopted for each course.

STUDENT (regno: string, name: string, major: string, bdate:date)

COURSE (course:int, cname:string, dept:string)
ENROLL (regno:string, course:int, sem:int, marks:int)
BOOK _ ADOPTION (course:int, sem:int, book-ISBN:int)
TEXT (book-ISBN:int, book-title:string, publisher:string, author:string)

i. Create the above tables by properly specifying the primary keys and the foreign keys.

```
CREATE TABLE SSTUDENT
(RREGNO       VARCHAR(30)  PRIMARY KEY,
 NAME         VARCHAR(30)  NOT NULL,
 MAJOR        VARCHAR(30)  NOT NULL,
 BDATE        DATE         NOT NULL);
CREATE TABLE CCOURSE
(COURSE       INTEGER       PRIMARY KEY,
 CCNAME       VARCHAR(30) NOT NULL,
 DEPT   VARCHAR(30) NOT NULL);
CREATE TABLE EENROLL
(RREGNO       VARCHAR(30) NOT NULL,
 COURSE       INTEGER      NOT NULL,
 SEM    INTEGER        NOT NULL,
 MARKS         INTEGER        NOT NULL,
 PRIMARY KEY (RREGNO, COURSE, SEM),
 FOREIGN KEY (RREGNO) REFERENCES SSTUDENT(RREGNO),
 FOREIGN KEY (COURSE) REFERENCES CCOURSE(COURSE));
```

CREATE TABLE TTEXT	
(BOOKISBN INTEGER	PRIMARY KEY,
BOOKTITLE VARCHAR(30)	NOT NULL,
PUBLISHER VARCHAR(30)	NOT NULL,
AUTHOR VARCHAR(30)	NOT NULL);

```
CREATE TABLE BBOOKADOPTION
(COURSE        INTEGER        NOT NULL,
 SEM    INTEGER        NOT NULL,
 BOOKISBN  INTEGER   NOT NULL,
 PRIMARY KEY (COURSE, SEM, BOOKISBN),
 FOREIGN KEY (COURSE) REFERENCES CCOURSE (COURSE),
 FOREIGN KEY (BOOKISBN) REFERENCES TTEXT (BOOKISBN));
```

ii. Enter at least five tuples for each relation.

iii. Demonstrate how you add a new text book to the database and make this book be adopted by some department.

Use insert statement to insert a new record

iv.   Produce a list of text books (include Course #, Book-ISBN, Book-title) in the alphabetical order for courses offered by the 'CS' department that use more than two books.

SELECT	C.COURSE, T.BOOKISBN, T.BOOKTITLE
FROM	CCOURSE C, BBOOKADOPTION BA, TTEXT T
WHERE	C.COURSE=BA.COURSE AND BA.BOOKISBN=T.BOOKISBN AND C.DEPT='CS' AND EXISTS (SELECT COUNT (COURSE) FROM BBOOKADOPTION WHERE COURSE=C.COURSE GROUP BY COURSE HAVING COUNT (COURSE)>=2) ORDER BY T.BOOKTITLE;

v.   List any department that has all its adopted books published by a specific publisher.

SELECT	C.DEPT, T.BOOKTITLE, T.PUBLISHER
FROM	CCOURSE C, TTEXT T, BBOOKADOPTION BA
WHERE	C.COURSE=BA.COURSE AND T.BOOKISBN=BA.BOOKISBN AND T.PUBLISHER ='JOHN WILEY'AND T.PUBLISHER= ALL (SELECT T1.PUBLISHER FROM CCOURSE C1, BBOOKADOPTION BA1, TTEXT T1 WHERE BA1.BOOKISBN=T1.BOOKISBN AND
	BA1.COURSE=C1.COURSE AND C.DEPT=C1.DEPT);

vi. Generate suitable reports.

vii. Create suitable front end for querying and displaying the results.

4. The following tables are maintained by a book dealer.

AUTHOR (author-id:int, name:string, city:string, country:string)

PUBLISHER (publisher-id:int, name:string, city:string, country:string)

CATALOG (book-id:int, title:string, author-id:int, publisher-id:int, category-id:int, year:int, price:int)

CATEGORY (category-id:int, description:string)

ORDER-DETAILS (order-no:int, book-id:int, quantity:int)

i. Create the above tables by properly specifying the primary keys and the foreign keys.

CREATE TABLE A AUTHOR

(AUTHORID	INTEGER PRIMARY KEY,
NAME	VARCHAR(30) NOT NULL,
CITY	VARCHAR(30) NOT NULL,
COUNTRY	VARCHAR(30) NOT NULL);

CREATE TABLE PPUBLISHER
(PUBLISHERID   INTEGER   PRIMARY KEY,
 NAME   VARCHAR(30) NOT NULL,
 CITY   VARCHAR(30) NOT NULL,
 COUNTRY   VARCHAR(30) NOT NULL);

CREATE TABLE BOOKCATEGORY
(CATEGORYID   INTEGER   PRIMARY KEY,
 DESCRIPTION   VARCHAR(30) NOT NULL);

CREATE TABLE CCATALOG
(BOOKID INTEGER PRIMARY KEY,
 TITLE   VARCHAR(30) NOT NULL,

AUTHORID	INTEGER	NOT NULL,
PUBLISHERID	INTEGER	NOT NULL,
CATEGORYID	INTEGER	NOT NULL,
YEAROFPUBLISH	INTEGER	NOT NULL,
PRICE	INTEGER	NOT NULL,

 FOREIGN KEY (AUTHORID) REFERENCES AAUTHOR(AUTHORID),
 FOREIGN KEY (PUBLISHERID) REFERENCES PPUBLISHER(PUBLISHERID),
 FOREIGN KEY (CATEGORYID) REFERENCES BOOKCATEGORY(CATEGORYID));

CREATE TABLE OORDERDETAILS
(ORDERNO   INTEGER   PRIMARY KEY,
 BOOKID   INTEGER   NOT NULL,
 QUANTITY INTEGER   NOT NULL,
 FOREIGN KEY (BOOKID) REFERENCES CCATALOG(BOOKID));
ii. Enter at least five tuples for each relation.

Insert statement 5 records at least

Give the details of the authors who have 2 or more books in the catalog and the price of the books is greater than the average price of the books in the catalog and the year of publication is after 2000.

SELECT	*	
FROM	AAUTHOR A	
WHERE	EXISTS	
	(SELECT	A1.AUTHORID,COUNT(A1.AUTHORID)
	FROM	AAUTHOR A1,CCATALOG C
	WHERE	A1.AUTHORID=C.AUTHORID AND A.AUTHORID=A1.AUTHORID AND C.YEAROFPUBLISH > 2000 AND C.PRICE > (SELECT AVG(PRICE) FROM CCATALOG) GROUP BY A1.AUTHORID HAVING C O U N T (A 1 . AUTHORID) >=2);

iv. Find the author of the book which has maximum sales.

```
SELECT        DISTINCT A.NAME
FROM          AAUTHOR A, CCATALOG C, OORDERDETAILS ODM
WHERE         A.AUTHORID=C.AUTHORID AND ODM.BOOKID=C.BOOKID
AND EXISTS
```

(SELECT	OD.BOOKID,SUM(OD.QUANTITY)	
FROM	OORDERDETAILS OD	
WHERE	OD.BOOKID=ODM.BOOKID	
GROUP BY	BOOKID	
HAVING	SUM(OD.QUANTITY)>= ALL	
	(SELECT	SUM(QUANTITY)
	FROM	OORDERDETAILS
	GROUP BY	BOOKID));

v. Demonstrate how you increase the price of books published by a specific publisher by 10%.

```
UPDATE        CCATALOG
SET           PRICE = (1.1) * PRICE
WHERE         AUTHORID = (SELECT        AUTHORID
              FROM                      AAUTHOR
              WHERE                     NAME = 'NAVATHE');
```

Generate suitable reports.

Create suitable front end for querying and displaying the results

5. Consider the following database for a banking enterprise

BRANCH(branch-name:string, branch-city:string, assets:real)

ACCOUNT(accno:int, branch-name:string, balance:real)

DEPOSITOR(customer-name:string, accno:int)

CUSTOMER(customer-name:string, customer-street:string, customer-city:string)

LOAN(loan-number:int, branch-name:string, amount:real)

BORROWER(customer-name:string, loan-number:int)

i. Create the above tables by properly specifying the primary keys and the foreign keys

```
CREATE TABLE BBRANCH
(BRANCHNAME          VARCHAR(30)                    PRIMARY KEY,
 BRANCHCITY   VARCHAR(30)                           NOT NULL,
 ASSETS              NUMBER(10,2)                    NOT NULL);

CREATE TABLE BBANKACCOUNT
(ACCNO               NUMBER(5)                       PRIMARY KEY,
 BRANCHNAME          VARCHAR(30)                      NOT NULL,
BALANCE              NUMBER(10,2),
FOREIGN KEY (BRANCHNAME) REFERENCES BBRANCH (BRANCHNAME));
CREATE TABLE BBANKCUSTOMER

(CUSTOMERNAME  VARCHAR(30)                            PRIMARY KEY,

 CUSTOMERSTREET  VARCHAR(30)                          NOT NULL,

 CUSTOMERCITY        VARCHAR(30)  CREATE TABLE     NOT NULL);
 DDEPOSITOR
(CUSTOMERNAME  VARCHAR(30)                            NOT NULL,
 ACCNO               NUMBER(5)                        NOT NULL,
 PRIMARY KEY (CUSTOMERNAME, ACCNO),
 FOREIGN KEY (CUSTOMERNAME) REFERENCES BBANKCUSTOMER (CUSTOMERNAME),
 FOREIGN KEY (ACCNO) REFERENCES BBANKACCOUNT (ACCNO) ON DELETE CASCADE);
CREATE TABLE LLOAN
(LOANNUMBER          INTEGER                    PRIMARY KEY,
 BRANCHNAME          VARCHAR(30)  NOT NULL,
 AMOUNT              NUMBER(10,2)         NOT NULL,
 FOREIGN KEY (BRANCHNAME) REFERENCES BBRANCH (BRANCHNAME));

CREATE TABLE BBORROWER
(CUSTOMERNAME  VARCHAR(30)       NOT NULL,
 LOANNUMBER          INTEGER                 NOT NULL,
 PRIMARY KEY (CUSTOMERNAME, LOANNUMBER),
 FOREIGN KEY (CUSTOMERNAME) REFERENCES BBANKCUSTOMER (CUSTOMERNAME),
 FOREIGN KEY (LOANNUMBER) REFERENCES LLOAN (LOANNUMBER));
```

ii. Enter at least five tuples for each relation

Find all the customers who have at least two accounts at the Main branch.

```
SELECT            *
FROM            BBANKCUSTOMER C
WHERE EXISTS
        (SELECT          DP.CUSTOMERNAME, COUNT (DP.CUSTOMERNAME)
         FROM            DDEPOSITOR DP, BBANKACCOUNT BA
         WHERE           DP.ACCNO=BA.ACCNO AND
```

C.CUSTOMERNAME=DP.CUSTOMERNAME AND

BA.BRANCHNAME='RESIDENCY ROAD' GROUP BY   DP.CUSTOMERNAME

```
        HAVING          COUNT(DP.CUSTOMERNAME)>=2);
```

iv. Find all the customers who have an account at all the branches located in a specific city.

```
SELECT            *
FROM            BBANKCUSTOMER BC
WHERE           NOT EXISTS

                        (SELECT          BRANCHNAME

                         FROM            BBRANCH

                         WHERE           BRANCHCITY='KIGALI'

                    MINUS

                         SELECT          BA.BRANCHNAME

                         FROM            DDEPOSITOR D,BBANKACCOUNT
            BA

                         WHERE           D.ACCNO=BA.ACCNO AND

            BC.CUSTOMERNAME=D.CUSTOMERNAME );
```

v. Demonstrate how you delete all account tuples at every branch located in a specific city.

DELETE FROM BBANKACCOUNT

WHERE   BRANCHNAME IN

(SELECT BRANCHNAME

 FROM BBRANCH

WHERE BRANCHCITY='NYAMAGABE');

vi. Generate suitable reports.

vii. Create suitable front end for querying and displaying the results.

NB: For front end design, programming language like visual basic 6.0 (or newer versions), can be used.

UNIT 5: ARRAYS, FUNCTIONS AND PROCEDURES IN VISUAL BASIC

5

5.1 Key Unit Competence

Use array, functions and procedures in Visual Basic program.

5.2 Prerequisite knowledge and skills:

Students have competencies related to some concepts of writing an algorithm and programs using C, C++ and VB. They got those competencies from different units namely Unit7 on Introduction to Computer Algorithm in Senior 4, Unit 13 on Function in C++ language in Senior 4, Unit 14 on Arrays in C++ in Senior 4, Unit 8 on introduction to Visual basic Senior 5, Unit 9 on Variables, Operators, Expressions and Control structures in Senior 5:

5.3. Cross-cutting issues to be addressed:

- **Financial Education:** To be developed when recording daily expenses. Students should be able to keep records of everyday's life expenses, they should have a culture of managing properly money, needs and wants according to what they earn per day or month as well as plan for savings. Importantly, students should be aware that the overall cost of the software is greatly reduced when the code is developed and maintained according to software standards.

- **Standardization Culture:** To be developed when explaining to students that there are software standards (rules which programmers are expected to follow). Students should be aware that well written software offers many advantages. It will contain fewer bugs and will run more efficiently than poorly written programs. Since software has a life cycle and much of which turns around maintenance, it will be easier for the original developer(s) and future keepers of the code to maintain and modify the software as needed. This will lead to increased productivity for the developer(s).

- **Inclusive Education:** Inclusive Education: Inclusive Education: students with and without disabilities participate and learn together in the same classes.

- **Peace and Values Education:** This will be developed when the teacher will inform students that they must be responsible and honest in terms of respecting software compliance and time given to customers otherwise it might cause conflict between the programmers and customers.
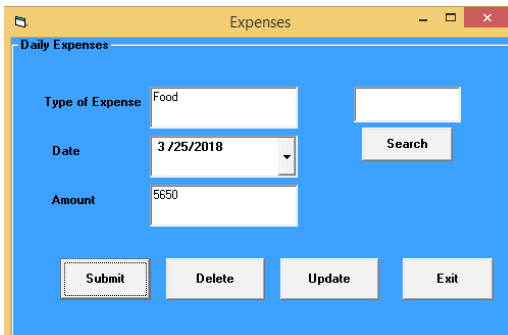
5.4. Guidance on the introductory activity

Instruction to do the introductory activity

1. This activity has to take place in the computer lab where students can use computers and each student must have a computer which has VB 6.0 compiler.

2. In pairs, students start to answer questions and then in plenary present their findings. Then after, individually, each student has to start the computer, opening VB compiler then type and runs the source codes that have been shared. The objective of this activity is to put students in the situation of thinking critically and come up with idea of developing software which can solve our daily life problems starting from our family daily life requirements. Students might not be able to answer all the questions but let them try and they will get answers as long they learn this unit.

Introductory Activity suggested answers:

1. The 365 times of records mean, every day task processed by the mother, in terms of programming storage, there should be a function or a procedure which can be called every time she wants to record daily expenses (reuse).

2. Design software which allows a user to enter daily expenses then produce the total expenses using a function.

3. The designed interface is:

4. *Public Function summarks(marks() As Double) As Double*

Dim avgabove(2) As Double
Dim i, j, sum As Double
sum = 0
For i = 0 To 2
For j = 0 To 2
sum = sum + marks(i)
Next j
Next i
summarks = sum
avg = sum / 15
Print "the average is:"; avg

```
For i = 0 To 2
For j = 0 To 2
If marks(i) >= avg Then
avgabove(i) = marks(i)
End If
Next j
Next i
For i = 0 To 2
For j = 0 To 2
List1.AddItem avgabove(i)
Next j
Next i
End Function
Private Sub Command1_Click()
Dim i, j As Double
Dim note(3) As Double
For i = 0 To 2
For j = 0 To 2
note(i) = Val(InputBox("enter student marks", "Students"))
Next j
Next i
Print "The total students marks is: "; summarks(note)
End Sub
```

5.5. LIST OF LESSONS

(Including assessment)

#	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes):	Number of periods
1	Introductory activity	Identify the importance of using array in the program	1
2	Understanding arrays in Visual Basic	Identify the importance of using array in the program	2
3	Arrays initialization and accessing elements of an array	Appreciate the use of arrays	3
4	Entering and displaying arrays elements	Design and write a Visual Basic program using an array	3

5	Built-in Functions	Appreciate the use Functions in Visual Basic Program Design and write a Visual Basic Program using a Built-in functions	3
6	User-defined Function	Give the syntax and step to write a function Identify the role of using each category of the function in the program Design and write a Visual Basic Program using a user defined and in-built functions Differentiate Inbuilt function from user-defined function and their usage	3
7	Procedures	Appreciate the use Functions in Visual Basic Program	3

LESSON 1: UNDERSTANDING ARRAYS IN VISUAL BASIC

Duration: 2 periods: 80 minutes

a. **Prerequisites/Revision/Introduction:**

Learning activity 5.1 is used to introduce the lesson entitled **Understanding arrays in Visual Basic.** The lesson can be conducted in class or in computer lab. Individually, students start by observing and analyzing the two tables highlighted by the learning activity 5.1.Students may have different ideas on the two tables, then after ask them to share in pairs what their observed and analyzed, from there, collect all ideas from

different pairs and give them time to answer the questions.

b. Teaching resources:

- Computer lab any room which has computers with VB Compiler
- Internet and textbooks to facilitate research

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.
- Students elect the group leader and secretary.
- Learners do the Learning Activity 5.1.
- Teacher walks around and sees if students are doing an activity and participating actively a in their respective group.
- Students present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Teacher summarizes the contents (Note in student's book) and gives examples that should be done by students.
- Teacher gives the instructions on how to do Application activity 5.1,
- Students do Application activity5.1

c. Probable answers to learning activity 5.1.

1. Students give the difference between the way data are stored in Table A and Table B. The Table A arranges data (elements) of an array under D1 format which means one dimensional (only one row or one column) whereas Table B arranges elements of an array under D2 format which means two dimensional where we might have one or many row and one or many columns

   Then after in group of 3 learners start VB compiler and declare variables and keep data for both tables. Proposed answer for question 2:

2.a   *Dim TableA(4) As Integer*

TableA(0)="John"
TableA(0)="Didier"
TableA(0)="Fiona"
TableA(0)="Williams"
2.b   Dim Table(3,4) As Integer
TableB(0,0)="James"
TableB(0,1)="Liliane"
TableB(0,2)="Jonson"
TableB(0,3)="Aline"
TableB(1,0)="Claude"
TableB(1,1)="Ilis"

TableB(1,2)="Aimable"
TableB(1,3)="Diane"
TableB(2,0)="Louise"
TableB(2,1)="Marie"
TableB(2,2)="Jemima"
TableB(2,3)="Baptiste"

3. The 500 different variables would be declared.

Yes it a very big challenges because it might take much time for a programmer to declare 500 variables, not only that accessing, maintaining and using 500 variable it is something which is not easy. The more declared variable, the much time the compiler and the processor will take to translate and execute the source codes. The best way to do it would be the use of an array which will hold all 500 students names as one variable.

d. Answer toapplication activities 5.1.

1. A one dimensional array or single dimensional array is a type of linear array.in which one dimensional array is structured and the collection of components that is called array elements. And accessing these elements involving with a single subscript it called one dimensional whereas two-dimensional Arrays is the array in which columns and rows have the elements of a 2D array with arrangement. The new operator for 2D arrays specifies both the number of rows or columns.

2. One dimensional array: Dim IdentStudent(100) as Double Two dimensional array: Dim IdentStudent(10,10) as Double

LESSON 2: INITIALIZATION AND ACCESSING ELEMENTS OF AN ARRAY

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

Students have acquired knowledge and skills in the lesson 1 as the prerequisites for this lesson. The learning activity 5.1 introduces the lesson. In pairs, Learners begin writing a VB program that initializes your First name, Last name, age, combination and level of studies.

Students may give different answer, these answers try to guide learner on the tight answer.

b. Teaching resources:

- Computer lab any room with VB compiler installed
- Internet and textbooks to facilitate research

Guidance on Activities

- Teacher organizes students in groups of 4 in order to do learning activity 5.2
- Students elect the group leader and secretary.

- Learners do Learning Activity 5.2
- Teacher walks around and sees if students are doing activity in their respective group.
- The teacher facilitate learners to write and run codes of Example 1 and 2 using VB compiler
- Students present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Ask individually students to open VB compiler and run the sources codes
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- Teacher gives the instructions on how to do Application activities 5.2 and
- Students do Application activities 5.2.

c. Answers to learning activities 5.2

```
1. Private Sub Command1_Click()
Dim Fname, Lname, Combination, Level As String
Dim Age As Integer
Fname = "SIBOYINTORE"
Lname = "Jean Baptiste"
Age = 15
Combination = "Computer Science and Mathematics"
Level = "Senior 5"
End Sub
2. Private Sub Command1_Click()
Dim Num(10) as Integer
Num(0)=25
Num(1)=68
Num(2)=84
Num(3)=366
Num(4)=7556
Num(5)=124
Num(6)=42645
Num(7)=58
Num(8)=12312
Num(9)=544
End Sub
```

3. You can access elements of an array by using array indices and loops.

Suppose you declared an array mark. The first element is mark(0), second element is mar(1) and so on.

mark (0)	mark(1)	mark (2)	mark (3)	mark(4)

d. Answers to application activity 5.2.

1. Array holds multiple values, whereas an ordinary variable holds a single value. The elements of an array are treated as individual's entities, and when a variable is a simple scalar variable such as an integer.

2. Dim AVG, S As Double

S = X(2) + X(5) + X(7)

AVG = S /3

Here, it has to be clear for the students that already array exists and contains elements. That's why they should not spend time once again by initializing.

LESSON 3: ENTERING AND DISPLAYING ARRAYS ELEMENTS

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

The learning activity 5.2, introduces the lesson Entering and displaying arrays elements as well as Unit 29: introduction to Visual basic Senior5. Students start by discussing different types of controls that can be used to input and to display elements of an array using Think Pair and Share.

b. Teaching resources:

- Computer lab or any room which has computers with installed VB compiler
- Internet and textbooks to facilitate research

Guidance on Activities

Teacher facilitates students in order to do learning activity accordingly.

Learners do the Learning Activity 5.3

- Teacher moves around and sees if every student does activity individually
- Teacher asks student to work in pairs
- Students share their findings with the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Teacher summarizes the contents (Note in students book) and gives examples

that should be done by students

- Teacher gives the instructions on how to do Application activity 5.3
- Students do Application activity 5.3

c. Answers to learning activity 5.3.

Below are some controls that can be used to input elements of arrays:

- Input box: It allows to display a message box where the user can enter a value or a message in the form of text

- Combo box: The function of the Combo Box is also to present a list of items where the user can click and select the items from the list. However, the user needs to click on the small arrowhead on the right of the combo box to see the items which are presented in a drop-down list. In order to add items to the list, you can also use the AddItem method. For example, if you wish to add a number of items to Combo box 1, you can key in the following statements:

Private Sub Form_Load ( )
Combo1.AddItem "Item1"
Combo1.AddItem "Item2"
Combo1.AddItem "Item3"
Combo1.AddItem "Item4"
End Sub

- **Text box:** The text box is the standard control for accepting input from the user as well as to display the output

Below are some controls that can be used to display elements of arrays:

- **Form:** The Windows Form is a vital component in the development of any Windows-based application. Forms essentially provide the windows that make up a Windows application. In fact, the terms window and form are often used interchangeably. Forms allow the Visual Basic developer to create windows and layout controls (such as buttons, labels etc) in those forms to provide the application's user interface. The object form can be used to display values using print function.

- **Label:** The label is a very useful control for Visual Basic, as it is not only used to provide instructions and guides to the users, it can also be used to display outputs

- **Msg box:** It produces a pop-up message box that prompt the user to click on a command   button before he /she can continues

- **List box:** The function of the List Box is to present a list of items where the user can click and select the items from the list. In order to add items to the list, we can use the AddItem method.

- **Image box:** The Image Box is another control that handles images and pictures. It functions almost identically to the picture box. However, there is one major difference, the image in an Image Box is stretchable, which means it can be resized. This feature is not available in the Picture Box. Similar to the Picture Box,

it can also use the LoadPicture method to load the picture. For example, the statement loads the picture grape.gif into the image box.

Image1.Picture=LoadPicture ("C:\VB program\Images\grape.gif")

- **Picture box:** The Picture Box is one of the controls that is used to handle graphics. You can load a picture at design phase by clicking on the picture item in the properties window and select the picture from the selected folder. You can also load the picture at runtime using the LoadPicture method. For example, the statement will load the picture grape.gif into the picture box. Picture1. Picture=LoadPicture ("C:\VB program\Images\grape.gif").

d. Answersto application activity 5.3.:

```
Private Sub Command1_Click()
Dim Number(10) As Integer
Dim i, odd(10), even(10) As Integer
For i = 1 To 10
Number(i) = InputBox("Input the student Marks", "Input Marks")
Next i
For i = 1 To 10
If Number(i) Mod (2) = 1 Then
odd(i) = Number(i)
Else
even(i) = Number(i)
End If
Next i
Print "the odd numbers are:"
For i = 1 To 10
If odd(i) <> 0 Then
Print odd(i)
End If
Next i
Print "the even numbers are:"
For i = 1 To 10
If even(i) <> 0 Then
Print even(i)
End If
Next i
End Sub
```

LESSON4: BUILT-IN FUNCTIONS

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

The learning activity 5.3 introduces the lesson built-in functions, as well as Senior 4: Unit 13: Function in C++ language. Students start by discussing the importance of using

functions use in programming context.

b. Teaching resources:

- Computer lab or any room which has computers with installed VB compiler
- textbooks to facilitate research

Guidance on Activities

- Teacher facilitates students in order to do learning activity accordingly.
- Learners do the Learning Activity5.3 and Activity 5.4
- Teacher moves around and sees if every student does activity individually
- Teacher asks student to work in group of 4 students
- Students react on the finding/ answers from other groups.
- Individually, every student types and run provided program examples in students book using VB compiler
- Teacher corrects false answers and completes the half correctly answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- Teacher gives the instructions on how to do Application activity 5.4
- Students do Application activity 5.4

c. Answers to learning activity 5.4.:

The first reason is reusability. Once a function is defined, it can be used over and over. A single function can be used in several different (separate) programs. For the programmer, functions reduce coding time and debugging time, thereby reducing the overall development time. With Functions complex problems can be divided into small unities so that they can be solved easily.

Answers to application activity 5.4.

```
Private Sub Command1_Click()
Dim N As Integer
Dim sinresult, cosresult, tanresult As Double
N = Val(InputBox("Input the student Marks", "Input Marks"))
sinresult = Sin(N)
cosresult = Cos(N)
tanresult = Tan(N)
Print ("The entered number is "); N
Print ("Its sinus is:"); sinresult
Print ("Its cosinus is: "); cosresult
Print ("Its tangente is:"); tanresult
End Sub
```

LESSON 5: USER DEFINED FUNCTIONS

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

The learning activity 5.4, introduces the lesson built-in functions for the lesson as well as Senior 4: Unit 13: Function in C++ language. Students start by designing the interface bellow and use provided codes Example a, Example b and Example c.

b. Teaching resources:

- Computer lab or any room which has computers with installed VB 6.0 compiler
- Textbooks to facilitate research

Guidance on Activities

- Teacher facilitates students in order to do learning activity accordingly.
- Learners do the Learning Activity 5.5
- Teacher moves around and sees if every student does activity individually
- Teacher asks student to work in group of 3 students
- Students react on the finding/ answers from other groups.
- Individually, every student types and run provided program examples in students book using VB compiler
- Teacher corrects false answers and completes the half correctly answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- Teacher gives the instructions on how to do Application activity 5.5.
- Students do Application activity 5.5.
- Answers to learning activities 5.5.
- Refer to the student's book; all answers for the activity are available in the book.

c. Answers to application activities 5.5.

1.

```
Private Sub Command1_Click()
Dim a, b, c, Big As Integer
a = Val(InputBox("Enter the first number", "Number1 "))
b = Val(InputBox("Enter the first number", "Number2 "))
c = Val(InputBox("Enter the first number", "Number3 "))
Big = FindMax(a, b, c)
Print ("The maximum number is:",Big)
End Sub
Function FindMax(ByRef num1, ByRef num2, ByRef num3) As Integer
Dim min, max As Integer
```

```vb
If num1 > num2 And num1 > num3 Then
max = num1
Else
If num2 > num1 And num2 > num3 Then
max = num2
Else
max = num3
End If
End If
FindMax = max
End Function
```

2.

```vb
Private Sub Command1_Click()
Print ("The sum of elements is:"); FindSum()
End Sub
Function FindSum() As Integer
Dim i, Num(5) As Integer
For i = 1 To 5
Num(i) = Val(InputBox("Enter the first number: ", "Number"))
Sum = Sum + Num(i)
Next i
FindSum = Sum
End Function
```

LESSON 6: PROCEDURES

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

The learning activity 5.5, introduces the lesson Built-in functions. Students start by discussing in group of 3 of 4 and do a learning activity 5.6

b. Teaching resources:

- Computer lab or any room which has computers with installed VB compiler
- Textbooks to facilitate research

Guidance on Activities

- Teacher facilitates students in order to do learning activity accordingly.
- Learners do the Learning Activity 5.6.
- Teacher moves around and sees if every student does activity individually
- Teacher asks student to work in group of 3 students
- Students react on the finding/ answers from other groups.
- Individually, every student types and run provided program examples in students

book using VB compiler

- Teacher corrects false answers and completes the half correctly answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- At the end of the lesson gives the instructions on how to do Application activity 5.6.
- At the end of the lesson students do Application activity 5.6.

c. Answers to learning activities 5.6.

1.
```
Private Sub Command1_Click()

Call MyIncome
End Sub
Private Sub MyIncome()
Dim MonthSalary, WithAmount As Double
MonthSalary = Val(InputBox("Enter your monthly salary: ", "Salary"))
WithAmount = Val(InputBox("Enter the amount you wish to withdraw: ", "Amount"))
WithMax = MonthSalary * 90 / 100
If WithAmount > WithMax Then
MsgBox ("Remember that 10% is reserved for the future need saving!!! ")
Else
MsgBox ("You can collect your money")
Print ("Thanks for banking with us")
End If
End Sub
```
Answers to application activity 5.6.
1.
```
Private Sub Command1_Click()
Call ManageProduct
End Sub
Private Sub ManageProduct()
Dim ManifacYear, ExpirYear, BuyYear As Double
ManifacYear = Val(InputBox("Enter the manifuctured Year: ", "Manufactured Year"))
ExpirYear = Val(InputBox("Enter the Expiring Year: ", "Expiring Year"))
While ExpirYear < ManifacYear
MsgBox ("WRONG EXPIRING YEAR!! REENTER THE EXPIRING YEAR: ")
ExpirYear = Val(InputBox("Enter the Expiring Year: ", "Expiring Year"))
Wend
BuyYear = Val(InputBox("Enter Year of Buying: ", "Buying Year"))
If BuyYear > ExpirYear Then
MsgBox ("ATTENTION PLEASE PRODUCT ALREADY EXPIRED!! BURN IT!!")
Else
```

MsgBox ("PRODUCT IS STILL VALID,YOU CAN SELL YOUR PRODUCT")
Print ("THANKS YOU FOR BUYING")
End If
End Sub

5.6. SUMMARY OF THE UNIT

This unit focuses of arrays where by learners will acquire competencies about the use of arrays in programming by differentiating one dimensional from two dimensional array, declaring, initializing, and inputting, accessing and displaying elements of each types of array. For this point learners should design a VB program using arrays. It provides as well competencies on use of functions and procedures where by learners will be able to differentiate built-in function from user-defined functions, declare (Function prototype), define and call the function. Through this unit learners will write a VB program using functions as well as using procedure by passing both arguments by value and by reference.

5.7. ADDITIONAL INFORMATION FOR TEACHERS

Before starting teaching, teachers should make sure all needed materials are available for all students on time, which means that no student should be excluded during teaching and learning process. The teachers should be active by facilitating learners when students will be doing different activities be it learning or application activities. The teacher should as well call upon to every learners to participate actively by giving views, ask questions where and when necessary. The teachers should apply different teaching techniques such as game, role play, etc. in order to encourage and bring all learners to attend the course being motivated and being in good atmosphere; teachers should always appreciate every student's contribution and work and correct positively wrong answers by explaining, demonstrating and applying what would be the right ones.

5.8. END UNIT ASSESSMENT

1. An array is a collection of data items, all of the same type, accessed using a common name.

2. Arrays generally store homogeneous data, same type of data in consecutive memory locations which will help us to fetch data in constant access time. Unlike linked lists, you will access data through index.

So if you want to store similar data and you want to perform search operations, less frequent addition/deletion of data then choose arrays over other data types.

3.

- **The first step is to declare a function/procedure (Function prototype):** This is a declaration of a function that specifies the function's name and type signature (data types of parameters, and return type).

- **The second step is to define a function/Procedure:** This is a section of

a program that performs a specific task.it is the body of the function which indicates what to do (the task).

- **The second step is to call a function/Procedure:** This is a fact of indicating the compiler to perform the task defined inside function body. We cannot execute the code defined inside function's body unless we call it from another function.

4. A Function must return a value but in Stored Procedure it is optional (Procedure can return zero or n values). Functions can have only input parameters for it whereas Procedures can have input/output parameters. Functions can be called from Procedure whereas Procedures cannot be called from Function.

5. User-defined functions allow programmers to create their own routines and procedures that the computer can follow; it is the basic building block of any program and also very important for modularity and code reuse since a programmer could create a user-defined function which does a specific process and simply call it every time it is needed whereas built-in functions are functions which are automatically declared by the compiler, and associated with a built-in function identifier.

6.

```
Private Sub Command1_Click()
Dim x, y, z As Integer
x = Val(InputBox("Enter the First coefficient: ", " Coefficient a"))
y = Val(InputBox("Enter the Second coefficient: ", " Coefficient b"))
z = Val(InputBox("Enter the Third coefficient: ", " Coefficient c"))
Call QuadEquation(x, y, z)
End Sub
Private Sub QuadEquation(ByRef a, ByRef b, ByRef c)
Dim Delta, x1, x2, x As Integer
Delta = b * b - 4 * a * c
If Delta < 0 Then
Print ("There is no real root")
Else
If Delta > 0 Then
Print ("We have two distinct roots: ")
x1 = Delta + b / a * c
x2 = Delta + b / a * c
Print ("The first root is equal to: "); x1
Print ("The second root is equal to: "); x1
Else
x = Delta / 2 * c
Print ("We have a single root:  "); x
End If
End If
End Sub
```

7. Private Sub Command1_Click()
Dim Num As Integer
Num = Val(InputBox("Enter a number you want to calculate Factorial: ", "Number"))
Print (" The factorial of "); Num
Print ("is: "); CalFact(Num)
End Sub
Function CalFact(ByRef Number)
Dim Fact As Integer
Fact = 1
For i = Number To 1 Step -1
*Fact = Fact * i*
Next i
CalFact = Fact
End Function

5.9. ADDITIONAL ACTIVITIES

Additional activities help you develop your talents, interests, and passions. They can also teach students practical skills like time management.

5.9.1. REMEDIAL ACTIVITIES

Q1. Differentiate a function from procedure, explain?

Function is an independent procedure that is written to perform a specific task. It is also Non-event procedure. Function returns a single value. to procedure that execute it. Procedure also type of subprogram, which consists of a block of statement that carries out well-defined task. It is also called sub procedure or procedure. This procedure does not respond to any event. They are called standard procedure to distinguish them from event procedure. Then Main difference between procedure and function is that function may return any value   cannot return any value to calling function

Q2. Explain the argument passing by reference or passing by values?

Answer: The argument can be pass by reference or passed by value. Where passing by reference means passing by address. In this mechanism the memory address or reference of variable is passed to the procedure. In this situation if the value of variable is change in procedure then its change in memory location its means in calling procedure.

Q3.What Is The Difference Between A User Defined Function And A Stored Procedure?

Answer. A user defined function and stored procedures are almost similar but there exists a difference between their implementation procedures in the code. Stored procedure needs to be invoked whereas a UDF can be used like any other statement.

Q.3 Explain how to access Array Data?

Data in an array can be accessed by referring to the name of the array and the element's index number.

5.9.2. CONSOLIDATION ACTIVITIES

Q1. What is the size of the variant data type?

Ans. The Variant data type has a numeric storage size of 16 bytes and can contain data up to the range of a Decimal, or a character storage size of 22 bytes (plus string length), and can store any character text.

Q2. Describe Different type of Passing Value?

Ans. By value, By ref, Optional, Param Array.

Note: - Optional keyword cannot be used while declaring arguments for a function using param array.

5.9.3. EXTENDED ACTIVITIES

Q1. Write the Function to pass an Array back to the calling procedure If you understand how to pass an Array to a called procedure, then writing the Function to return an array back to a calling program

Answer:

Private Function ReturnArray()
As Variant Dim x(3) As Integer 'Declare a Static Integer Array of 4 elements
x(0) = 1 x(1) = 2
x(2) = 3
x(3) = 4
ReturnArray = x 'Pass the array back as a return value
End Function
Private Sub cmdReturnArray_Click()
Dim retval As Variant
Dim obj retval = ReturnArray 'Assign the return value to a Variant Variable
For Each obj In retval
Form1.Print obj
Nex
End Sub

Q.2 Mention when to use Function procedures and what are its characteristics?

You use Function procedures when you want to execute a series of statements and return a value.

- Function procedures start and end with Function and End Function statements
- A function procedure may or may not take input.
- Function procedures return a value by assigning the value to its name

Q.3 Explain the characteristics of Sub procedures?

- You can use sub procedures if you want to run a series of statement without

returning any value.

- Sub procedures start with "Sub" and ends with "End Sub" statements
- Sub procedures can take arguments but cannot return a value
- Sub procedures may or may not take an input.

UNIT 6: VISUAL BASIC PROJECT

6

6.1. Key unit competence:

To be able to connect Visual Basic Interface to Database and create a simple Visual Basic standard desktop applications for a real life situation

6.2. Prerequisite knowledge and skills

Students have knowledge in introduction to Visual basic from unit 8 and 5 learnt in S5 and S6 respectively.

6.3. Cross-cutting issues to be addressed

Financial Education: To be covered when explaining to students cost related to the technical requirements for creating Visual basic project.

Standardization Culture: To be covered when explaining to students that there are standards required in selecting devices to be used to make a VB project.

Inclusive Education: Students with and without disabilities participate and learn together in the same class. Teacher should avail and install appropriate software for vision impairment learners such as Non Vision Desktop Access (NVDA), Job Access with Speech (JAWS) etc., This will facilitate them to listen what is being done. Keyboard should have some buttons with bumps or nipples for facilitating vision impairment learners to touch easily.

Fig. 1: F and J bumps keys indicate visually impaired learners.

If teacher has learners with vision impairment, should indicate bumps keys on keyboard that will facilitate them to touch on keyboard and special software for facilitating them to listen what is touched.

Peace and Values Education: Learners have to work together in harmony even sharing a computer and each has to respect other's project work.

6.4. Guidance on the introductory activity

Instruction to do the introductory activity

Guide learners how to plan and gather information for the chosen VB project

Guide learners to computer lab and make sure that VB6.0 is installed in all computers and let them manipulate computers by creating frontend interface as shown in student content s' guide.

Guide learners to create a backend with Ms Access as BDMS.

Guide learners to open ODBC for database connectivity with VB front end.

Facilitate learners to use DAO, Data controls and properties for connecting Database to VB forms.

Guide learners to evaluate created front end interface basing on ergonomic rules.

6.5. LIST OF LESSONS

No	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes):	No of Periods
1	Project 1:Requirement Analysis and Project Planning	• Describe requirement analysis and project planning • Describe steps of developing a visual basic project • Analyze real life situation to plan and develop a short VB project with appropriate database connectivity	3 Periods
2	**Project2: Front end user interface in Visual Basic**	• Creating front end interfaces basing on SRS • Appreciate Visual Basic programming as strong tool to develop standard desktop applications with database connectivity	2 Periods
3	Project 3: Back end database in Ms-Acces as DBMS	• Creating Database including different tables using Ms Access as DBMS • Analyze real life situation to plan and develop a short VB project with appropriate database connectivity	2 Periods
4	Project 4: ODBC configuration	• To be able to create Connectivity between front and back end interfaces • Configure Open Data Base Connectivity (ODBC) in administrative tools of operating system • Drag and Drop DAO/RDO or ADO object on form, establish, configure and test connectivity	2 Periods

5	Project 5: DAO, RDO and ADO objects in Visual Basic	• Describe Data Access Object (DAO), Remote Data Object (RDO) and Advanced Data Object (ADO) to establish connectivity between VB user interface and database • Drag and Drop DAO/RDO or ADO object on form, establish, configure and test connectivity	2 Periods
6	Data controls, properties and data manipulation and coding (ADODC, RECORDSET, ADDNEW, DELETE, UPDATE, MOVENEXT, MOVELAST, MOVEFIRST, MOVEPREVIOUS code in VB for data manipulation)	• Write code to insert, delete, update, search and display records from database through Visual Basic Interface • Analyze real life situation to plan and develop a short VB project with appropriate database connectivity	3 Periods
7	project 6: Principles for designing a friendly and ergonomic user interface	• Designing good interface basing on ergonomics rules. • Analyze real life situation to plan and develop a short VB project with appropriate database connectivity	2 Periods

LESSON1: REQUIREMENT ANALYSIS AND PROJECT PLANNING

Number of Periods: 3 (120 minutes)

a) Prerequisites/Revision/Introduction

Learners had skills on VB as they learnt introduction to Visual Basic in S5. They can transfer this knowledge in doing analysis and planning for the project.

b) Teacher resources

- Textbook
- Computer Lab/ computer, project& wireless mouse.
- Black or white board

f) Guidance on Project 6-1:

The teacher should guide and ask learners about software requirement specification. Teacher can give an example ofbuilding a house. an engineer determines the materials, budget and technical skills that will be used, such as measures of the plot to make sure if it is appropriate, develop drawings of how the final product will look, estimating the cost of the materials, man power, and the finishing design of whole house, determines potential problems that may happen etc. To make Visual Basic Project, you gather all requirements, and then you plan your project. Learners will think and make a SRS considering their school as case study basing on tips highlighted in student content (Student Book).

LESSON 2: FRONT END USER INTERFACE IN VISUAL BASIC

Period: 2 (80 minutes)

a) Prerequisites/Revision/Introduction:

Project 6-1 is used to introduce the lesson "Front end user interface in Visual Basic". The teacher invites students to go in computer lab. Through teachers' instructions, learners switch computers and open Microsoft Visual Basic6.0. Teacher will help learners to recall different parts/ elements of Integrated Development Environment (IDE) and steps involved in building a Visual Basic application.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research
- Projector
- Computer
- White or black board

Guidance on Project 6-2

- Teacher organizes students into groups of 2or 3 students or individual depending on availability of computers.
- Students elect the group representatives if necessary.
- Basing on SRS created in previous activity, teacher asks learners to design frontend of their finds.
- Teacher plays a role of facilitating the activity.

LESSON3: BACK END DATABASE IN MS-ACCES AS DBMS

Period: 2 (80 minutes)

a) Prerequisites/Revision/Introduction:

Previous activity will be used to introduce the lesson "Back end database in Ms-Acces as DBMS". The teacher invites students to go in computer lab. Through teachers' instructions, learners switch computers and open Microsoft Visual Basic6.0 then they

open their saved work and observe frontend interface created ones then teacher asks to draw tables on draft booklet and later create the database that contains those tables in Ms Access as DBMS. Teacher will help learners to create a database in Ms Access. Teacher may use also both Ms Access and MySQL for extending learners' skills if it is possible depending on time.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research
- Projector
- Computer
- White or black board

c) Guidance on Project 6-3

- Teacher organizes students into groups of 2or 3 students or individual depending on availability of computers.
- Students elect the group representatives if necessary.
- Basing on frontend created in previous activity, teacher asks learners to design and create their own database in Ms Access. Teacher plays a role of facilitating the activity.

LESSON4: ODBC configuration

Period: 2 (80 minutes)

a) Prerequisites/Revision/Introduction:

Previous activities will be used to introduce the new lesson "ODBC configuration". The teacher guides learners to go in computer lab. Through teachers' instructions, learners switch on computers and open Microsoft Visual Basic6.0 then teacher guides learners all steps should be followed to open ODBC, after learners will open their saved work (front-end interfaces) and saved database and reflect how both frontend and backend(database) should be linked and link them with teacher' s facilitation.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research
- Projector
- Computer
- White or black board

c) Guidance on Project 6-4

- Teacher organizes students into groups of 2or 3 students or individual depending on availability of computers.

- Students elect the group representatives if necessary.
- Basing on frontend created and backend in previous activity, teacher asks learners to link them.
- Teacher will guide learners by following steps to open ODBC and following different procedures indicated in student content in order they may be able to make a linkage by uploading database.

LESSON 5: DAO, RDO AND ADO OBJECTS IN VISUAL BASIC

Period: 2 (80 minutes)

a) Prerequisites/Revision/Introduction:

Previous activity was about linkage of fronted and backend with ODBC. This will be used to introduce the lesson "DAO, RDO and ADO objects in Visual Basic". The teacher guides learners to go in computer lab. Through teachers' instructions, learners switch on computers and open Microsoft Visual Basic6.0 and upload their saved projects. With teacher s' facilitation, learners will drag and drop Data Access Object (DAO) or Remote Data Object(RDO) or ADO object on their VB forms to establish, configure and test connectivity.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research
- Projector
- Computer
- Flash disk
- White or black board

c) Guidance on Project 6-5

Teacher organizes students into groups of 2or 3 students or individual depending on availability of computers.

Students elect the group representatives if necessary.

Basing on frontend and backend created in previous activity, teacher asks learners to link them.

After opening ODBC and uploading database, now teacher guides learners to connect all tables to the frontend and setting properties.

Teacher guides learners how to drag and drop DAO/RDO or ADO object on VB form to establish, configure and test connectivity.

LESSON 6: DATA CONTROLS, PROPERTIES, DAO MANIPULATION AND CODING

(ADODC, RECORDSET, ADDNEW, DELETE, UPDATE, MOVENEXT, MOVELAST, MOVEFIRST, MOVEPREVIOUS code in VB for data manipulation)

Period: 3 (120 minutes)

a) Prerequisites/Revision/Introduction:

This is the sequence of previous lesson where learners got familiar to drag and drop DAO or RDO object on VB forms to configure and test connectivity, now this will be used to introduce new lesson "Data controls, properties and data manipulation and coding (ADODC, RECORDSET, ADDNEW, DELETE, UPDATE, MOVENEXT, MOVELAST, MOVEFIRST, MOVEPREVIOUS code in VB for data manipulation)". The teacher guides learners to go in computer lab. Through teachers' instructions, learners switch on computers and open Microsoft Visual Basic6.0 and open their project and start inserting appropriate codes for updating, editing, deleting, exiting adding new, next, previous, Top and Bottom.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research
- Projector
- Computer
- Flash disk
- White or black board

c) Guidance on Project 6-6

- Teacher organizes students into groups of 2or 3 students or individual depending on availability of computers.
- Students elect the group representatives if necessary.
- Basing on frontend and backend created in previous activity, teacher asks learners to link them.
- After establishing, configuring and testing connectivity with DAO object, teacher will guide learners to insert appropriate codes for such objects.
- Teacher guides learners to write code to insert, delete, update, search and display records from database through Visual Basic Interface and explaining the importance of each by practice.

LESSON 7: PRINCIPLES FOR DESIGNING A FRIENDLY AND ERGONOMIC USER INTERFACE

Period: 2 (80 minutes)

a) Prerequisites/Revision/Introduction:

This is the last lesson of this unit. Learners are now able to make the VB project. This new lesson is relating to the improvement of created project by improving interfaces and basing on ergonomics' rules. The teacher explains to learner's different tips to make a good interface respecting ergonomics rules. This will help learners to make a project whose relevant interface.

b) Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research
- Projector
- Computer
- Flash disk
- White or black board

c) Guidance on Project 6-7

- Teacher organizes students into groups of 2or 3 students
- Students elect the group representative and secretary.
- Basing on different tips have been seen to make a project, teacher will ask learners to highlight important points that should be followed to make inspirational interface.
- Learners go in computer lab for improving their created projects respecting all highlighted tips in student book to make relevant interface.

6.6. UNIT SUMMARY

In this unit we have seen all steps to Describe Requirement Analysis and Project Planning as well as creating and connecting both frontend and backend. At the end of this unit teacher has to make sure if all learners are able to connect Visual Basic Interface to Database and create a simple Visual Basic standard desktop applications for a real life situation using appropriate tools, objects and properties.

6.7. ADDITIONAL INFORMATION

To teach lessons of this unit, teacher has to make computer lab ready and download at least one shareware for visually impaired learners such as Non Vision Desktop Access(NVDA) if they are in his classroom. Teachers has to give enough homework about a taught lesson to help learners to improve their understanding. For more details about this unit teacher can do an internet research and reading textbook concerning this unit as it is referred to the appendix of this book.

6.8. END UNIT ASSESSMENT

This part provides the answers of end unit assessment activities designed in integrative approach to assess the key unit competence with cross reference to the textbook.

The teacher's guide suggests additional questions and answers to assess the key unit competence.

Lab activity:

As a student of S6 MCE or MPC, you get a chance to do an internship at your sector's health centre and the Director of health center asks you to create a program for health centre that will help them register patients by recording patient and administer drugs. How do you think you will fulfil your task using VB?

Answers: in this project follow the same steps to create frontend and backend then you connect them **(Unity 6 in student book)**

6.9. ADDITIONAL ACTIVITIES

6.9.1. Remedial activities

Remedial Activities: Suggestion of Questions and Answers for remedial activities for slow learners.

1. Suppose you have connected your VB project to Ms Access database, give the syntax and example of:

    a) to add a record into your database

    b) to delete a record by preventing the blank record

   Answer:

   a) Add record into a database

To add a record into a database we use the method AddNew.

Syntax :Controlname.RecordSet.AddNew

Ex. Adodc1.RecordSet.AddNew

   b) Delete a record

To delete a record, we use delete method:

Private Sub CmdDelete_Click()

Adodc1.RecordSet.Delete

End Sub

NOTE: To prevent the display of blank record, we move the record:

Private Sub CmdDelete_Click()

Adodc1.Recordset.Delete

Adodc1.Recordset.MoveNext' prevent the error in case a record is not available

End sub

Q2. a) ISHIMWE wants to connect MS Access database to his VB form, but unfortunately he does not see ADO data control on visual basic toolbox. What are the steps can you tell him to follow so that he can be able to view ADO on visual basic toolbox?

b) Assume that your database is connected to a VB form, write the methods which will help a user to add new record, to delete a record, to move to the next record and to move to the previous record.

Answer

a) To add the ADO control on the form, perform the following steps:

1. Select the command *Component* in the project menu

2. Click on Controls in the dialog box which opens

3. Select *Microsoft Ado Data Controls 6.0 (OLEDB)*

4. Click ok button

5. This control will be added to the toolbox.

6. To connect ADO objects on the data source use a « *ConnectionString* » and specify the datasource (the database name you want to connect)

7. Then you have to specify the access path after clicking the connection property.

b) answer is guided from student content.

6.9.2. Consolidation activities

Consolidation activities: Suggestion of questions and answers for deep development of competences.

1. a) Briefly explain the ADO (ActiveX Data Objects) objects.

   b) What are the three ways to connect to a database in visual basic?

Answers:

1. a) The ADO Object Model (ADO Objects)

ADO has three main independent objects:the **Connection object, the Recordset object**, and the **Command object**.

Following Figure depicts the complete ADO 2.0 object model showing the objects and their properties.

Objects

Collections
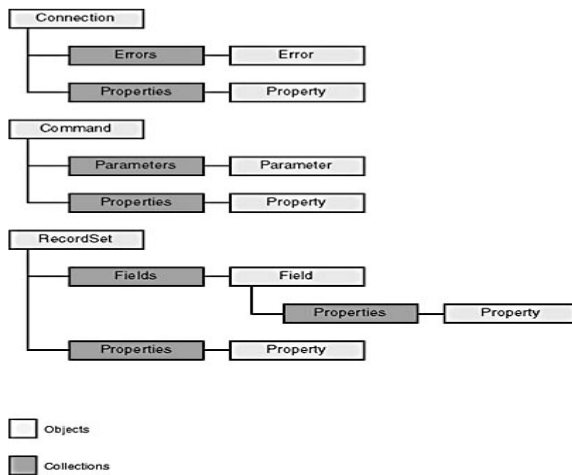
The Connection Object

The ADO Connection object represents an open connection to a data source. This data source might be a database, an ODBC source, or any other source for which an OLE DB provider exists.

The Recordset Object

The Recordset object contains all the data that you read from a database or that you're about to send to it. A Recordset can include several rows and columns of data.

 You can access only one row at a time, the so-called current row or current record. You navigate through a Recordset by changing the current record.

The Command Object

The ADO Command object defines a command or a query that you can execute on a data source. Command objects are useful when you plan to execute the same command or query several times (on the same or on a different data source) and when you want to run stored procedures or parameterized queries.

b) There are three ways to connect to a database: using a **data link,** using an **ODBC data source** and **connection string** (that has been used in student content).

6.9.3 Extended activities

Extended activities: Suggestion of Questions and Answers for gifted and talented students.

1. Create a project Visual BASIC to manage a library

2. Create a project that will be used in your school discipline master office (Discipline Management System) that will manage discipline information concerning to the students such as students' information, permission, type of fault and sanction.

Answers: refer to student book to follow all steps of making a project. After specifying software requirements, learners will create necessary forms (front -end) and database including needed table (backend), coding later creating their connection

UNIT 7: PROCESS MANAGEMENT AND SCHEDULING ALGORITHMS

7

7.1. Key unit competence

To be able to explain how processes are managed by Operating System and understand process scheduling algorithms.

7.2. Prerequisite knowledge and skills

Learners should have knowledge and skills on Operating System concepts (senior 4)

7.3. Cross cutting issues to be addressed

- **Gender Education:** Care should be taken that both sexes are given equal opportunities. For example, when forming groups each group should contain boys and girls.

- **Inclusive Education:** Regardless of physical appearance and abilities learners should all be treated equally. This makes the learners to find out that they are all of great importance and feel motivated during class.

- **Peace and value Education:**

- Students' ideas and opinions should be respected during class discussions. Remember that someone's idea is very important. It may be correct or not but what is important is to build on that idea.

7.4. Guidance on the introductory activity

Introduction to do the introductory activity

- This activity takes place in smart classroom Put the learners into groups and ask them to open the page where there is the introductory activity of Unit 7 in the students' textbook.

- Ask them to do the introductory activity in their respective groups.

- Give to learners time to answer the questions independently while facilitating those facing difficulties.

- Then ask them to present their findings.

Here are possible answers to the introductory activity

a) EXCEL.EXE, taskmgr.exe, winlogon.exe and explorer.exe. In case there are other open programs, their processes will also be listed in the application tab.

b) In the table (task manager) six tabs are displayed namely: Applications tab,

Processes tab, Services tab, Performance tab, Networking tab and Users tab

i) **The application tab** contains the list of open and running applications. At the bottom, there are three buttons:

- **End Task:** this closes an application or process.

- **Switch To:** this switches between applications or processes.

- **New Task:** this starts an application from the dialog box that opens when you click this button.

ii) **The Processes tab** contains a list of all the running processes.

iii) **The services tab** lists all the services that can run on the computer. For each service you see the Name of the service, the PID (process identifier), description of the service, status (whether a process is Running or Stopped) and Group (the service group). The services tool allows you to specify whether a process starts automatically, automatically with a delayed start, manually or is disabled.

iv) **The performance tab** provides an overview of the computer's CPU and memory usage. It contains the following information:

- CPU usage in real time and in a history graph

- Memory usage in real time and in a history graph

- Physical memory statistics

- Kernel memory statistics

- System totals for handles, threads, processes, uptime and the page file.

v) **The networking tab** enables the computer user to monitor the network performance on all Network Interface Cards (NICs) installed on the computer. The tab shows the network utilization on a computer with Wireless Network Connection and Local Area Connection.

vi) **The users tab** provides the user with the information about the users connected to the computer. When you click on users tab, you find the username, ID, status, client name and session type. You can right-click on any connected user to perform a variety of functions such as sending the user a message, disconnecting the user, logging off the user and initiating a remote-control session to the user's machine.

c) Ms Excel application exits. The reason why it closes is that since a program comprises of one or more processes, once its processes are ended, the program also exits.

7.5. LIST OF LESSONS

#	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes)	Number of periods
1	Process	Differentiate a process and a program Describe how operating system manages processes Identify states of a process	3
2	Thread	Describe the role of threads in operating system management Differentiate between thread and a process	3
3	Process Scheduling	Describe the process scheduling of Operating system	3
4	Process Scheduling Algorithms:	Describe different process scheduling algorithms	3

LESSON 1: PROCESS

(3 Periods: 120 minutes)

a) Prerequisites/revision/ introduction:

Through guided discovery, assist learners to review what an operating system is and its functions (s4 unit 15). Learning activity 7.1. is used to introduce the lesson. The learners read the text in the students' book carefully and they discuss questions that follow in groups:

b) Teaching resources:

- Computers
- Projector
- Internet

c) Learning activities

Guidance:

- Put the learners into groups.
- Ask the learners to open their text books and read carefully the text given under learning activity 7.1
- The learners open the task manager by pressing Ctrl + Alt+ Del on the keyboard and click on task manager.

- Move around to see if the learners are doing the activity correctly.

- The learners present their findings in groups.

- The learners react to the findings that are presented by the groups

- Summarize the results from the group discussions and correct them where necessary.

- Instruct the learners on how to do Application activity 7.1

- The learners do the Application activity 7.1

Answers to learning activity 7.1.

1. A process

2. The running programs are system programs such as the operating system and application programs such as Microsoft word.

The differences between system software and application software are:

SYSTEM SOFTWARE	APPLICATION SOFTWARE
It provides a platform for the user to interact with the hardware.	It serves a specific purpose on the computer.
It runs in the background and acts as a platform.	Runs in the foreground and interacts with the user.
Example: operating system	Example: Microsoft word

3. In the task manager window, under the performance tab and click on resource monitor. Then click on memory tab to see the processes that consume a lot of memory space and list them down.

d) Answers to application activity 7.1.

1. a) Refer to Student Book section 7.1.3

   b) Refer to Student Book section 7.1.5

   c) Refer to Student Book section 7.1.4

   d) Ms Word, VLC Media Player, Internet Explorer, Google Chrome, Mozilla Firefox, Ms Excel.

2. a) true

b) True

c) True

LESSON 2: THREADS

2 periods: 120minutes

a) Prerequisites/Revision/Introduction:

Briefly review the previous lesson by asking learners to identify difference between

a process and a program and why it is necessary to divide a program into processes. Learning activity 7.2. is used to introduce the lesson. It is carried out in the smart classroom. Ask the learners to go to the internet and answer the questions in activity 7.2.

b) Teaching resources:

- Computer lab /smart classroom
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Organize the learners into groups of two or three to do learning activity 7.2. Make sure there is reliable internet connectivity.
- The learners go to internet and research on the questions given in the activity.
- Move around to see if learners are doing activity well.
- The learners present their answers in groups.
- The learners react to the results presented by other groups
- Summarize the contents of the group discussions (Notes in learners' book).
- Give the instructions on how to do Application activity 7.2.
- Learners do the Application activity 7.2.

Answers to learning activity 7.2.

a) Refer to Student Book section 7.2.1 and 7.2.2.

b) Refer to Student Book section 7.2.3.

d) Answers to application activity 7.2.

1. The benefits of threads are:

- There is efficient communication between threads because they do not need to use inter process communication.
- Threads allow utilization of multiprocessor architectures to a greater scale and efficiency. Hence they maximize parallelism.
- They only need a stack and storage for registers therefore, threads are cheap to create.
- Threads use very little resources of an operating system in which they are working.
- Context switching is fast when working with threads.
- Use of threads provides concurrency within a process.

2. Refer to Student Book section 7.2.3.

LESSON 3: PROCESS SCHEDULING

a) Prerequisites/revision/ introduction:

Briefly review the previous lesson by asking learners to answer questions about the importance of threads in process management. Learning activity 7.3 introduces this lesson. Ask the learners to read the paragraph in the learning activity 7.3 and answer the questions that follow:

b) Teaching resources:

- Computer lab /smart classroom
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance:

- Ask the learners to open their text books and read carefully the text given under learning activity 7.3
- The learners read the text and in groups they discuss the questions that follow.
- Move around to see if the learners are doing the activity correctly.
- Instruct the learners on how to do Application activity 7.3
- The learners do the Application activity 7.3

Answers to learning activity 7.3.

i) The operating system helped him to do the three tasks at once.

ii) The operating system breaks down the programs into a number of smaller processes. When one process of a program says ms word has finished utilizing the CPU and is ready to do I/O operations, the CPU is allocated to a process of another program which needs execution. The CPU switches from one process to another almost instantaneously and to the user this change is not noticeable and gives the impression of simultaneous operation of the three programs. This is called multitasking. The algorithm to allow this, is First Come First Serve (FCFS)scheduling algorithm

d) Answers to application activity 7.3.

- a. Process
- b. Long term scheduler
- c. PCB
- d. Dispatcher
- e. Short term scheduler

LESSON 4: PROCESS SCHEDULING ALGORITHMS:

a) Prerequisites/revision/ introduction:

Briefly review the previous lesson by asking learners to state what process scheduling is and the three types of schedulers. Using learning activity 7.4. to introduce the lesson.

b) Teaching resources:

- Computer lab /smart classroom
- Internet and textbooks to facilitate research
- Learning activities:

Guidance:

- Organize learners in groups of three or five.
- Learners discuss the possible answers to the questions in the learning activity 7.4 (Ref to student book)
- Move around checking if the learners are all active in their groups.
- Ask the group representatives to present their findings to the rest of the class.
- All learners participate in open discussion on the findings presented by other groups
- Summarize the contents of the group discussions.
- At the end of this lesson give guidance on how learners are supposed to do the application activity 7.4
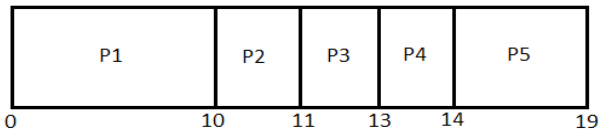- Learners do the application activity.

Answers to learning activity 7.4.

1. In the application list, the applications are arranged in ascending order of their names. For example Document1-MicrosoftWord will come first, followed by Google-Opera and Microsoft Excel-Book1 will come third in the list. This is by default. If you click on the drop down arrow, the arrangement changes from ascending to descending order.

2. The reason why the order of processes changes in the resource monitor window are:

   a) Some processes have completed their execution time and have terminated.

   b) There are some processes which have been sent to the ready queue still waiting for an I/O completion.

   c) There are processes which have been preempted from the CPU by high priority processes.

3. The computer bases on the following 5 scheduling algorithms:

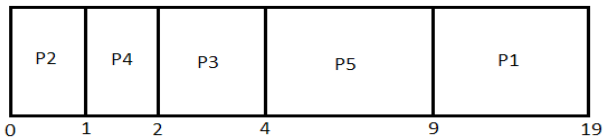- First-Come, First-Served (FCFS) Scheduling

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- Shortest-Job-First (SJF) Scheduling
- Priority Scheduling
- Round Robin (RR) Scheduling
- Multiple-Level Queue Scheduling

d) Answers to application activity 7.4

Gantt charts

P1	P2	P3	P4	P5

0 … 10 … 11 … 13 … 14 … 19

SJF

P2	P4	P3	P5	P1

0 … 1 … 2 … 4 … 9 … 19

Non-preemptive priority

P2	P5	P1	P3	P4

0 … 1 … 6 … 16 … 18 … 19

RR (quantum =1ms)

P1	P2	P3	P4	P5	P1	P3	P5	P1	P5	P1	P5	P1	P5	P1	P1	P1	P1	P1

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
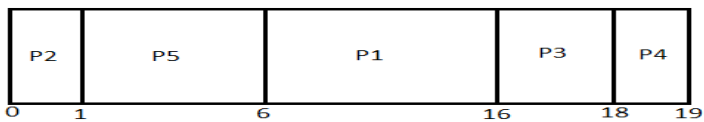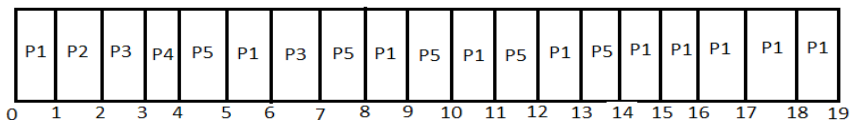
b) Waiting time for each process

For FCFS

Process	Waiting time (ms)
P1	0
P2	10
P3	11
P4	13
P5	14

For SJF

Process	Waiting time (ms)
P1	9
P2	0

Process	
P3	2
P4	1
P5	4

For non-preemptive priority

Process	Waiting time (ms)
P1	6
P2	0
P3	16
P4	18
P5	1

RR (quantum =1ms)

Process	Waiting time (ms)
P1	9
P2	1
P3	5
P4	3
P5	9

7.6 UNIT SUMMARY

- A process is an instance of a computer program that is currently being executed
- Process is dynamic entity
- Program is a static entity.
- Process state is defined as the current activity of the process.
- Process has five states: New, Ready, Running, Waiting and Terminated.
- Each process in the system is represented by a data structure called a process control block.
- Thread is a light weight process.
- Multithreading refers to the ability of an operating system to support multiple threads of execution within a single process.
- Kernel level threads are threads within a process that are maintained by the Kernel.
- User level threads are unknown to the operating system and are created and managed by a threads library that runs in the user space of a process.
- User level threads are faster to create and manage than Kernel level threads.
- Schedulers are special system software which handle process scheduling.

- Schedulers are of three types:
  - i) Long term scheduler (job scheduler)
  - ii) Short term scheduler (CPU scheduler)
  - iii) Medium term scheduler
- Long term scheduler selects the processes from the queue and then loads them into memory.
- Short term scheduler is also known as dispatcher.
- Process changes state from new to ready is long term scheduler.
- Process changes state from ready to running is short term scheduler.
- Non preemptive scheduling: Once a process has been given to the CPU, the CPU cannot be taken away from that process.
- Preemptive scheduling is when a process has been given to the CPU and the CPU can be taken away from that process.
- FCFS CPU scheduling algorithm is non preemptive.
- SJF scheduling algorithm is preemptive and non preemptive.
- Priority scheduling algorithm can either be preemptive ot non preemptive.
- Priority scheduling algorithm suffer from starvation.
- RR scheduling algorithm is preemptive algorithm.
- Time sharing systems uses the RR method.
- Multilevel queue algorithms allow different algorithms to be used for various classes of processes.
- Aging is atechnoque to prevent starvation.
- Time slice is also called time quantum.
- Efficiency of RR depends on the size of the time quantum in relation to the average CPU **cycle.**

7.7 END OF UNIT ASSESSMENT

ANSWERS

I. Multiple choice question answers:

|	
1	A
2	B
3	B
4	A
5	A
6	B
7	C

II. Answers the following structured questions:

1. What do you understand by the following terms?

   A. **Process:** A process is a program in execution. It is an instance of program execution

   B. **Process state:** The process state is an indicator of the nature of the current activity in a process. I.e. new, ready, running, waiting and terminated.

   C. **Process control block:** A Process Control Block is a data structure maintained by the Operating System for every process that stores information about processes.

2. Draw a labeled diagram for the process state transitions. Refer to Student Book section 7.1.4

3. Explain the following:

   A. Short term scheduler

   B. Long term scheduler

   C. Medium term scheduler

   D. Refer to Student Book section 7.3.4

4. Compare the process and program. Refer to Student Book section 7.1.3

5. What is the role of PCB? List the attributes of PCB. Refer to Student Book section 7.1.5

6. What are benefits of threads?

   • There is efficient communication because they do not need to use interprocess communication.

   • Threads allow utilization of multiprocessor architectures to a greater scale and efficiency.

   • They only need a stack and storage for registers therefore, threads are cheap to create.

   • Threads use very little resources of an operating system in which they are working. That is, threads do not need new address space, global data, program code or operating system resources.

   • Context switching is fast when working with threads. Context switching is the procedure of storing the state of an active thread or process for the CPU when it has to start executing a new one.

   • Use of threads provides concurrency within a process.

7. What are the differences between user level threads and kernel supported threads? Refer to Student Book section 7.2.3

8. For the following example, calculate the average waiting time and average turnaround time for the following algorithms.

A. FCFS

B. Preemptive SJF

C. Round Robin (1 time unit)

Process	Arrival time	Burst time
P1	0	8
P2	1	4
P3	2	9
P4	3	5

a. FCFS
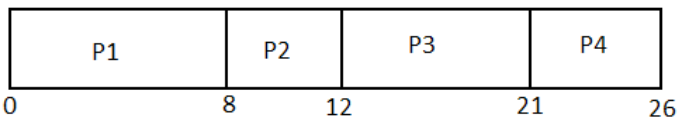
Waiting time:

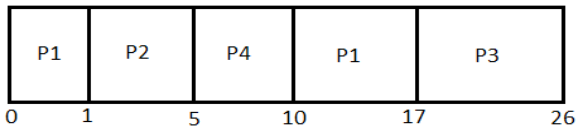| Process	Waiting time (ms)
P1	0-0 =0
P2	8-1=7
P3	12-2=10
P4	21-3=18

Average waiting time = (0+7+10+18)/4 = 35/4 = 8.75 ms

Turnaround time = Burst time + Waiting time

Process	TurnAround time (ms)
P1	8+0=8
P2	4+7=11
P3	9+10=19
P4	5+18=23

Average turnaround time= (8+11+19+23)/4 = 61/4 = 15.25ms

b. Preemptive SJF

P1	P2	P4	P1	P3

```
0   1       5      10      17          26
```

Waiting time:

Process	Waiting time (ms)
P1	0+(10-1) =9
P2	1-1 =0
P3	17-2=15
P4	5-3=2

Average waiting time = (9+0+15+2)/4 = 26/4 = 6.5 ms

Turnaround time:

Process	Turn Aroundtime (ms)
P1	8+9=17
P2	4+0=4
P3	9+15=24
P4	5+2=7

Average turnaround time= (17+4+24+7)/4 = 52/4 = 13ms

c) Round Robin (1 time unit)

P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P3	P4	P1	P3	P1	P3	P1	P3	P3

```
0  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25  26
```
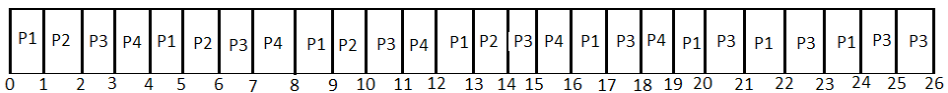
Process	Waiting time (ms)
P1	16
P2	9
P3	15
P4	11

Average waiting time = (16+9+15+11)/4 = 51/4 = 12.75 ms

Turnaround time:

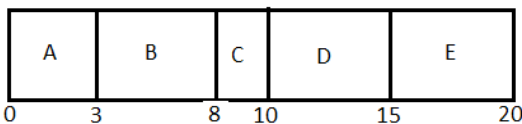| Process	TurnAround time (ms)
P1	8+16=24
P2	4+9=13
P3	9+15=24
P4	5+11=16

Average turnaround time= (24+13+24+16)/4 = 77/4 = 19.25ms

9. Consider the following set of processes

Process	Arrival time	Burst time
A	0	3
B	1	5
C	3	2
D	9	5
E	12	5

Draw the Gantt chart and calculate the waiting time and the average turnaround time for each of the following scheduling algorithms:

a. FCFS

A	B	C	D	E

0   3   8   10   15   20

Waiting time:

Process	Waiting time (ms)
A	0-0=0
B	3-1=2
C	8-3=5
D	10-9=1
E	15-12=3

Average waiting time = (0+2+5+1+3)/5 = 11/5 = 2.2 ms

Turnaround time:

Process	TurnAround time (ms)
A	3
B	7
C	7
D	6
E	8

Average turnaround time= (3+7+7+6+8)/5 = 31/5 = 6.2ms

b. Non preemptive SJF

Waiting time:

Process	Waiting time (ms)
A	0-0=0
B	5-1=4
C	3-3=0
D	10-9=1
E	15-12=3

Average waiting time = (0+4+0+1+3)/5 = 8/5 = 1.6 ms

Turnaround time:

Process	TurnAround time (ms)
A	3
B	9
C	2
D	6
E	8

Average turnaround time= (3+9+2+6+8)/5 = 28/5 = 5.6ms

A	C	B	D	E

0   3 5   10   15   20
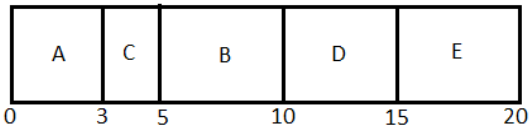
Waiting time:

Process	Waiting time (ms)
A	0-0=0
B	5-1=4
C	3-3=0
D	10-9=1
E	15-12=3

Average waiting time = (0+4+0+1+3)/5 = 8/5 = 1.6 ms

Turnaround time:

Process	TurnAround time (ms)
A	3
B	9
C	2
D	6
E	8

Average turnaround time= (3+9+2+6+8)/5 = 28/5 = 5.6ms

10. Differentiate preemptive and non preemptive scheduling giving the application of each of them.

In non-preemptive algorithms, once a process enters the running state, it cannot be preempted until it completes its allocated time whereas in preemptive scheduling a scheduler may preempt a low priority running process anytime when a high priority process enters into a ready state. FCFS, SJF and priority based scheduling are examples of non-preemptive scheduling. SJF, priority based scheduling and RR are examples of preemptive scheduling.
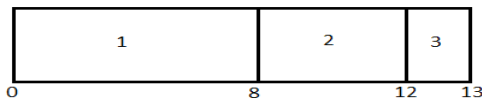
11. Suppose the following jobs arrive for processing at the times indicated. Each job will run the listed amount of time.
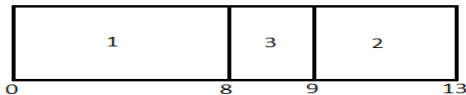
Job	Arrival time	Burst time

1	0.0	8
2	0.4	4
3	1.0	1

a.   Give the Gantt chart illustrating the execution of these jobs using the non-preemptive FCFS and SJF scheduling algorithm.

i) For   FCFS

ii) SJF

b. What is the wait time of each job for the above algorithm?

i) For FCFS

Job	Waiting time (ms)
1	0-0.0=0
2	8-0.4=7.6
3	12-1.0=11

ii) For SJF

Job	Waiting time (ms)
1	0-0.0=0
2	9-0.4=8.6
3	8-1.0=7

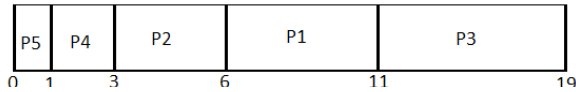12. For the following set of processes, find the average waiting time using Gantt chart for

i. SJF

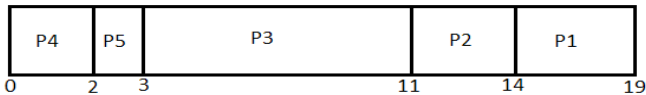ii. Priority scheduling

Process	Burst time	Priority
P1	5	5
P2	3	4

P3	8	3
P4	2	1
P5	1	2

The processes have arrived in the order P2, P1, P4, P3 and P5.

i) SJF

P5	P4	P2	P1	P3
0	1	3	6	11	19

Process	Waiting time (ms)
P1	6
P2	3
P3	11
P4	1
P5	0

Average waiting time = (6+3+11+1+0)/5 = 21/5 = 4.2 ms

P4	P5	P3	P2	P1
0	2	3	11	14	19

Process	Waiting time (ms)
P1	14
P2	11
P3	3
P4	0
P5	2

Average waiting time = (14+11+3+0+2)/5 = 30/5 = 6 ms

UNIT 8: FILE MANAGEMENT

8

8.1. Key Unit Competence:

To be able to describe role of operating system in file management and explain file management

8.2. Prerequisite knowledge and skills:

Students have learnt concepts of operating system in the previous year's units such as:

- Unit 4 on computer software installation and unit 15 on introduction to Operating System in Senior 4.
- Unit 7on process management and scheduling algorithm in Senior 6.

8.3. Cross-cutting issues to be addressed:

- **Financial Education:** To be covered when explaining to students cost related to file management on different storage devices. Students should understand that file management is one of the fundamentals for any business to succeed and organization can save money when its files are well managed.

- **Standardization Culture:** To be covered when explaining to students that there are standards required in organizing file in the computer, such as naming of file, file structure and file extension.

- **Peace and Values Education:** Students should understand how to prevent unauthorized users from accessing personal files or organizational files. Students must be aware that poor file management can be source of conflict within an organization.

8.4. Guidance on the introductory activity

Instruction to do the introductory activity

1. This activity take place in the computer lab and each student must have a computer which has any word processing software.

2. Students open Microsoft word and type the text in the students' book. Then after typing the text, students save the file on the desktop. Teacher should let students choose the file name of the word document. The objective of the introductory activity is to introduce the file management concepts.

3. Then, students start to answer questions from the students' book in group of 4 or 5 students. They may not be able to answer all the questions but let them try and get answers as they learn this unit.

Below are suggested answers for questions in the Introductory Activity.

1. It is a very important to save any document because the document is kept and it can be needed for future use.

2. In fact, the user does not know where he saves a document on the hard drive (physical address). This means that the user is not able to give the platter number, track number and sector number on the hard drive from which a document is saved.

3. It is not possible to save two files having the same name in the same location. It create naming conflict. It does not respond to the naming scheme of the operating systems.

4. File and document are two terms used interchangeably. The difference between the file and the folder is that a file stores data and a folder stores files and other folders. The folder is often called a directory. Folder is used to organize files on the computer.

5. The following are some of the properties of a file:

   a. **Name:** It is the only information which is in human readable form.

   b. **Identifier:** The file is identified by a unique tag (number) within file system.

   c. **Type:** It is needed for systems that support different types of files.

   d. **Location:** Pointer to file location on device.

   e. **Size:** The current size of the file.

   f. **Protection:** This controls and assigns the power of reading, writing, executing.

   g. **Time, date, and user identification:** This control the time, date and user who access the file for the last time.

6. The reason behind folders having same icons is that they are created by the operating system while files are created by the application system that is why each application has its own icon and the file extension.

7. In order to protect your document from deletion and edition by unauthorized people below precautions should be considered:

   • Set permissions on files and folders

   • Make sure files are protected by a password

   • Back up files on a regular basis to prevent data loss

   • Avoid file theft and unauthorized access by protecting data with encryption

8. The answer depends on the operating system you are using. Below are file system

for the most used operating system:

- The Microsoft Windows operating system have two file systems FAT (File Allocation Table) and NTFS (New Technology File System).
- Linux supports ext* family file systems which include the ext2, ext3 and ext4.
- Apple File System (APFS) is a proprietary file system developed and deployed by Apple Inc for macOS and IOS.

8.5. LIST OF LESSONS

#	Lesson title	Learning objectives	Number of periods
1	INTRODUCTORY ACTIVITY	Introduce the unit title 8: File management	1
2	U N D E R S T A N D COMPUTER FILE	Describe structure of file, file system	3
3	FILE TYPE	Explain types of files Explain how file system manages computer hardware and computer software.	2
4	FILE ACCESS MECHANISMS	Explain mechanism of accessing files	3
5	FILE SPACE ALLOCATION	Describe mechanism of accessing files, and space allocation of a file in memory	2
6	END UNIT ASSESSMENT	Evaluate the key unit competence	1

GUIDANCE ON DIFFERENT LESSONS OUTLINED ABOVE

LESSON 1: UNDERSTAND COMPUTER FILE

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

Learning activity 8.1 introduces the understanding computer file lesson. The lesson can be conducted in class or in computer lab. Students start by observing the figure in the learning activity 8.1 in the students' book. Students may have different view on the picture, gather all ideas from students, your role as a teacher is to channel their ideas and views to one conclusion.

Students discuss the role of the root directory in hierarchical file system for the operating system. Basic role of root directory is that the root directory is the highest directory in the hierarchy. The root directory can also be the beginning of a particular folder structure. The root directory contains all other folders on the drive, and the folder may contain files.

After identifying the elements in Figure 8.1, students will be able to differentiate between a file and a folder. It is just the difference between the file and the folder

where the file stores the data and the folder stores the files and other folders.

b. Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.
- Students elect the group leader and secretary.
- Learners do the Learning Activity 8.1.
- Teacher walks around and sees if students are doing activity in their respective group.
- Students present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- Teacher gives the instructions on how to do Application activity 8.1
- Students do Application activity 8.1

d. Answer for the Application activity 8.1

QUESTION A

1. Cluster is the logical unit of file storage on a hard disk; it's managed by the computer's operating system. Any file stored on a hard disk takes up one or more clusters of storage.

2. Refer to the students' book.

3. Organizing data in a hierarchical model of files and folders allows you to add context to your data. Data users can understand and use data in the short, medium and long term.. It helps in avoiding disorganized data and it saves time and prevents errors.

4. Refer to the students' book.

5. The difference between home directory and working directory is that :

a. Home Directory: Every user has one home directory and has complete control over it. On login, home is the default working directory for the user. It contains the configuration files and user credentials(user name and password) login and logout of the user While

b. Working directory is the directory in which the user is working currently the

home directory may also be the working directory, if the user is working in it.

6. An **absolute pathname** is a pathname that starts from the root path and specifies all directories between the root directory and the specified directory or file while a relative pathname is a **pathname** that specifies some abbreviations for traversing up the directory structure and down to another directory or file in the same directory tree.

Here are some examples for absolute pathnames:

- In DOS/Windows: C:\Documents and Settings\user1\Local Settings\Application Data\Adobe\Acrobat
- Unix: /users/user1/Library/QuickTime/
- Mac: HD:Users:user1:Library:Quicktime:

Here are some examples of relative pathnames:

- In DOS/Windows: ..\Application Data\Adobe\Acrobat
- Unix: ~user1/Library/QuickTime/, ~../user1/Library/QuickTime/
- Mac: ::user1:Library:Quicktime

QUESTION B

1. Right-click a file and select the Properties .You can quickly open the file properties if you press and hold the Alt key and double click the file or press Enter.

2. No. Because folders are created by the operating system. Therefore application software cannot create a folder.

3. No, Ordinary Files / Simple File are normally created by the application software, operating system cannot create files.

4.   There is not difference between folder and directory. Folder is used in windows operating system and directory is used in LINUX, UNIX and DOS operating systems.

LESSON 2: FILE TYPE

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

Students are going to use the knowledge and skills learnt in the lesson 1 as the prerequisites for thestructure, attribute classification and type extension of files lesson. The learning activity 8.2 introduces the lesson and students start by observing the figure in the activity. The figure features different icons which represent various application programs.

Below are proposed answers for questions in the activity 8.2

1.   Students may give various answers as a teacher try to guide them to the rightanswer.

2.   The reason why files do not have the same graphical representation (icon) is that

files are made by different application software. Files are create by a specific application software and that application gives a specific file extension and icon to that file.

3. The operating system recognizes the application software that open a file through the file extension. File extension of a file tells the operating system which application program that open that file.

4. The operating system in order to recognizes the file types, it uses file extension.

a. **Teaching resources:**

• Computer lab

• Internet and textbooks to facilitate research

b. Learning activities:

Guidance on Activities

• Teacher organizes students in group of 4 or 4 in order to do learning activity 8.2.

• Students elect the group leader and secretary.

• Learners do Learning Activity 8.2.

• Teacher walks around and sees if students are doing activity in their respective group.

• Students present their answer to the rest of the class.

• Students react on the finding/ answers from other groups.

• Teacher corrects false answers and completes the half correct answers

• Teacher summarizes the contents (Note in students book) and gives examples that should be done by students

• Teacher gives the instructions on how to do Application activity 8.2

• Students do Application activity 8.2.

Answers to learning activity 8.2.

The teacher guides learners in doing learning activity 8.2

d. Answers to application Activity 8.2

1. File type can be represented by

b) file extension

2. Name and describe the two basic classifications of files. (refer to the student's book)

• Text files: A text file is used to store standard and structured textual data / information that is human readable. It is defined in several different formats, including the most popular ASCII for cross-platform usage and ANSI for Windows-based operating platforms.

- A binary file is a file stored in binary format. A binary file is computer-readable but not human-readable. All executable programs are stored in binary files.

3. Distinguish between a file type and a file extension.

- A file type is a name given to a specific kind of file. For example, a Microsoft Word document and an Adobe Photoshop document are two different file types

- File extension is used by the operating system to identify type of the file. File extension is used to launch the application software automatically when files is opened.

4. Refer to the text book

5. What would happen if you give the name "myFile.jpg" to a text file?

It depends on what application program you use to open the file. If you use a program that expects an image file, you would get an error. If you use a program that expects a text file, there would be no problem.

6. Refer to the text book

LESSON 3: FILE ACCESS MECHANISMS

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

The learning activity 8.3 introduces the file access mechanisms lesson. The prerequisites for the lesson are MS DOS commands. Students are going to create various folders and subfolders using MS DOS. They are going to describe path used to access different folders and subfolders. Students play with DOS command in order to access folders.

b. Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in group of 4 in order to do learning activity 8.3.
- Students elect the group leader and secretary.
- Learners do Learning Activity 8.3.
- Teacher walks around and sees if students are doing activity in their respective group.
- Students present their answer to the rest of the class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correct answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- Teacher gives the instructions on how to do Application activity 8.3.

- Students do the Application activity 8.3.

d. Answers to the Application Activity 8.3.

1. Refer to the students' book

2. Compare sequential and direct file access.

   Both sequential and direct file access find and access a record. In sequential access the file pointer begins at the beginning of the file and can only move in one direction. Thus sequential access is linear: The only record that can be accessed is the first or the one immediately following the last one accessed. In direct access the file pointer can be moved to any specific record and the data accessed from that place.

3. Refer to the students' book.

4. Refer to the students' book.

5. a) Sequential access always accesses the next record. You implement sequential access on a disk by not giving the user an access command that takes a record address as a parameter.

   b) Each record on a magnetic tape is conceptually numbered from the first to the last. The operating system keeps a counter of which record was read last. When a user gives an access command to read a specific record, if the record number is beyond the last record read, then records are read and skipped until the correct record is found. If the record number comes before the last record read, the tape is rewound and records are read and skipped until the correct record is found.

LESSON 4: FILE SPACE ALLOCATION

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

The learning activity 8.4 introduces the lesson file space allocation and the prerequisites for the lesson are the previous lesson in senior 4: unit 2: computer architecture, assembling and disassembling a computer. Students start by observing the picture in the activity, the figure shows different files stored on the hard disk, let students explore it and gathers all the answer in order to start the lesson with their lessons. Students are going to give view on the figure in the students' book and all views are welcomed.

b. Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.

- Students elect the group leader and secretary. He/She participates in this election by making sure less active students are given opportunity to lead their groups.
- Learners do the Learning Activity 8.4.
- Teacher walks around and sees if students are doing activity in their respective group.
- Students present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- Teacher gives the instructions on how to do Application activity 8.4.
- Students do Application activity 8.4.

## Answers to learning activity 8.4.

The proposed answers for the questions in the learning activity 8.4 are:

1. The OS maintains a table indicating which blocks of memory are free. The OS also maintains a table for each directory that contains information about the files in that directory.

2. In order to keep track on the file stored in the secondary memory the operating use the 3 technic such as Contiguous allocation, Linked allocation, Indexed allocation

3. Computer usually uses its input/output channels to access secondary storage and transfers the desired data using intermediate area in primary storage.

d) Answers to Application activity 8.4.

1.The three major methods of allocating disk space that are in wide use are : d) all of the mentioned	2.In contiguous allocation : a) each file must occupy a set of contiguous blocks on the disk
3.In linked allocation : b) each file is a linked list of disk blocks	4.In indexed allocation : c) all the pointers to scattered blocks are placed together in one location
5. Contiguous allocation of a file is defined by : a) disk address of the first block & length	6. One difficulty of contiguous allocation is : a) finding space for a new file

8.6. Summary of the unit
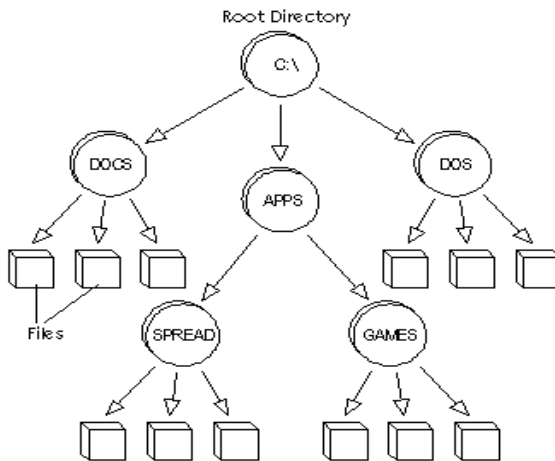
File management describes the fundamental methods for naming, storing and handling files. The data is kept in a hierarchical file system in which folders contain files and subfolders beneath them. Although we use the computer operating system to keep data organized. The fundamental aspects of file management are how we name files and folders, how we arrange these nested folders, and how we handle the files in these folders.

The operating system plays role in organization of data. I enhance organizing and finding files on the storage devices.

Below are some best practices in file management:

- Choose one place to store related files.
- Creating a hierarchy model rather than putting everything in one single folder.
- Having a standard in file naming by never save files under the default name provided by application software.

One of the most important elements file management is that there is a place for everything in the computer. Whether, it is computer's program files, word processing files, spreadsheet file files, pictures and videos. Each of your files should be categorized and put into the designated folder for easy and accessible use.

8.7. Additional Information:

This section provides additional content for the teacher to have a deeper understanding of the topic.

Why is file management needed?

The operating system maintains a secure and well managed file system for all the users of the computer system. Mechanisms exists to ensure correct and authorized use of any of the files under the file manager's care. This part of the operating system is the

most visible to the user, as the user will have specific file requirements and will expect requirement results to be evidenced.

The file manager ensures data integrity and files are kept secure. In order to do this the file manager maintains accurate information about all the files, their use and their movement throughout any file management system. A file can be created, modified or deleted in some way as a direct result of some form of processing activity - which in turn is undertaken by the process manager. As such the file manager needs to ensure that all its files are fully protected from misuse or accidental damage at all times.

The file manager has a predetermined policy that states how a file is created, used, stored and retrieved. Ultimately the policy is based on flexibility of access to the files and protection of the files. The file manager is mainly concerned with providing a suitable interface for users to manipulate files. Users need to be able to store data long term. This obviously requires a very large and non-volatile memory area. This area needs to be organized and controlled.

The file manager provides this area in a controlled and structured way. The file manager typically creates a file 'tag' which basically acts as a file descriptor. This descriptor will typically log details of the use of any file, its movement, the file's symbolic name, and its current status, (for example if a file is protected, or archived, etc.). Once a file is actually opened the file manager will append further information to the file descriptor, such as for example, where a file is physically kept in secondary storage (to allow for a file's return, etc.).

8.7 END UNIT ASSESSMENT

1. A file is the smallest amount of information that can be written to secondary memory. It is a named collection of data, used for organizing secondary memory.

2. A file is a named collection of data. A directory is a named collection of files.

3. A file is considered as an executable when it has .exe as file extension.

4. Refer to the students' book

5. What are the different directory structures available?

6. Refer to the students' book

7. Refer to the students' book

8. Consider a system that supports the strategies of contiguous, linked, and indexed allocation. What criteria should be used in deciding which strategy is best utilized for a particular file?

Answer:

- Contiguous: if file is usually accessed sequentially, if file is relatively small.
- Linked: if file is large and usually accessed sequentially.
- Indexed: if file is large and usually accessed randomly.

9. Refer to the students 'book

10.

   a. Print the content of the file.

   b. Print the content of record

   c. This record can be found using hashing or index techniques.

8.8. ADDITIONAL ACTIVITIES

8.8.1. Consolidation activities:

Suggestion of questions and answers for deep development of competences.

1. A directory that contains another directory is called what?

Answer: parent directory

2. A directory contained within another directory is called what?

Answer: subdirectory

3. The directory that is not contained in any other directory is called what?

Answer: root directory

4.   The structure showing the nested directory organization is called what?

Answer: directory tree

5. What is the directory called in which you are working at any one moment?

Answer: working directory

8.8.2. Remedial activities

(Suggestion of questions and answers for deep development of competences)

1. Given the following file permission, answer these questions.

	Read	Write/Delete	Execute
Owner	Yes	Yes	Yes
Group	Yes	Yes	No
World	Yes	No	No

   a) Who can read the file?

   Answer: Any one can read the file.

   b) Who can write or delete the file?

Answer: The owner and members of the group can write or delete the file.

c) Who can execute the file?

Answer: Only the owner can execute the file.

d) What do you know about the content of the file?

Answer: Because the owner has permission to execute the file, it must contain an executable program.

2. What is the minimum amount of information a directory must contain about each file?

Answer: A directory must contain the file name, the file type, the address on disk where the file is stored, the current size of the file, and permission information.

3. Explain the purpose of the open and close operations in file management.

Answer:

a. The *open* operation informs the system that the named file is about to become active.

b. The *close* operation informs the system that the named file is no longer in active use by the user who issued the close operation.

4. List advantages of operating system "knowing" and supporting many file types.

Answer: Can prevent user from making ridiculous mistakes. Can make system convenient to use by automatically doing various jobs after one command.

5. What is direct access?

Answer: A file in which any record or block can be read next. Usually the blocks are fixed length.

8.8.3. Extended activities

1. How do most operating systems represent a directory?

Answer: As a file.

2. What is a sequential file?

Answer: A file that is read one record or block or parameter at a time in order, based on a tape model of a file.

3. How does user specify block to be fetched in direct access?

Answer: By specifying the relative block number, relative to first block in file, which is block 0.

4. Can a direct access file be read sequentially? Explain.

Answer: Yes. Keep a counter, cp, initially set to 0. After reading record cp, increment cp.

5. How can an index file be used to speed up the access in direct-access files?

   Answer: Have an index in memory; the index gives the key and the disk location of its corresponding record. Scan the index to find the record you want, and then access it directly.

6. List two types of system directories

   Answer:

   - Device directory: describing physical properties of files.
   - File directory : giving logical properties of the files.

7. List operations to be performed on directories.

   Answer: Search for a file, create a file, delete a file, list a directory, rename a file, traverse the file system.

UNIT 9: MEMORY MANAGEMENT

9

9.1. Key Unit Competency:

To be able to explain the role of operating system in Memory Management

9.2. Prerequisite knowledge and skills:

Students have learnt concepts of operating system in the previous year's units such as:

Unit 4 on computer software installation and unit 15 on introduction to Operating System in Senior 4.

Unit 7 on process management and scheduling algorithm and unit 8 on file management in Senior 6.

9.3. Cross-cutting issues to be addressed:

- **Financial Education:** To be covered when explaining to students cost related to the main memory, the main memory impact to the cost of the computer. Students should understand that main memory size is considered when a business or an organization is considering IT equipment to be bought.

- **Standardization Culture:** To be covered when explaining to students that there are standards required for the memory management such as partition, virtual memory capacity.

9.4. Guidance on the introductory activity

Instruction to do the introductory activity

1. This activity takes place in the computer lab or in the classroom. This unit discusses the theoretical part of memory management.

2. Students start by observing the figure in the introductory activity. The reason of the picture is to recall to all students know about how these computer parts communicate. Students may give various answers about the figure in the book as teachers you streamline students' answers.

3. Then, students start to answer questions from the students' book in group of 4 or 5. They may not be able to answer all the questions but let them try and get answers as they learn this unit.

4. For question number one the answer provided in this book is not the only

one, each student can give any answer according to the knowledge he has in the computer system. Teacher will have to streamline answers from students.

Below are suggested answers for questions in the Introductory Activity.

1. The figure shows different internal parts of the computer system such as BUS, RAM, Processor and others.

2. The Central Processing Unit (CPU) is the unit, which performs most of the processing inside a computer. It acts as the brain of the computer. The CPU has three typical components: Control Unit: extracts instructions from memory and decodes and executes them. Arithmetic Logic Unit (ALU): handles arithmetic and logical operations and register that acts as the memory.

3. The role of Input and Output devices in computing system is that they are required by the CPU in to communicate with others parts of the computer. Input devices bring information into the computer and output device send/displays information to the outside

4. Yes computer has a memory. The main difference between the memory and storage is that a memory keeps data/information temporally and storage keeps data/information permanently.

5. The role played by CD ROM, Floppy Drive, Hard drive is that they are considered as secondary memory and keep data permanently while RAM is considered as the main memory/primary memory and is volatile and temporary.

6. The program in the execution is called a process. The operating system places processes into main memory. The operating system manages all processes inside the main memory.

7. Inside computers, there are many internal components. In order for these components to communicate with each other they make use of wires that are known as a 'bus'. A bus is a common pathway through which information flows from one computer component to another.

8. The process in execution is give time to access the CPU , space in the main memory and the access of the Input and Output devices

9. The multi- programming is achieved by having many processes running in the main memory.

9.5. LIST OF LESSONS

#	Lesson title	Learning objectives	Number of periods
1	Introductory activity	Give a general idea of memory management	1

2	Understanding memory management	Explain characteristics of computer memory Describe main memory characteristics	3
3	Logical and physical address memory space	Explain the logical and physical addressing	2
4	Allocating and placing partitions in memory	Explain the techniques of allocating processes in the memory partitions	2
5	Memory fragmentation	Identify different type of memory fragmentation	2
6	Virtual memory concepts	Explain the techniques used in virtual memory management. Appreciate how computer memory is managed by operating System.	3
7	End unit assessment	Evaluate the key unit competence	1

LESSON 1: UNDERSTANDING MEMORY MANAGEMENT

Duration: 3 periods: 120 minutes

a. Prerequisites/Revision/Introduction:

Learning activity 9.1. introduces the understanding memory management lesson. The lesson can be conducted in class or in computer lab. Students start by reading the scenario in the students' 'book. The purpose of the scenario is to link the human memory and the computer memory.

b. Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.
- Students elect the group leader and secretary.
- Learners do the Learning Activity 9.1.
- Teacher walks around and sees if students are doing activity in their respective groups.

- Students present their answer to the rest of class.

- Students react on the finding/ answers from other groups.

- Teacher corrects false answers and completes the incomplete answers

- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students

- At the end of the lesson teacher gives the instructions on how to do Application activity 9.1

- Students do Application activity 9.1.

Answers to learning activity 9.1

1. As the human being computer has a temporary and permanent. The temporary memory is used to keep information for short time and permanent memory keeps information for long time.

2. It is not possible to think of two situations in the same time. This is how CPU runs processes. Only one process is allowed to access the CPU at a given time.

3. The part that store information is the permanent is considered as the hard disk.

4. It depends on the capacity of Uwera has to recall permanent information stored in her permanent memory.

5. Computer itself doesn't actually remember anything. It uses the secondary which is the permanent memory to recall or utilize the information save there.

d. Answers to application activity 9.1

1. The difference between the primary memory and secondary memory is that Processor access directly the primary memory in a random manner while unlike primary memory, secondary memory is not directly accessed through CPU. The secondary memory is accessible in same way as mass storage devices such as hard disk, memory chips, Pen drive, floppy disk storage media, CD and DVD.

2. The difference between volatile memory and non-volatile memory is that volatile memory is the kind of memory that holds the information till the computer or device is running on power but loses the stored information when the power supply is interrupted or is off. A typical example of volatile memory is RAM. On the other hand non-volatile memory is the kind of memory which does not lose its contents because of power supply in case of main power source shutdown.

3. Main memory is considered as the working memory because it holds the information that the computer is currently working on.

4. Refer to the students' book

5. Memory hierarchy a concept that is necessary for the CPU to be able to manipulate data. This is because it is only able to get instructions from cache memory. Cache memory is located on the processor chip, and is the fastest kind of memory. As a

result of this, it is also the smallest, meaning that we can't hold all of our processes in it at once. So we use RAM. RAM is much larger than cache memory, but not located directly on the CPU, so it is slower. Instructions are loaded into RAM until the CPU needs them. They are only held as long as power is supplied, and this is why we need Disk memory. Disk memory is what holds all of our files and programs when not in use. It is the memory we are all most familiar with. We want to design computers that can store lots of data AND operate very fast. However, when we build memory storage devices, there is a trade-off between speed and memory. Either you can build very large memory, like disk hard drive, or very fast memory, like the registers in your CPU. Memory Hierarchy lets us have the best of both worlds - speed and size. You have a small amount of ultra-fast memory, a larger amount of slower memory, and a huge amount of very slow memory. By cleverly choosing what data to store in which type of memory, we can appear to have a huge amount of very fast memory.

6.

Storage	Access method
Magnetic Storage	Sequential Access
Optical Storage	Direct Access
Flash Storage	Random Access
Semi-Conductor Storage	Random Access

Refer to the students' book

LESSON 2: LOGICAL AND PHYSICAL ADDRESS MEMORY SPACE

Duration: 2 periods: 80 minutes

a. Prerequisites/Revision/Introduction:

Learning activity 9.2 introduces the logical and physical address memory space lesson. The lesson can be conducted in class or in computer lab. Students start by answering problem in the students' book. The stated problem can be a subject of the internet research where student are going to find the advantage of the system that run a computer program and separate the program in execution into two parts: code and data. The purpose of the problem is to let students find that code and data are always separated.

b. Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.

- Students elect the group leader and secretary.
- Learners do the Learning Activity 9.2.
- Teacher walks around and sees if students are doing activity in their respective group.
- Students present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the incomplete answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- At the end of the lesson teacher gives the instructions on how to do application activity 9.2.
- Students do Application activity 9.2.

Answers to learning Activity 9.2.

The major advantage of this scheme is that it is an effective mechanism for code and data sharing. For example, only one copy of an editor or a compiler needs to be kept in memory, and this code can be shared by all processes needing access to the editor or compiler code. Another advantage is protection of code against erroneous modification. The only disadvantage is that the code and data must be separated, which is usually adhered to in a compiler generated code.

d. Answers to application activity 9.2.

1. Address binding is the process of mapping the program's logical or virtual addresses to corresponding physical or main memory addresses

2. Refer to the students' book

3. The advantage of dynamic loading is that unused libraries and routines are never loaded in the main memory and therefore more free memory is available to the running processes.

4. Relocation register is a base register used to give the lowest physical address for a process.

5. Refer to the students' book
   - Logical address: 13 bits
   - Physical address: 15 bits

6. The basic difference between Logical and physical address is that Logical address is generated by CPU in perspective of a program. On the other hand, the physical address is a location that exists in the memory unit.

LESSON 3: ALLOCATING AND PLACING PARTITIONS IN MEMORY

Duration: 2 periods: 80 minutes

a. Prerequisites/Revision/Introduction:

Learning activity 9.3. introduces the allocating and placing partition in memory lesson. The lesson can be conducted in class or in computer lab. Students start by observing the figure in the students' book, the figure shows memory partition of same size and memory partition of unfixed size. After examining the figure students answers questions. Below are answers:

b. Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.
- Students elect the group leader and secretary.
- Learners do the Learning Activity 9.3.
- Teacher walks around and sees if students are doing activity in their respective group.
- Students present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the incomplete answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- At the end of the lesson teacher gives the instructions on how to do Application activity 9.3.
- Students do Application activity 9.3.

Answers to learning activity 9.3.

1. Always, there is a reserved partition for the operating system.
2. There are different types of partitions. Partitions can be eithers of the same size or can be of different size. It is because processes do not have the same size.
3. There are various algorithm used by the operating system to place processes into the main memory First fit, next fit and best fit.

d. Answers to application activity 9.3.

1. Memory is divided into two sections, one for the operating system and one for the application program.

2.

   a) 39438

   b) 32517

   c) 37259

3.   The formula is L + A

4.

   a) 43097

   b) 44748

   c) Address out of bounds of partition.

5.   Refer to the students' book

LESSON 4: MEMORY FRAGMENTATION

Duration: 2 periods: 80 minutes

a. Prerequisites/Revision/Introduction:

Learning activity 9.4 introduces the memory fragmentation lesson. The lesson can be conducted in class or in computer lab. Students start by reading the problem in the learning activity 9.4 of the students' book. Students place different processes in the given partitions. Then students are called to calculate amount of free memory. Then after, students think various method used to avoid the wastage of computer of memory.

b. Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.
- Students elect the group leader and secretary.
- Learners do the Learning Activity 9.4.
- Teacher walks around and sees if students are doing activity in their respective group.
- Students present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the incomplete answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students

- At the end of the lesson teacher gives the instructions on how to do Application activity 9.4
- Students do Application activity 9.4

Answers to learning activity 9.4.

d. Application activity

Answers to application activity 9.4

1. Dynamic memory allocation is when an executing program requests a memory space in the main memory and the operating system give it a block of main memory. The program in execution then uses this memory for some purpose

2. Fixed Partitions is the process of dividing the main memory into a set of non-overlapping blocks.

3. Internal fragmentation is the wasted space within each allocated block because of rounding up from the actual requested allocation to the allocation granularity. External fragmentation is the various free spaced holes that are generated in either your memory or disk space. Memory compaction is the processes to eliminate small partitions of available into the main memory. It allows smaller partitions to form fewer larger ones and to allow larger processes to run.

4. Compaction is used to solve the fragmentation problem in segmentation storage.

LESSON 5: VIRTUAL MEMORY CONCEPTS

Duration: 2 periods: 80 minutes

a. Prerequisites/Revision/Introduction:

Learning activity 9.5 introduces the Virtual memory concepts lesson. The lesson can be conducted in class or in computer lab. Students start by observing the figure in learning activity 9.5 in the students' book. Students view about the figure in the activity may vary and it depends on what learners know but the figure show secondary memory, primary memory and the exchange of both memories. Then after students answer question asked.

b. Teaching resources:

- Computer lab
- Internet and textbooks to facilitate research

Learning activities:

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.
- Students elect the group leader and secretary.
- Learners do the Learning Activity 9.5.

- Teacher walks around and sees if students are doing activity in their respective group.
- Students present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the incomplete answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- At the end of the lesson teacher gives the instructions on how to do Application activity 9.5.
- Students do Application activity 9.5.

Answer to learning activity 9.5.

1. Program or data is accessed from secondary memory and it is first loaded into primary memory /RAM and data is then sent to the processor. The primary memory /RAM plays an important intermediate role, since it provides much faster data access speeds than secondary memory.

2. The technic used by the operating system to move a process from the main memory to secondary memory is called switching

3. By using the Virtual memory, the system will ensure that processes will get the requested amount of memory despite being greater than physical memory.

d. Application activity:

Answers to application activity 9.5

1. Memory segmentation is the division of a computer's primary memory into segments or sections. It's used in the allocation of memory to the particular process.

2. Advantages of paging in memory management are
   - No external fragmentation.
   - User's views of memory and actual physical memory are separated. The user view memory as a single contiguous space that contains only one process. But in fact, the user process is non-throughout physical memory
   - Efficient use of main memory.

3. Refer to the students' book

4. Refer to the students' book

5. What do you understand by paging?

6. The content of the page table is Base address of each process and corresponding page number

7. Advantages does segmentation have over paging are :

- Can associate protection with critical segments, without protecting other items.
- Can share code and data with other users, tightly, so that only the desired partition are shared.

9.6. UNIT SUMMARY

Memory management is the process of controlling and coordinating computer main memory by assigning memory partition to various running programs and it optimizes overall system performance.

In the Operating system, memory management involves the allocation, deallocation and constant reallocation of memory partition to individual programs as user demands change.

At the application program level, memory management ensures the availability of adequate memory for the object and data structure of each running program at all times.

Memory management makes sure that when an application program requests a block of memory, the memory manager also called the allocator. The allocator assigns a memory partition to each program that is access the memory. When a process no longer needs the data in previously allocated memory partition, then the memory partition blocks become available for reassignment for other programs.

Application memory management combines two related tasks:

Allocation: When the program requests a block of memory, the memory manager must allocate that block out of the larger blocks it has received from the operating system.

Recycling: When memory blocks have been allocated, but the data they contain is no longer required by the program, then the blocks can be recycled for reuse.

9.7. Additional Information

This section provides additional content for the teacher to have a deeper understanding of the topic.

Memory management problems

The basic problem in managing memory is knowing when to keep the data it contains, and when to throw it away so that the memory can be reused. This sounds easy, but is, in fact, such a hard problem that it is an entire field of study in its own right. In an ideal world, most programmers wouldn't have to worry about memory management issues. Unfortunately, there are many ways in which poor memory management practice can affect the robustness and speed of programs, both in manual and in automatic memory management.

Typical problems include:

1. **Premature frees and dangling pointers**

Many programs give up memory but attempt to access it later and crash or behave

randomly. This condition is known as a premature free and the surviving reference to the memory is known as dangling pointers.

2. **Memory leak**

Some programs continually allocate memory without ever giving it up and eventually run out of memory. This condition is known as a memory leak.

3. **External fragmentation**

A poor allocator can do its job of giving out and receiving blocks of memory so badly that it can no longer give out big enough blocks despite having enough spare memory. This is because the free memory can become split into many small blocks, separated by blocks still in use. This condition is known as external fragmentation.

4. **Poor locality of reference**

Another problem with the layout of allocated blocks comes from the way that modern hardware and operating system memory managers handle memory: successive memory accesses are faster if they are to nearby memory locations. If the memory manager places far apart the blocks a program will use together, then this will cause performance problems. This condition is known as poor locality of reference.

9.8. End unit assessment

1. **Explain the use of Dynamic loading in memory management?**

Answer: With Dynamic loading, a routine is not loaded until it is called. All routines are kept on disk in a relocatable load format. The main program is loaded into memory and is executed. When a routine needs to call another routine, the calling routine first checks to see whether another routine has been loaded. If not, the re-locatable linking loader is called to load the desired routine into memory and to update the program's address tables to reflect this change. Then, Control is passed to the newly loaded routine.

2. **Explain the memory Swapping?**

Answer: It is a process of bringing in each process in its entirety, running it for a while and then putting it back on the disk.

3. **Discuss the advantage of Dynamic Loading?**

Answer: The advantage of Dynamic Loading is that an unused routine is never loaded. (i.e) when large amounts of code are needed to handle infrequently occurring cases, such as error routines. Here although program size may be large, the portion that is used may be much smaller and better memory space utilization.

4. **What do you understand by Dynamic Linking?**

Answer: In this Dynamic Linking, a stub is included in the image for each library-routine reference. This Stub is a small piece of code that indicates how to locate the appropriate memory-resident library routine or how to load the library if the routine is not already present.

5. **Explain external fragmentation and internal fragmentation?**

Answer:

- External Fragmentation exists when enough total memory space exists to satisfy a request, but it is not contiguous and storage is fragmented into a large number of small holes.

- The memory allocated to a process may be slightly larger than the requested memory. The difference between these two numbers is called as Internal Fragmentation.

6. **What do you understand by Paging? Give advantages of paging in memory management?**

Answer: Paging is a Memory-management scheme that permits the physical -address space of a process to be Non-contiguous.

Advantages:

- Avoids the considerable problem of fitting the varying -sized memory chunks onto the baking store

- Fragmentation problems are also prevalent baking store, except that access is much slower, so compaction is impossible.

7. **Discuss Memory Compaction concept?**

Answer: When swapping creates multiple holes in memory, it is possible to combine them all into one big by moving all the processes downward as far as possible.

8. **What are the differences between pager and swapper?**

Answer: The difference between pager and swapper is:

- Pager swaps a page into memory when this page will be needed into memory while swapper swaps the entire processes into memory

- Pager uses in demand-paging system and swapper uses in paging system

- Define the virtual memory? What are advantages of virtual memory?

Answer: Virtual memory is a technique that allows the execution of processes that are not completely in memory.

Advantages:

- Enables users to run programs that are larger than actual physical memory. 2)VM makes the task of programming much easier.

- Virtual memory allows processes to share files easily and to implement shared memory.

- It provides an efficient mechanism for process creation.

- Consider a user program of logical address of size 6 pages and page size is 4 bytes. The physical address contains 300 frames. The user program consists of 22 instructions a, b, c . . . u, v. Each instruction takes 1 byte. Assume at that time the

free frames are 7, 26, 52, 20, 55, 6, 18, 21, 70, and 90.

Find the following?

   a. Draw the logical and physical maps and page tables?

   b. Allocate each page in the corresponding frame?

   c. Find the physical addresses for the instructions m, d, v, r?

   d. Calculate the fragmentation if exist?

Answer:

Logical map		Page table		Physical map

	. a
0	. b
	. c
	. d
	. e
1	. f
	. g
	. h
	. i
2	. j
	. k
	. l
	. m
3	. n
	. o
	. p
	. q
4	. r
	. s
	. t
	. u
5	. v
	.

Logical map

Page number	Frame number
0	7
1	26
2	52
3	20
4	55
5	6

page table

	Contents
6	. u
	. v
	.
7	. a
	. b
	. c
	. d
20	. m
	. n
	. o
	. p
26	. e
	. f
	. g
	. h
52	. i
	. j
	. k
	. l
55	. q
	. r
	. s
	. t

Physical map

The physical address = page size * frame number + offset

   The physical address of m = 4*20 +0 = 80

   The physical address of d = 4*7+3 = 31

   The physical address of v = 4* 6 +1 = 25

   The physical address of r = 4*55+ 1= 221

   The external fragmentation = 0

   The internal fragmentation = 2

9.9. ADDITIONAL ACTIVITIES

9.9.1. Remedial activities

Suggestion of questions and answers for deep development of competences.

1. What is the disadvantage of using overlays?

   Answer: Programmer must carefully design the program and data structures so that the overlays won't interfere with each other.

2. What is dynamic loading?

   Answer: Loading a routine only when it is called and not yet in memory; the routine will not be loaded into memory until first time it is called.

3. State and explain **Storage management strategies?**

   Answer

   There are many strategies are used to obtaining the best possible use of the main storage. Some of these strategies are:

. **Fetch strategies** are concerned with when to obtain the next piece of program or data for transfer to main storage from secondary storage. There are two approaches.

   • **Demand fetch strategies:** The next piece of program or data is brought into the main memory when it is referenced by a running program.

   • **Anticipatory fetch strategies:** They make predict and guesses and anticipating the future where program control will go next.

Placement strategies: They are concerned with determining where in main storage to place a new program. Strategies are most commonly used to select a free hole from the set of available holes.

There are three placement strategies:

   • **First fit.** The incoming job places in the first hole that is big enough. It does not need search all the hole set. It is faster strategies to placement.

   • **Best fit.** Allocate the smallest hole that is big enough. It needs to search the entire list, unless the list is ordered by size. This strategy produces the smallest leftover hole.

   • **Worst fit.** Allocate the largest hole enough. Again, it must search the entire list, unless it is sorted by size. This strategy produces the largest leftover hole, which may be more useful than the smaller leftover hole from a best-fit approach.

Replacement strategies: They are concerned with determining which piece of program of data to displace to make room for a new program or data.

9.9.2. Consolidation activities:

Suggestion of questions and answers for deep development of competences.

1.   Why does the computer must keep several processes in main memory?

Answer: To improve both the utilization of the CPU and the speed of its response to users

2.   What are the differences between?

   a) Logical and physical address?

   b) Page table and segment table?

   c) First-fit placement and best-fit placement?

   d) Contiguous and non – contiguous storage allocation

   e) Segmentation and paging storage?

Answer

a) Logical and physical address

Logical address	Physical address
It is the address generated by the CPU	It is the address actually seen by the memory hardware

b) Page table and segment table

	Page table	Segment table
1	It contains the base address of each page in physical memory	It contains the segment address in physical memory.
2	The entries in page table are page number and corresponding frame number	The entries are segment base and segment limit

c) First-fit placement and best-fit placement?

	First-fit	Best-fit
1	The incoming job is placed in the first hole that is big enough.	The incoming job is placed in the small hole that is big enough.
2	It does not need search the entire hole set to place the job.	It need search the entire hole set to place the job.
3	It is faster to allocate.	It is slower.
4	More waste in storage	Less waste in storage

d) Contiguous and non – contiguous storage allocation

|	Contiguous storage	Non-contiguous storage
1	A program occupies a single contiguous block of storage locations.	A program is divided into several blocks or segments that may be placed in memory in pieces not necessary adjacent to one another.
2	Faster in store	Slower in store
3	More waste in memory	Less waste in memory

e) Segmentation and paging storage?

	Segmentation	Paging
1	The physical memory is breaking into variable-sized blocks called segments	The physical memory is breaking into fixed-sized blocks called frames and logical memory is breaking into blocks of the same size called pages
2	Address generated by CPU is divided into segment number (S) and segment offset (d).	Address generated by CPU is divided into Page number (p) and Page offset (d).
3	Each segment has a name and a length (variable size)	A pages are fixed size
4	Physical address = segment base + offset	Physical address = page size * frame number + offset
5	May be external fragmentation	No external fragmentation

8.9.3. Extended activities

Suggestion of questions and answers for deep development of competences.

a) Suppose that we have free segments with sizes: 6, 17, 25, 14, and 19. Place a program with size 13kB in the free segment using first-fit, best-fit and worst fit?

Answer:

OS
6
In use
17
In use
25
In use
14
In use
19

First – fit

Worst – fit

Best - fit

13 K request
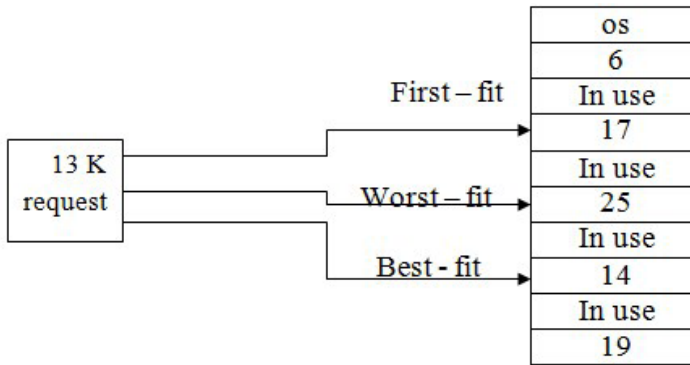
b)   Discus advantages of overlays allocation storage, compaction, page table, segment table.

Answer

a) Overlays allocation storage allows allocating to run a program that its size larger than the amount of memory.

b) Compaction solves the fragmentation problem in segmentation storage.

c) Page table uses to the physical memory of each page.

d) Segment table uses to the physical memory of each segment.

UNIT 10: COLLECTIONS IN JAVA

10

10.1. Key Unit Competence

To be able to use collections to store data in Java

10.2. Prerequisite knowledge and skills

Students should have knowledge and skills related to introduction to Java learnt in Senior 5 Unit-10: OOP and Java senior 5; data structure senior 5 Unit-2

10.3. Cross-cutting issues to be addressed:

- **Peace and value education:** During group activities, debates and presentations, learners should help each other and respect opinions of other colleagues.

  Students must be aware of crimes that use computer program.

- **Inclusive Education:** students with and without disabilities participate and learn together in the same classes.

- **Gender education:** Involve both girls and boys in all programming activities: No activity is reserved only to girls or boys.

10.4. Guidance on the introductory activity

Instruction to do the introductory activity:

- This activity takes place in the class where teacher organizes students into groups.

- Ask students to do the introductory activity in their respective groups.

- Move around to see how students are working.

- Invites representatives of groups to presents their findings.

- Ask the rest of the class to evaluate findings and some questions to boost the students.

- Tell the students that they will have complete answers in the coming lessons.

10.5. List of lessons

#	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes):	Number of periods
1	Introduction to the Collection Framework	Create a collection using Set, list Queue and Map collection classes and iterate elements store in collection	2
2	The collection interfaces and Class Java Collections – List interface	Differentiate algorithms used different collection classes Put a list of a given elements in a tree nodes	3
3	Java Collections – Set interface	Differentiate algorithms used different collection classes	3
4	Java Collections – Map interface	Differentiate algorithms used different collection classes	2
5	Java collections – Queue interface	Use appropriate methods to access objects in queue	2
6	Java Collections – Stack	Use appropriate methods to access objects in queue	2
7	Java Collection – Tree	Use appropriate methods to access objects in tree Put a list of a given elements in a tree nodes	2
8	End unit Assessment		2

Guidance on different lessons outlined above

LESSON 1: INTRODUCTION TO THE COLLECTION FRAMEWORK

a) Prerequisites/Revision/Introduction:

For better understanding of this lesson, learners will get prerequisites from other units related to programming

b) Teaching resources:

1. Computer lab
2. Software edit e.g. Netbean
3. Internet and textbooks to facilitate research

c) Learning activity 10.1:

Guidance

- Organizes students in group in order to do learning Activity 10.1,
- Elect the group leader and secretary.
- Teacher gives the instructions on how to do Learning Activity 10.1
- Teacher walks around and sees if students are doing activity in their respective group.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Summarizes the contents and gives examples that should be done by students.

Answers to learning activity 10.1

Students will refer to computer science books, internet and other teaching aids.

d) Answers to application activity 10.1.

1) For this question, students will answer questions refer to section 10.1 of Unit 10

2) What are the benefits of Java Collections Framework?

There are primarily four qualities that make Java Collections Framework extremely useful for the programmers:

- Performance – Collection classes are highly efficient data structures to improve speed and accuracy.

- Reusability   – Collection classes can intermix with other types to promote reusability.

- Maintainability – Supports consistency and interoperability in the implementation and hence makes the code easy to maintain.

- Extensibility – Allows customization of primitive collection types as per developer's requirements.

3) What are the basic interfaces of Java Collections Framework?

Collection is the root of the collection hierarchy. A collection represents a group of objects known as its elements. The Java platform doesn't provide any direct implementations of this interface.

Set is a collection that cannot contain duplicate elements. This interface models the mathematical set abstraction and is used to represent sets, such as the deck of cards.

List is an ordered collection and can contain duplicate elements. You can access any element from it's index. List is more like array with dynamic length.

A **Map** is an object that maps keys to values. A map cannot contain duplicate keys: Each key can map to at most one value.

Queue: The Queue interface defines some methods for acting on the first element of the list, which differ in the way they behave, and the result they provide.

4) List at least 2 practices related to Java Collections Framework?

-If we don't want duplicates values

-If we want a sorted element

5) What is the use of Java Collections Framework?

Java Collection Framework (JCF) represents a set of interfaces and classes which provide efficient ways to store and handle data in a Java application. It includes several classes that support operations like searching, sorting, insertion, manipulation, and deletion.

LESSON 2: JAVA COLLECTIONS – LIST INTERFACE

a. Prerequisites/Revision/Introduction:

For learners to well understand this lesson must introduction on Java, Data structure and able to explain JCF.

b. Teaching resources:

- Computer lab
- Software edit Netbean
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance

- This activity takes place in the class where teacher organizes students into groups.
- Ask students to do the introductory activity in their respective groups.
- Move around to see how students are working.
- Invites representatives of groups to presents their findings.
- Ask the rest of the class to evaluate findings and some questions to boost the students.

Answers to learning activity 10.2

1)In this application, we don't own any travel. we are just a middle man and our task is to first enquire "Alpha Ltd", then enquire "Beta Ltd" about the list of travels available and later if customer choose for booking then inform the respective travel agency vendor to do booking here will need ArrayList class. The List interface will be applicable because; For this, first we need to tell the travel agencies to give us list of travels and will need to add the travels in the application and to list and to get the list of Booking. here the Method of list interface are applicable.

2)

The methods that will be used are:

add (), this will help ta add travels to the ArrayList ,

set (int index, Object o):to update the booking and travels,

set (int index, Object o):to remove the booking already done

Object get (int index):returns the object of list of travels and booking which is present at the specified index.

3) For displaying the travels: The toString method of the ArrayList class (as well as other collection classes) will be designed to make it easy to quickly print out the contents of the list.

d) Answers to application activity 10.2

1.

ArrayList and LinkedList are two popular concrete implementations of List interface from Java's popular Collection framework. Being List implementation both ArrayList and LinkedList are ordered, the index based and allows duplicate. The main difference between ArrayList vs LinkedList is that former is backed by an array while later is based upon linked list data structure, which makes the performance of add(), remove() and contains()different for both ArrayList and LinkedList.

2.

```
public class Arraylist2 {
public static void main(String[] args) {
LinkedList<String> district = new LinkedList<String>();
// add the original district
district.add("Gakenke");
district.add("Rubavu");
district.add("Gasabo");
district.add("Nyagatare");
district.add("Nyabihu");
System.out.println(district);
// replace Gasabo with Nyarugenge
district.set (3, "Nyarugenge");
System.out.println("Gasabo is replaced:"+district);
district.addFirst("Bugesera");
System.out.println("Bugesera is added to the fist position:"+district);
district.add(4, "Karongi");
district.removeFirst();
System.out.println(district);
```

```
       }
   }
```

```
run:
[Gakenke, Rubavu, Gasabo, Nyagatare, Nyabihu]
Gasabo is replaced:[Gakenke, Rubavu, Gasabo, Nyarugenge, Nyabihu]
Bugesera is added to the fist position:[Bugesera, Gakenke, Rubavu, Gasabo, Nyarugenge, Nyabihu]
[Gakenke, Rubavu, Gasabo, Karongi, Nyarugenge, Nyabihu]
BUILD SUCCESSFUL (total time: 0 seconds)
```

3   .

ArrayList and Vector are similar classes in many ways.

Both are index based and backed up by an array internally.

Both maintain the order of insertion and we can get the elements in the order of insertion.

The iterator implementations of ArrayList and Vector both are fail-fast by design.

ArrayList and Vector both allows null values and random access to element using index number.

These are the differences between ArrayList and Vector.

Vector is synchronized whereas ArrayList is not synchronized.

ArrayList is faster than Vector because it doesn't have any overhead because of synchronization.

ArrayList is more versatile because we can get synchronized list or read-only list from it easily using Collections utility class.

LESSON 3: Java Collections – Set interface and implementations

a) Prerequisites/Revision/Introduction:

For learns to well understand this lesson must introduction on Java and Data structure and introduction to the Java Collection Framework.

b) Teaching resources:

- Computer lab
- Software editor: NetBeans, notepad
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Organizes students in group in order to do learning Activity 6.1,
- Elect the group leader and secretary.
- Teacher gives the instructions on how to do Learning Activity 6.1
- Teacher walks around and sees if students are doing activity in their respective

group.

- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Summarizes the contents and gives examples that should be done by students.

Answers to learning activity 10.3

1. The method used in this program

add():   Adds an object to the collection.

2. the HashSet creation

Set setA = new HashSet ();

3. Set implementations

HashSet, LinkedHashSet and TreeSet.and explanation Refer to the student Book section 10.2.2; unit 10

d) Answers to application activity 10.3

1.

  a) ABC 3

  b) [A, B, C] 3

  c) ABC 2

  d) [A, B, C] 2

Answer: b; Explanation: HashSet obj creates an hash object which implements Set interface, obj.size() gives the number of elements stored in the object obj which in this case is 3.

2. **HashSet** is Implemented using a hash table while TreeSet is implemented using a tree structure

HashSet is faster than TreeSet and should be preferred choice if sorting of element is not required.

HashSet allows null object but TreeSet doesn't allow null Object and throw NullPointerException

 HashSet doesn't guaranteed any order while TreeSet maintains objects in Sorted .

LESSON 4: JAVA COLLECTIONS – MAP INTERFACE

a) Prerequisites/Revision/Introduction:

For learns to well understand this lesson must introduction on Java and Data structure and introduction to the Java Collection Framework.

b) Teaching resources:

- Computer lab
- Software editor: NetBeans, notepad
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Organizes students in group in order to do learning Activity 6.1,
- Elect the group leader and secretary.
- Teacher gives the instructions on how to do Learning Activity 6.1
- Teacher walks around and sees if students are doing activity in their respective group.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Summarizes the contents and gives examples that should be done by students.

Answers to learning activity 10.4

1) The method used in this program

public Object put(Object key, Object value) is used to insert an entry in this map.

2)the HashMap creation

Map<Integer, String> mapmarks = new HashMap<>();

3) Map implementations

HashMap, TreeMap, and LinkedHashMap

4) Analyze the program and give the output.

Map<Integer, String> mapmarks = new HashMap<>();
 mapmarks.put(80, "tom");
mapmarks.put(75, "Alice");
mapmarks.put(65, "Antoine");
mapmarks.put(50, "peter");
 System.out.println(mapmarks);)The output will be:
{80=tom, 65=Antoine, 50=peter, 75=Alice}

d) Answers to application activity 10.4

1. Answer: Refer to the student book

2. When the element is added to a HashMap, first its hashCode is calculated (an int

value). Then a certain number of lower bits of this value are used as an array index. This index directly points to the cell of the array (called a bucket) where this key-value pair should be placed. Accessing an element by its index in an array is a very fast.

3.

```
package excercisemap;
import java.util.*;
public class ExcerciseMap {
    public static void main(String[] args) {
            // Create and add objects in HashMap
             HashMap<String, Integer> cache = new HashMap<String, Integer>();
              //you can create HashMap from copying data from another Map or  Hashtable
             Hashtable<Integer, String> source = new Hashtable<Integer,String>();
             HashMap<Integer, String>  map = new HashMap(source);
             //Adding elements
              map.put(21, "Twenty One");
              map.put(22, "Twenty One");
              //Retrieving value from HashMap
              Integer key = 21;
             String value = map.get(key);
             System.out.println("Key: " + key +" value: "+ value);
             //Size and Clear in HashMap
System.out.println("Size of Map before: " + map.size());
map.clear(); //clears hashmap , removes all element
System.out.println("Size of Map after clearing: " + map.size());
  //adding new values
   map.put(21, "Twenty One");
map.put(31, "Thirty One");
map.put(41, "Thirty One");
     //ContainsKey and ContainsValue
     System.out.println("Does HashMap contains 21 as key: " + map.containsKey(21));
     System.out.println("Does HashMap contains 21 as value: " + map.containsValue(21));
        System.out.println("Does HashMap contains Twenty One as value: " + map.
containsValue("Thirty One"));

     // Sorting HashMap in Java
     System.out.println("Unsorted HashMap: " + map);
     TreeMap sortedHashMap = new TreeMap(map);
```

```
        System.out.println("Sorted HashMap: " + sortedHashMap);
    }
}
```

LESSON 5: Java collections – Queue interface

a) Prerequisites/Revision/Introduction:

For learners to well understand this lesson must introduction on Java and Data structure and introduction to the Java Collection Framework.

b) Teaching resources:

- Computer lab
- Software editor: NetBeans, notepad
- Internet and textbooks to facilitate research

Learning activities:

Guidance

- Organizes students in group in order to do learning Activity 6.1,
- Elect the group leader and secretary.
- Teacher gives the instructions on how to do Learning Activity 6.1
- Teacher walks around and sees if students are doing activity in their respective group.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Summarizes the contents and gives examples that should be done by students.

Answers to learning Activity 10.5

1) A queue holds a list of waiting customers in a bank's counter. Each customer is served one after another, follow the order they appeared.

2) The first customer comes is served first, and after him is the 2nd, the 3rd, and so on.When the customer is served, he or she leaves the counter (removed from the queue), and the next customer is picked to be served next.

3) The FIFO principle is that Items stored first are retrieved first in the queue.

d) Answers to application activity 10.5

1. PriorityQueue is an unbounded queue based on a priority heap and the elements are ordered in their natural order or we can provide Comparator for ordering at the time of creation. PriorityQueue doesn't allow null values and we can't add any object that doesn't provide natural ordering, or we don't have any comparator for them for ordering.

2. Refer to the student book in section 10.2.4 unit 10

3. queue.poll() and queue.remove() retrieves the head element of the queue. The remove() function will throw a NoSuchElementException if the queue is empty at the time of its execution whereas the poll() function returns a null value in a similar case.

4&5) The teacher gives guidance on how to write the programs as reqested in the student book.

LESSON 6: JAVA COLLECTIONS – STACK

a) Prerequisites/Revision/Introduction:

For learns to well understand this lesson must introduction on Java and Data structure and introduction to the Java Collection Framework.

b) Teaching resources:

- Computer lab
- Software editor: NetBeans, notepad
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Organizes students in group in order to do learning Activity 6.1,
- Elect the group leader and secretary.
- Teacher gives the instructions on how to do Learning Activity 6.1
- Teacher walks around and sees if students are doing activity in their respective group.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Summarizes the contents and gives examples that should be done by students.

Answers to learning Activity 10.6

1) A queue holds the piece of bread in a plate. Each bread is putted to the plate from the bottom to the top then after taking bread the top bread will be the first bred to be taken.

2) The last bread comes is served first, and after it, is the 2nd, then 3rd, and so on.

3) The LIFO principle is that items stored last is retrieved first in the queue. On the figure the top bread will be taken first.

d) Answers to application activity 10.6

1. Output

```
Output - stackimpl (run)  ×
    run:
    element pushed : 3
    element pushed : 4
    element pushed : -19
    element pushed : 349
    element pushed : 35
    element poped : 35
    element poped : 349
    Element peek : -19
    position of element 349 3
    element poped : -19
    element poped : 4
    element poped : 3
    BUILD SUCCESSFUL (total time: 0 seconds)
```

2. Output

```
Output - stack2 (run)  ×
    run:
    [3, 5]
    BUILD SUCCESSFUL (total time: 6 seconds)
```

LESSON 7: Java collections – Tree

a) Prerequisites/Revision/Introduction:

For learns to well understand this lesson must introduction on Java and Data structure and introduction to the Java Collection Framework.

b) Teaching resources:

- Computer lab
- Software editor: NetBeans, notepad
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Organizes students in group in order to do learning Activity 6.1,
- Elect the group leader and secretary.
- Teacher gives the instructions on how to do Learning Activity 6.1
- Teacher walks around and sees if students are doing activity in their respective group.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correctly answers
- Summarizes the contents and gives examples that should be done by students.

Answers to learning activity 10.7.

1. What is a node in tree?

A node in tree data element stored in a structure.

2. Illustrate relationship between A and B; E and F?

A is a root node and is parent of B means B is child of A.

E is F's sibling

3. Illustrate your school organization structure? This will be illustrating according to your School.

d) Answers to application activity 10.7

1)Answers:

Preorder: L,K,A,J,B,C,I,H,E,D,F,G

Postorder: A,B,C,J,K,I,D,E,F,G,H,L.

Breadth-first: L,K,I,H,A,J,E,F,G,B,C,D

2)package hashmap;

import java.util.*;

public class HashMap {

   public static void main(String[] args) {

    Map<Integer, String > empInfo = new TreeMap<Integer,String>();

empInfo.put(20,"kalisa");

    empInfo.put(4,"Emmy");

    empInfo.put(9,"Diane");

    empInfo.put(15,"Karera");

System.out.println(empInfo);

   }

   }

10.6. Summary of the Unit

In this unit titled Collection in Java we have seen the different interfaces with its implementation and classes.A collection represents a group of objects, known as its elements. Some collections allow duplicate elements and others do not. Some are ordered and others unordered.

Here are the interfaces like List,Map,Set and Queue and their implimenatios classes like ArrayList, , HashSet,HashMap, LinkedHashSet, LinkedList, PriorityQueue, PriorityQueue, TreeSet, Vector ect.. Every interface and class has its own used method.

10.7. Addition information

Apart of this interfaces and class covered to this unit, there is other interfaces,classes and Abstract that are not covered.

- **Interface:** Iterator, Collections

- **Abstract:** AbstractCollection, AbstractList, AbstractQueue, AbstractSequentialList, AbstractSet

- **Classes:** ArrayBlockingQueue, ArrayDeque, ArrayList, AttributeList, BeanContextSupport, ConcurrentHashMap. KeySetView, ConcurrentLinkedDeque, ConcurrentLinkedQueue, ConcurrentSkipListSet, CopyOnWriteArrayList, CopyOnWriteArraySet, DelayQueue, JobStateReasons, LinkedBlockingDeque, LinkedBlockingQueue, LinkedTransferQueue, PriorityBlockingQueue, RoleList, RoleUnresolvedList, SynchronousQueue, EnumSet, Ect..

10.8. End Unit Assessment

Answers:

1. Refer to student book

2. It is one of the frequently asked collection interview question , the main differences is:

Vector is synchronized while ArrayList is not. Vector is slow while ArrayList is fast. Every time when needed, Vector increases the capacity twice of its initial size while ArrayList increases its ArraySize by 50%.

3. *List listA = new ArrayList();*

List listB = new LinkedList();

List listC = new Vector();

List listD = new Stack();

4. What is Queue and Stack, list their differences?

Both Queue and Stack are used to store data before processing them. java.util.Queue is an interface whose implementation classes are present in java concurrent package. Queue allows retrieval of element in First-In-First-Out (FIFO) order but it's not always the case. There is also Deque interface that allows elements to be retrieved from both end of the queue.

Stack is similar to queue except that it allows elements to be retrieved in Last-In-First-Out (LIFO) order.

Stack is a class that extends Vector whereas Queue is an interface.

5. Java program to insert an element into the array list at the first position

```
import java.util.*;
 public class Exercise3 {
```

```java
    public static void main(String[] args) {
    // Creae a list and add some colors to the list
    List<String> list_Strings = new ArrayList<String>();
    list_Strings.add("Red");
    list_Strings.add("Green");
    list_Strings.add("Orange");
    list_Strings.add("White");
    list_Strings.add("Black");
    // Print the list
      System.out.println(list_Strings);
      // Now insert a color at the first and last position of the list
      list_Strings.add(0, "Pink");
      list_Strings.add(5, "Yellow");
      // Print the list
      System.out.println(list_Strings);
    }
    }
```

6. Write a Java program to search a key in a Tree Map

```java
 import java.util.*;
public class Example3 {
  public static void main(String args[]){

 // Create a tree map
  TreeMap<String,String> tree_map1=new TreeMap<String,String>();
        // Put elements to the map
        tree_map1.put("C1", "Red");
        tree_map1.put("C2", "Green");
        tree_map1.put("C3", "Black");
        tree_map1.put("C4", "White");
        System.out.println(tree_map1);
           if(tree_map1.containsKey("C1")){
              System.out.println("The Tree Map contains key C1");
            } else {
           System.out.println("The Tree Map does not contain key C1");
        }
        if(tree_map1.containsKey("C5")){
           System.out.println("The Tree Map contains key C5");
        } else {
```

```
        System.out.println("The TreeMap does not contain key C5");
        }
      }
    }
```

10.9. Additional activities

10.9.1. Remedial

1. Question: What interface represents a collection that does not allow duplicate elements?

   Answer: Set

2. Question: What interface represents a double-ended queue?

   Answer: Deque

3. Question: What interface represents an ordered collection that may contain duplicate elements?

   Answer: List

4. Question: What interface represents a collection that holds elements prior to processing?

   Answer: Queue

5. Question: What interface represents a type that maps keys to values?

   Answer: Map

6. Which of these packages contain all the collection classes?: java.lang, java.util, java.net and java.awt

Answer: java.util,

7. Which of these classes is not part of Java's collection framework? :Maps, Array, Stack and Queue

Answer: map: Explanation: Maps is not a part of collection framework.

8. Which of these interfaces is not a part of Java's collection framework?: List, Set, SortedMap and SortedList

Answer: SortedList

Explanation: SortedList is not a part of collection framework.

9. Which of these methods deletes all the elements from invoking collection?: clear(), reset(), delete() and refresh()

Answer: clear() Explanation: clear() method removes all the elements from invoking collection.

10. What is Collection in Java?

- A group of objects
- A group of classes
- A group of interfaces
- None of the mentioned

Answer: a

What is the output of this program?

```
import java.util.*;
    class vector
    {
      public static void main(String args[])
      {
        Vector obj = new Vector(4,2);
        obj.addElement(new Integer(3));
        obj.addElement(new Integer(2));
        obj.addElement(new Integer(5));
        obj.removeAll(obj);
    System.out.println(obj.isEmpty());
      }
    }
```

- 0
- 1
- true
- false

Answer: c; Explanation: firstly elements 3, 2, 5 are entered in the vector obj, but when obj.removeAll(obj); is executed all the elements are deleted and vector is empty, hence obj.isEmpty() returns true.

10.9.2. Consolidation

1. What interface represents a collection that does not allow duplicate elements?
    Answer: Set

2. What is Java Collections Framework? List out some benefits of Collections framework? (result refer in text book of student)

3. What are the classes implementing List and Set interface?

    - Class implementing List interface: ArrayList, Vector, LinkedList ,
    - Class implementing Set interface: HashSet, TreeSet

4. What are the classes implementing Map and Queue? Answer: Class implementing List interfaces and Class implementing Set interface:

10.9.3. Extended

Write a program that supports: Adding Elements, Accessing Elements, Removing Elements, Clearing a List, List Size and display Output by using the following classes: ArrayList , LinkedList, HashSet, HashMap

Answer:

```
package pkginterface;
import java.util.ArrayList;
import java.util.HashMap;
import java.util.HashSet;
import java.util.LinkedList;
import java.util.List;
import java.util.Map;
import java.util.Set;
public class INTERFACE {
   public static void main(String[] args) {
    // ArrayList
    List a1 = new ArrayList();
    a1.add("Tom");
    a1.add("Paul");
    a1.add("John");
    System.out.println(" ArrayList Elements");
    System.out.print("\t" + a1);
    // LinkedList
    List l1 = new LinkedList();
    l1.add("tom");
    l1.add("Paul");
    l1.add("John");
    System.out.println();
    System.out.println(" LinkedList Elements");
System.out.print("\t" + l1);
// HashSet
    Set s1 = new HashSet();
    s1.add("Tom");
    s1.add("Paul");
    s1.add("John");
    System.out.println();
    System.out.println(" Set Elements");
    System.out.print("\t" + s1);
```

```
    // HashMap
    Map m1 = new HashMap();
    m1.put("Tom", "8");
    m1.put("paul", "31");
    m1.put("John", "12");
    m1.put("Alica", "14");
    System.out.println();
    System.out.println(" Map Elements");
    System.out.println("\t" + m1);
  }
}
```

UNIT 11: JAVA ENTERPRISE WEB APPLICATIONS

11

11.1. Key Unit Competency

To be able to design and run a java enterprise web application

11.2. Prerequisite knowledge and skills

Students should have knowledge and skills related to HTML and CSS learnt in Senior 4, database and Java learnt in Senior 5, Structured Query Language and Java collections learnt in Senior 6.

11.3. Cross-cutting issues to be addressed

- **Peace and value education:** Students should be aware of the proper utilization of Web content (e.g., text, graphics, code), including original content, misleading/inaccurate information, copyrighted content, licensing, avoiding violation.

- **Financial education:** Students must be aware offinancial costs and benefits in developing accessible websites

- **Gender:** Student mustknow thatboth girls and boys are equally involved in the course. The teacher makes sure that working groups are mixed.

- **Inclusive Education:** The teacher must involve students with physical impairment in working groups

- **Standardization culture:** Students must be aware of ethical and legal issues in web development. To avoid posting information which is against Rwandan culture such as pornography…

11.4. Guidance on the introductory activity

Instruction to do the introductory activity:

1. The teacher instructs students to go to page where figure 11.1 is in textbook.

2. The teacher organizes students into groups

3. The teacher asks students to do the introductory activity in their respective groups.

4. The teacher let the students work independently on the activity.

5. The teacher moves around to see how students are working.

6. The teacher may ask some questions to boost the students.

a. What is client / server?

b. What are the applications of client / server?

7. The teacher invites representatives of groups to presents their findings (3 or 4 groups).

8. The teacher ask students to evaluate findings.

9. The teacher tells the students that in the coming lessons they will have complete answers.

11.5. List of lessons

#	Lesson title	Learning objectives	Number of periods
1	Tomcat	Appreciate the use of controller to link user's views and the database.	1
2	Installation and configuration of tomcat configuration directory	Configure and manipulate tomcat web server.	2
3	Hypertext Transfer Protocol (HTTP) request / response	Understanding HTTP request/response	1
4	Web application	Understanding web application	2
5	A Uniform Resource Locator (URL)	Name appropriately the URL to be displayed to the user in deployment descriptor(web.xml)	1
6	Project creation	Organize J2EE content in their appropriate folders.	3
7	Java Server Pages	Create a dynamic web application using JSPSERVLET Create JSP pages using features namely Scriplet , Expression, Directive, Declaration and Comments in JSP Design a form in JSP pages and access values in servlet using request methods like getParameter.	3

8	Java Standard Tag Library	Use collections to set servlet attributes and display them in JSP content using Java Standard Tag Library and Expression Language	1
9	Java Database Connectivity (JDBC) connection	Establish a JDBC connection to MYSQL database Create a J2EE application which interact with the database Interrogate the database using SQL queries in a J2EE application	3
	Assessment		1
			18

LESSON 1: TOMCAT

(Duration: 1 periods: 40 minutes)

a. Prerequisites/Revision/Introduction:

The teacher invites students to visit the school computer lab. Students switch on computers and observe installed java runtime version. The teacher asks students to take notes of what they observed.

b. Teaching resources:

- Projector
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do activity 11.1.
- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 11.1 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on findings / answers from other groups.
- Teacher corrects false answers and completes the half corrected answers.
- Teacher summarizes the contents or teacher refers to notes in students' book

and gives examples that should be done by students.

- Teacher requests students to do Application activity 11.1.
- Students do Application activity 11.1.

Answer of activity 11.1

1. Let students determine that application server supports distributed transaction and Enterprise Java Bean (EJB) while web server only supports Servlets and Java Server Pages. Application Server can contain web server in them. Most of App server e.g. JBoss or WAS has Servlet and JSP container. In order to run EJB or host enterprise Java application (.ear) file you need an application server like JBoss, WebLogic, WebSphere or Glassfish, while you can still run your servlet and JSP or java web application (.war) file inside any web server like Tomcat or Jetty.

d) Answers of application activity 11.1

For all the questions refer to student book, section 11.1.1, 11.1.2 and 11.1.3

LESSON 2: INSTALLATION AND CONFIGURATION OF TOMCAT CONFIGURATION DIRECTORY

(Duration: 2 periods: 80 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to switch on computers and visit the download section of Tomcat website. Students observe available resources with a special attention to Binary Distributions. The teacher asks students to take notes of what they observed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research
- 32-bit/64-bit Tomcat Windows Service Installer

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 11.2.
- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 11.2 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.

- Teacher corrects false answers and completes the half corrected answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 11.2.
- Students do Application activity 11.2.

Answer of activity 11.2

1. Students observe and write notes on different types (32-bit or 64-bit) and version (7, 8, 10 etc.) of Operating System installed in their computers.

2. Students observe programs installed in their computers and indicate web servers if any. They may include but not limited to Glassfish, JBoss Enterprise Application Platform, Apache Tomcat, Apache TomEE. ...

d) Answer of application activity 11.2

1. Students demonstrate their ability to open and apply proper changes to Tomcat configuration files (server.xml, user.xml and web.xml). Students should also realize that they have set permission to view the server status and not application manager, hence the link to server status is different from the link for application manager.

2. The teacher will make a follow up and helps students how to add user name, password and permission

3. Question 3,4 and 5 will be practically done by students in guidance of the teacher.

LESSON 3: HYPERTEXT TRANSFER PROTOCOL (HTTP) REQUEST/ RESPONSE

(Duration: 1 periods: 40 minutes)

a) Prerequisites/Revision/Introduction:

The teacher requests students to discuss on activity 11.3. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research
- Tomcat installed and running on computers in computer lab

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 11.3.
- Students elect the group leader and secretary.

- Teacher asks the students to work independently in groups on Activity 11.3 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of 3 or 4 groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half corrected answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 11.3.
- Students do Application activity 11.3.

Answer of activity 11.3

1. Refer to student textbook, section 11.3.2

d) Answer of application activity 11.3

1. Students explain that the request is initiated by the client and not the server.

2. Students explain that the response is sent by the server as a feedback to the client's request.

LESSON 4: WEB APPLICATION

(Duration: 2 periods: 80 minutes)

a) Prerequisites/Revision/Introduction:

The teacher requests students to brainstorm on the main characteristics of website and web application. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research
- Sample URLs for website and web application

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 11.4
- Students elect the group leader and secretary.
- Teacher distributes sample URLs to groups.
- Teacher asks the students to work independently in groups on Activity 11.4 during some given time.

- Teacher walks around and sees if students are doing activity in their respective groups.

- Representatives of groups present their answer to the rest of class.

- Students react on the findings / answers from other groups.

- Teacher corrects false answers and completes the half corrected answers.

- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.

- Teacher asks students to do Application activity 11.4

- Students do Application activity 11.4

Answer of activity 11.4

1. Students demonstrate that websites are informational while web applications are interactive.

d) Answer of application activity 11.4

1. A web application resources can be bundled and run on multiple containers from multiple vendors.

2. A servlet is a platform-independent web application component that is hosted in a servlet container. Servlets communicate with web clients using a request/response model managed by a servlet container, such as Apache Tomcat. While the Java Server Pages (JSP) is a technology for developing Webpages that supports dynamic content. Servlet is html in java whereas JSP is java in html.

3. Refer to student textbook, section 11.4.4

4. Codes and output should look as follows:

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<HTML>
<BODY>
<% out.println("Welcome to Munini Secondary School!"); %>
</BODY>
</HTML>
```


Teachers' Guide
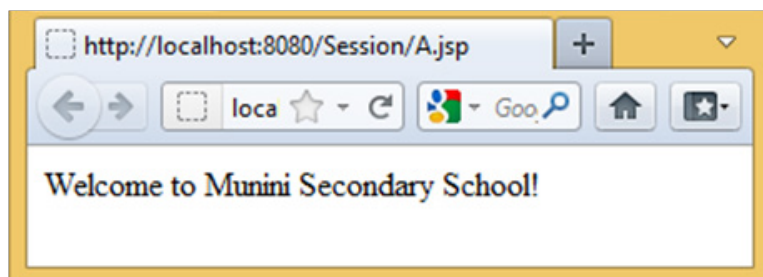
LESSON 5: A UNIFORM RESOURCE LOCATOR (URL)

(Duration: 1 periods: 40 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to the computer lab and switch on computers. The teacher asks students to run two given URLs in their browsers and discuss on syntax and their outputs. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research
- Sample URLs

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 11.5
- Students elect the group leader and secretary.
- Teacher distributes available network devices to groups.
- Teacher asks the students to work independently in groups on Activity 11.5 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half corrected answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 11.5
- Students do Application activity 11.5

Answers of activity 11.5

1. Students should be able to remark that the outputs are different though both URLs have the same starting part.

b) Answer of application activity 11.5

1. Student clearly identifies different parts of given URLs (scheme name, domain, path and query string)

2. Advantages of static websites and web pages

- Much more functional website

- Much easier to update

- Can connect with database

- New content brings people back to the site and helps in the search engines

- Can work as a system to allow staff or users to collaborate

3. Barriers of static websites and webpages

- The Content is always same.

- A static website contains Web pages with fixed content.

- Each page is coded in HTML and displays the same information to every visitor.

LESSON 6: PROJECT CREATION

(Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to read the activity 11.6 and discuss on the process to create a website project and test it on their computers. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Projector

- Computer lab (any room which has networked computers)

- Internet and textbooks to facilitate research

- Netbeans

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 11.6

- Students elect the group leader and secretary.

- Teacher asks the students to work independently in groups on Activity 11.6 during some given time.

- Teacher walks around and sees if students are doing activity in their respective groups.

- Representatives of groups present their answer to the rest of class.

- Students react on the findings / answers from other groups.

- Teacher corrects false answers and completes the half corrected answers.

- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.

- Teacher asks students to do Application activity 11.6

• Students do Application activity 11.6

Answer of activity 11.6

1. Students may argue the following:
    − Step 1: To install html editor like Notepad++, Editplus, …
    − Step 2: To install java runtime, JDK, Netbeans, etc.
    − Step 3: To install a web server like Tomcat, GlassFish, etc.
    − Step 4: Create a directory structure for the web site
    − Step 5: Creating web pages using html, JSP, servlet and JDBC when necessary.
2. Students show their ability to provide budget estimates for the development of the website, web hosting and internet connectivity.

d) Answer of application activity 11.6

− Using Netbeans, create a new Java Web Application project named "Senior6"
− Create a new servlet with give class name and servlet name as indicated below:
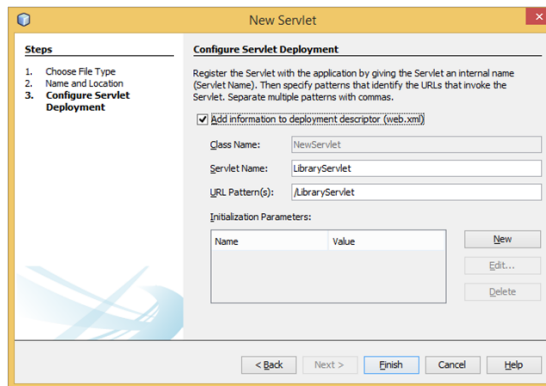
− Students demonstrate that they are able to link the index page to the servlet.

− The final output should look like this:
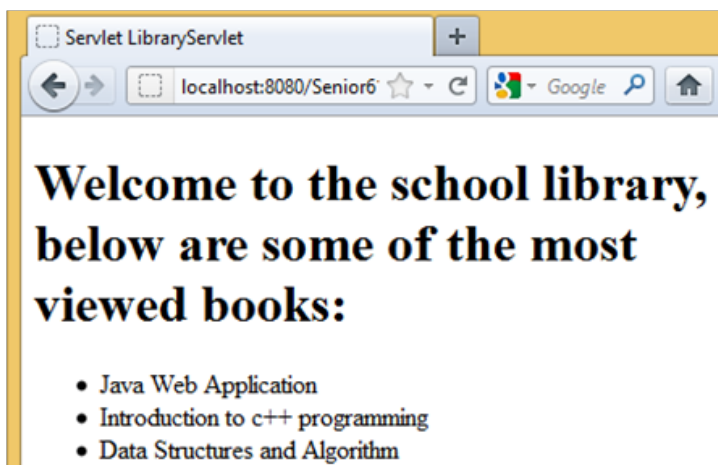
LESSON 7: JAVA SERVER PAGES

(Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to observe the differences between codes provided on activity 11.7. The teacher asks students to take notes of what they observed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research
- Netbeans

c) Learning activities:

- Guidance on Activities
- Teacher organizes students in groups in order to do Activity 11.7
- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 11.7 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half corrected answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 11.7
- Students do Application activity 11.7

Answer of activity 11.7

Students should be able to notice the use of special tags <% %> in index1 which is not used in index2

d) Answer of application activity 11.7

1. Advantages of JSP over Servlet:

   - Servlets use println statements for printing an HTML document which is usually very difficult to use. JSP has no such boring task to maintain.
   - JSP needs no compilation, CLASSPATH setting and packaging.
   - In a JSP page visual content and logic are separated, which is not possible in a

servlet.

- There is automatic deployment of a JSP, recompilation is done automatically when changes are made to JSP pages.

2. JSP pages add server-side code to an HTML page.

   a. JSP creates dynamic pages, while HTML creates static pages.

3. The output will look like this:Type equation here.
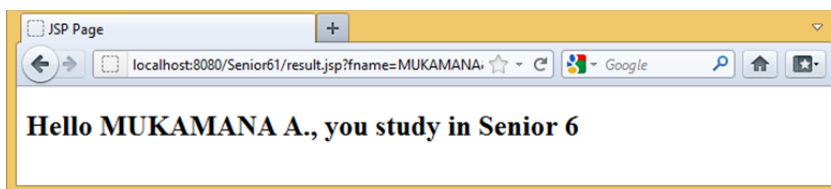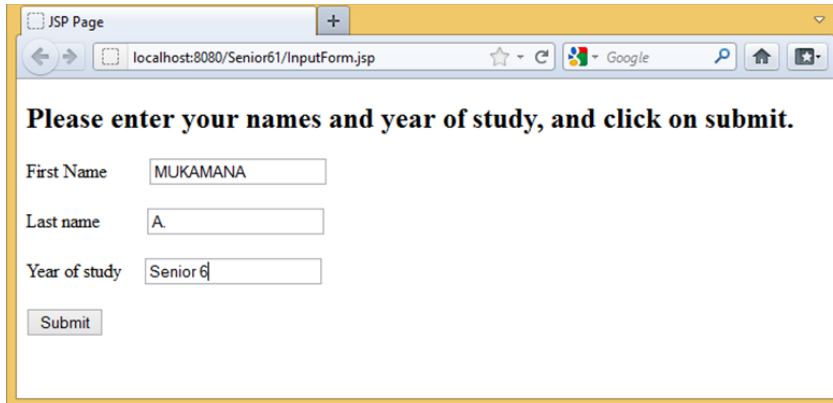
LESSON 8: JAVA STANDARD TAG LIBRARY

(Duration: 1 periods: 40 minutes)

a) Prerequisites/Revision/Introduction:

The teacher invites students to read and discuss on activity 11.8. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)
- Internet and textbooks to facilitate research
- Netbeans

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 11.8.

- Students elect the group leader and secretary.
- Teacher asks the students to work independently in groups on Activity 11.8 during some given time.
- Teacher walks around and sees if students are doing activity in their respective groups.
- Representatives of groups present their answer to the rest of class.
- Students react on the findings / answers from other groups.
- Teacher corrects false answers and completes the half corrected answers.
- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.
- Teacher asks students to do Application activity 11.8.
- Students do Application activity 11.8.

Answer of activity 11.8

1. A tag is said to be a paired tag if the text is placed between a tag and its companion tag. In paired tags, the first tag is referred to as Opening Tag and the second tag is referred to as Closing Tag. An unpaired tag does not have a companion tag. Unpaired tags are also known as Singular or Stand-Alone Tags. Below are examples of both paired and unpaired tags:

    – Paired tags: <p>this is example of paired tag</p>

    – Unpaired tag:
<img src='test.png' >

2. Examples of tags:

    a. Formatting tags: <font>, <u>,<b> etc.

    b. Page structure tags : title , head , body etc.

    c. Control tags: Form tags, Script tags, Radio buttons etc.

d) Answer of application activity 11.8

1. Refer to student text book on section 11.8.2

LESSON 9: JAVA DATABASE CONNECTIVITY (JDBC) CONNECTION

(Duration: 3 periods: 120 minutes)

a) Prerequisites/Revision/Introduction:

The teacher requests students to discuss on activity 11.9. The teacher asks students to take notes of what they discussed.

b) Teaching resources:

- Projector
- Computer lab (any room which has networked computers)

- Internet and textbooks to facilitate research

- MySQL

- MySQL Connector/J

- Netbeans

c) Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do Activity 11.9.

- Students elect the group leader and secretary.

- Teacher asks the students to work independently in groups on Activity 11.9 during some given time.

- Teacher walks around and sees if students are doing activity in their respective groups.

- Representatives of groups present their answer to the rest of class.

- Students react on the findings / answers from other groups.

- Teacher corrects false answers and completes the half corrected answers.

- Teacher summarizes the contents (Note in students' book) and gives examples that should be done by students.

- Teacher asks students to do Application activity 11.9

- Students do Application activity 11.9

Answer of activity 11.9

1. Students demonstrate that there must be a Database Management System software and a web server connected in order to allow communication between the website and the database.

2. Refer to section 11.5.3 (b)

d) Answer of application activity 11.9

Refer to section 11.9

11.6. Summary of the unit

This unit of J2EE Web application is a complement to HTML and CSS learnt in Senior 4, database and Java learnt in Senior 5, Structured Query Language and Java collections learnt in Senior 6. It introduces Apache Tomcat as a web server and application Server. Tomcat has three main components (Jasper, Catalina, and Coyote) and its most important configuration files are: Server.xml, Tomcat-user.xml[add user], Web.xml and Contex.xml

HTTP request / response uses HTTP which is an asymmetric request-response client-server protocol. An HTTP client sends a request message to an HTTP server. The server,

in turn, returns a response message.

A web application is a collection of servlets, html pages, classes, and other resources that can be bundled and run on multiple containers from multiple vendors. Briefly, a web application is a container that can hold any combination of the following list of objects:

- Servlets
- Java Server Pages (JSPs)
- Utility classes - is a static class that perform small and repetitive operations on a kind of instance (example of utils classes ArrayUtils or IOUtils from Apache)
- Static documents, including HTML, images, JavaScript libraries, cascading style sheets (CSS), and so on
- Client-side classes

URL is the global address of documents and other resources on the World Wide Web. Its main purpose is to identify the location of a document and other web resources available on the Internet, and specify the mechanism for accessing it through a web browser.

Two ways to create a web application project are covered in this unit. The first one is by using Tomcat, the second is by using Netbeans. Servlet and Java Server Pages are introduced with clear examples and exercises for practice. At the end, the unit guides the students through the process of linking a website to a database using JDBC.

11.7. Additional information

All codes used in this unit were tested, the teacher is always requested to run it and help students to do the same practice.

11.8. End unit Assessment

1. How can you change the connector port while configuring Apache Tomcat?

    Answer: Refer to student textbook, section 11.2.2 (a)

2. How does the servlet container interact with java servlet?

    Answer: Refer to student textbook, section 11.4.4

3. How could you access and run Tomcat Servlet and JSP examples?

    Answer: Refer to student textbook, section 11.4.7 (c)

4.   Develop a web application so that it stores information in a session variable. Use the session variable in the JSP output page.

    Answer: Students can develop various web applications. Below is an example of a web application to display a session info including the creation date and time, access time and session id:

The codes is as follows:

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<%@ taglib uri="http://java.sun.com/jstl/core_rt" prefix="c" %>
<%@ taglib uri="http://java.sun.com/jsp/jstl/fmt" prefix="fmt" %>
<html>
<head><title>View Session JSP </title></head>
<body>
<h2>Session Info From A JSP</h2>

The session id:
<c:out value="${pageContext.session.id}"/>
<h3>Session date values formatted as Dates</h3>

<jsp:useBean id="timeValues" class="java.util.Date"/>
<c:set    target="${timeValues}"    value="${pageContext.session.creationTime}"
property="time"/>
The    creation    time:    <fmt:formatDate    value="${timeValues}"    type="both"
dateStyle="medium" />
<br><br>
<c:set  target="${timeValues}"  value="${pageContext.session.lastAccessedTime}"
property="time"/>
The    last    accessed    time:    <fmt:formatDate    value="${timeValues}"    type="both"
dateStyle="short" />
<c:out value="${timeValues}"/>
</body>
</html>
```

11.9. Additional activities
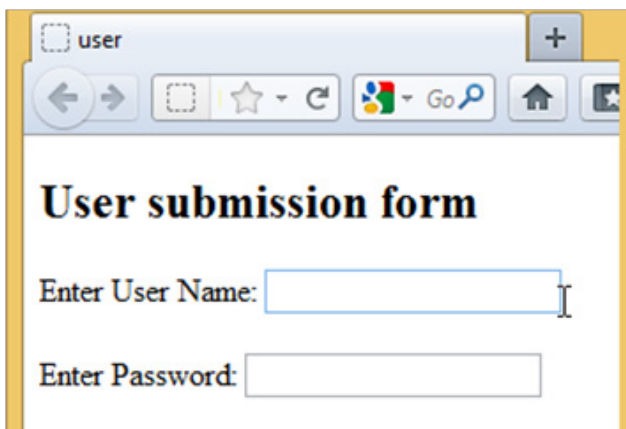
11.9.1. Remedial Activities

Suggestion of Questions and Answers for remedial activities for slow learners.

1. Write a program using the request.getParameter() method to enter the Name and Password of a user and display the output on another JSP page.

Answer: Codes should be written as follows:

```
user.jsp:
Codes
<html>
<head>
<title>user</title>
</head>
<body>
<h1>User submission form</h1>
<form action="UserDisplay.jsp" method="post">
Enter User Name:
<input type="text" name="uname">
<br>
<br>
Enter Password:
<input type="password" name="pname">
<br>
<br>
<input type="submit" name="submit" value="Submit">
</form>
</body>
</html>
```
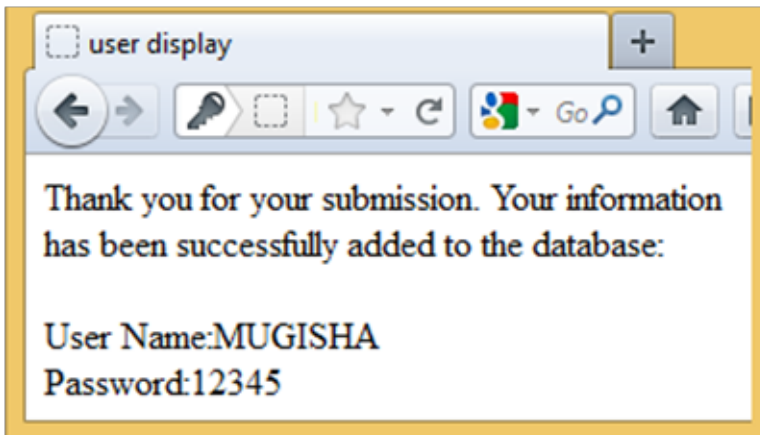
Output:

userdisplay.jsp:

Codes   Output

```
<html>
<head>
<title>Example of Implicit objects</title>
</head>
<body>
<font face=Times New Roman size=3>
Thank you for your submission. Your information has been
successfully added to the database:
<br>
<br>
<%
String sUName = request.getParameter("uname");
String sPName = request.getParameter("pname");
%>
User Name:<%=sUName%><br>
Password:<%=sPName%><br>
</font>
</body>
</html>
```


11.9.2. Consolidation activities

Suggestion of questions and answers for deep development of competences.

1. Create a servlet that makes a bulleted list of four random numbers.

    a. Reminder 1: you use Math.random() to output a random number in Java.

    b. Reminder 2: you make a bulleted list in HTML as follows

    • List item 1

    • List item 2

Answer: Codes should be written as follows:

Index.html:

Codes

```
<html>
<head>
<title>Displaying a random number </title>
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
</head>
<body>
<h3>Click here to generate 3 random numbers <a href="SampleRandomNumber">
View </a></h3>
</body>
</html>
```
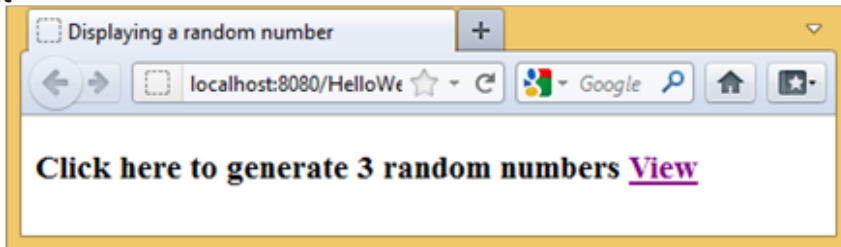
Output

Random.java:

```
Codes
import java.io.IOException;
import java.io.PrintWriter;
import javax.servlet.ServletException;
import javax.servlet.http.HttpServlet;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;

public class SampleRandomNumber extends HttpServlet {
 protected void processRequest(HttpServletRequest request, HttpServletResponse response)
    throws ServletException, IOException {
   response.setContentType("text/html;charset=UTF-8");
   try (PrintWriter out = response.getWriter()) {
     out.println("<!DOCTYPE html>");
     out.println("<html>");
     out.println("<head>");
     out.println("<title>Servlet SampleRandomNumber</title>");
     out.println("</head>");
     out.println("<body>");
     out.println("<ul>");
     out.println("<li> The first random number is: " +(int)(Math.random()*20)"</li>");
    out.println("<li> The second random number is: "+(int)(Math.random()*20)"</li>");
     out.println("<li> The third random number is: "+(int)(Math.random()*20)"</li>");
     out.println("</ul>");
     out.println("</body>");
```
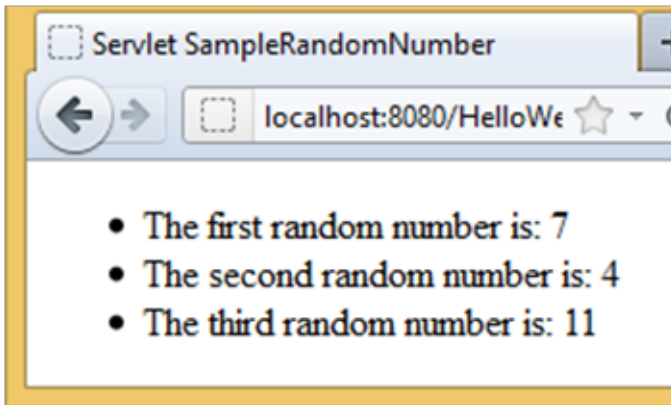
```
    out.println("</html>");
  }
}}
```
Output

11.9.3. Extended activities

Suggestion of Questions and Answers for gifted and talented students.

1. Create a JSP page that can be accessed only by registered users. Use form-based authentication. Unregistered users should be requested to register.

Answer:

Sample codes and output for login page

Codes

```
<%@page contentType="text/html" pageEncoding="UTF-8"%>
<!DOCTYPE html>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
<title>Login Page</title>
</head>
<body>
<h3>Please enter your User name and Password</h3>
<pre>
<form method="post" action="validate.jsp">

User Name : <input type="text" name = "username">
User Pass : <input type="password" name = "password">
<input value="Submit" type="submit">
</form>
</pre>
</body>
</html>
```
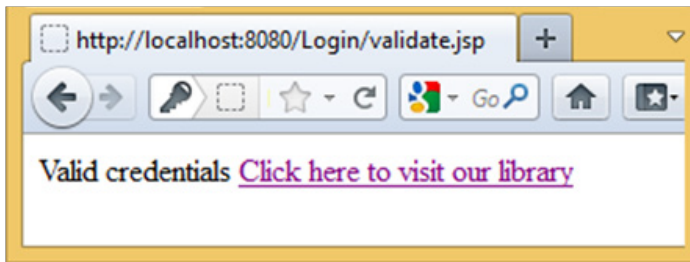**Output**

Sample codes to validate the username and password

Codes

```jsp
<%@ page import ="java.sql.*" %>
<%
  try{
    String username = request.getParameter("username");
    String password = request.getParameter("password");
    Class.forName("com.mysql.jdbc.Driver");  // MySQL database connection
    Connection conn = DriverManager.getConnection("jdbc:mysql://localhost:3306/
logindb?" + "user=root&password=");
     PreparedStatement pst = conn.prepareStatement("Select   uname,upass from
user where uname=? and upass=?");
    pst.setString(1, username);
    pst.setString(2, password);
    ResultSet rs = pst.executeQuery();
    if(rs.next())
    out.println("Valid credentials <a href='books.jsp'>Click here to visit our library</
a>");
     else
    out.println("Invalid login credentials <a href='registration.html'> Click here to
register </a>");
  }
  catch(Exception e){
    out.println("Something went wrong !! Please try again");
  }
%>
```

Output
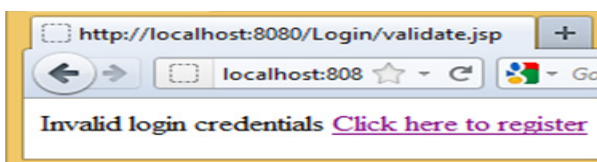
UNIT 12: INTRODUCTION TO COMPUTER GRAPHICS

12

12.1 Key unit competence:

To be able to describe computer graphics terminology, create, capture graphics images and edit them using software

12.2 Prerequisite knowledge and skills:

Students should have knowledge and skills related to computer graphics learnt in senior 3, unit 7 introduction to computer graphics.

12.3 Cross-cutting issues to be addressed:

- **Peace and value education:** students must be aware of crimes that are committed using computer graphics on different websites or in magazines.

- They must also use the photo of others with their permissions, if not; this can cause conflict.

- **Environment and sustainability**: students should be informed about the refurbishment and disposal of perished photo capturing tools.

- **Standardization culture:** students must have the culture of not taking and keeping pictures that are against Rwandan culture.

12.4 Guidance on the introductory activity

Instruction to do the introductory activity:

1. The teacher instructs students to go to page where figure 12.1 is in the textbook. The number of the group member varies depending on the activity

2. The teacher organizes students into groups.

3. The teacher asks students to do the introductory activity in their respective groups.

4. The teacher asks the students to work independently for some while

5. The teacher moves around to see how students are working and provides guidance to needy groups

6. The teacher invites representatives of groups to presents their findings

7. The teacher asks students to evaluate findings.

8. The teacher tells the students that in the fourth coming lessons they will have complete answers.

12.5. List of lessons

#	Lesson title	Learning objectives	Number of periods
1	INTRODUCTORY ACTIVITY	Answer questions of the introductory activity	1
2	DEFINITION OF COMPUTER GRAPHICS TERMS	Explain computer graphics related terms Demonstrate the difference between vector graphics and bitmap graphics State different graphics file format	3
3	IMAGE CAPTURING TOOLS	Describe parts and functions of a digital camera, scanner as image capturing tool Appreciate the use of camera and scanner as digital image capturing tool	3
4	AREA OF GRAPHICS USE	Identify places and areas where graphics are mostly used	3
5	GRAPHICS SOFTWARE, FEATURES AND EDITING TOOLS	Manipulate vector graphics by using graphic features Appreciate the use of graphics to improve data presentation Enjoy the way graphics is used to improve the appearance Edit digital graphics images in various software such as MS-Paint, Microsoft Office Picture Manager, Adobe Photoshop.	5
6	BASIC GRAPHICS ELEMENTS	Creating vector graphics and bitmap graphics using basic graphic elements Know and understand how to use vector basic graphic elements to create the graphics	3
7	END UNIT ASSASSMENT	Answer the questions of end unit assessment	2

LESSON 2: DEFINITION OF COMPUTER GRAPHIC TERMS

Duration: 3 periods: 120 minutes

a. Prerequisites/revision/introduction:

Learning activity 12.1 is used to introduce the lesson. Students take pictures with different telephones; they visit the school computer lab and save the image taken in different folders on computers. Students observe the pictures saved and try to find the appearance of those pictures. Answers from students may be biased, from those answers the teacher explains to students and introduces the lesson.

b. Teaching resources:

Computer lab., internet, textbooks to facilitate the research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in groups in order to do learning activity.
- Students elect the group leader and secretary.
- learners take pictures in their groups and do Learning Activity 12.1
- The teacher asks the students to work independently for some while
- Teacher walks around and sees if students are doing activity in their respective groups
- Students present their answer to the rest of the class.
- Students react on the finding/ answers from other groups.
- Teacher corrects false answers and completes the half correct answers
- Teacher summarizes the contents (Note in students book) and gives examples that should be done by students
- Teacher lets students discuss the different appearances of images taken by different tools. The definition of different image types and other related terms are discussed in Students Book.

Answers of activity 12.1.

The teacher organizes the activities by using three different mobile phones and takes the pictures from the same group of students. By using the projector, the teacher asks the students to compare the quality of those pictures.

d. Application activities 12.1

Answers:

From question 1 to 7 of Application activity 12.1, refer to lesson 12.1 Definition of computer graphics terms

- Image is easily scalable in vector

• Refer to lesson 12.1 Definition of computer graphics terms in student book

LESSON 3: IMAGE CAPTURING TOOLS

Duration: 3 periods: 120 minutes

a. Prerequisites/revision/introduction:

Students get prerequisites from Introduction to computer graphics in senior 3. Teacher asks students what they have learnt in those lessons. From answers given by students, teacher introduces the activity 12.2. The objective of this activity is to differentiate the image capturing tools, to describe the parts of image capturing tools, and to give their functions.

b. Teaching resources:

Computer lab, Internet and textbooks to facilitate research

c. Learning activities

Guidance

• This lesson can be conducted in the computer lab, class room or outside.

• Teacher asks students to form groups to do the Learning Activity 12.2

• Students elect the group leader and secretary in order to perform Learning Activity 12.2

• Learners do Learning Activity 12.2

• Teacher walks around, sees if students are doing Learning Activity 12.2 in their respective group and provides guidance.

• Students present their answer to the rest of the class.

• Students react on the findings/answers from other groups.

• Teacher corrects false answers and completes the half correct answers

• Teacher summarizes the contents (Note in student's book) and gives students the opportunity to use digital camera and scanner

• Teacher gives the instructions on how to do Application activities 12.2

Answers of activity 12.2

1. On the figure 12.2, there is a telephone, digital camera, scanner and a paper.

2. Telephone, digital camera and scanner are tools which used to capture images in different ways.

3. Telephone is most useful, because nowadays many people have telephone

4. The parts of each device and its functions are discussed in section 12.2

d. Application activities 12.2

1. A Digital camera is a camera which produces digital images that can be stored in a

computer and displayed on screen while a scanner is an electronic device which can capture images from physical items (printed text, handwriting, photographic prints, and similar sources) and convert them into digital formats, which in turn can be stored in a computer, and viewed or modified using software applications

2. Digital camera records and stores photographic images in digital format.

3. Refer to lesson 12.2 in Importing pictures using USB cable

4. The scanned documents never can be as good in quality as the original documents that you scanned, both because of software and hardware limitations

From question 4 to 5 of Application activity 12.2, refer to lesson 12.2

LESSON 4: AREA OF GRAPHICS USE

Duration: 3 periods: 120 minutes

a. Prerequisites/revision/introduction

Learning activity 12.3 is used to introduce the lesson. Students visit the school library. Students observe the books and magazines covers, and respond to the questions in the activity. Answers from students may not be completely right, from the answers given by students the teacher explains to students and introduce the lesson using explanation related to the lesson.

b. Teaching resources:

- School library
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance on Activities

- Teacher organizes students in group in order to do learning activity.
- Students elect the group leader and secretary.
- learners observe different books and magazine cover and do Learning Activity 12.3
- Teacher walks around and sees if students are doing activity in their respective group.
- Students present their answers to the rest of the class.
- Students react on the finding answers from other groups.
- Teacher corrects false answers and completes the half correct answers
- Teacher summarizes the contents (Notes in students book)
- Teacher gives the instructions on how to do Application activity 12.3

Answers of activity 12.3

1. The books and magazine have different images on their covers.

2. If any magazine has the attractive picture on its first page, this may attract the customers to buy it or to read it.

3. A school or any institution can be advertised in different ways:

4.   through magazines, social media, on radio, TV….

5. The pictures are used in different ceremonies, in house decoration

d. Application activities 12.3

1. Computer graphics are used in advertisement in order to attract many customers

2. In entertainment, computer graphics is used to modify the appearance of the pictures or images in music, video…

3. Any school logo can be modified using graphic software such as Paint and Photoshop. It can be modified by changing its color, size and light

4.   Answers of question 4 and 5 refer to lesson 12.3 in student book.

LESSON 5: GRAPHICS SOFTWARE, FEATURES AND EDITING TOOLS

Duration: 4 periods: 160 minutes

a. Prerequisites/revision/introduction:

Teacher introduces this lessons using what students/learners have seen in Computer graphics in senior 3. During this lesson students must be in computer lab where it is possible to use Ms-Paint, Micro soft office picture manager and Adobe Photoshop.

b. Teaching resources:

Computer lab, Ms Paint, Micro soft Picture manager, Adobe Photoshop, Internet and textbooks to facilitate research

c. learning activities

Guidance

- This lesson can be conducted in the computer lab.
- Teacher asks students to form pairs to do the Activity 12.4
- The teacher asks the students to work independently for some while
- Teacher walks around and sees if students are doing Learning Activity in their respective pairs.
- Students present their answer to the rest of class.
- Students react on answers from other pairs.
- Teacher corrects false answers and completes the half correct answers
- Teacher summarizes the contents (Note in student book) and asks student to draw a house using lines only.

• Teacher give the instructions on how to do Application activities 12.4

Answers of activity 12.4

1. On the picture, there is 3 different photo of the same image but the color is different.

2. The appearance is not the same for those pictures. Some picture are of white and black color other are colored

3. For the picture creation and modification tools refer to section 12.4.3 graphic editing tool. This section contains explanation and tools which used to edit a photo

4. Refer to the tools mentioned in the Student Book

d. Application activity 12.4

1. The use and importance of Ms Paint is discussed in Section 12.4.1 contains graphic software.

2. The difference between Photoshop and MS office picture manager are discussed in lesson 12.4

3. Refer to lesson 12.4, find the answers of the question 3

4. The difference between Ms-Paint and Photoshop is found in lesson 12.4

5. For the use of Lasso tool in Photoshop, refer to section 12.4.2. This section contains photo editing tools in different graphic software.

6. When working with an image-editing program, such as Adobe Photoshop, you can modify both the image size and canvas size of an image. While they sound similar, they modify the image in two different ways.

   When you modify the canvas size of an image, you either increase or decrease the amount of area of the image canvas. This means that adding to the canvas size will add blank area around the image (or fill it with the background color if there is only one layer). Conversely, if you decrease the canvas size, the image will be cropped, meaning you will lose some of the image depending on where you crop it. When you modify the image size of an image, you change how large the image is. When you increase the image size, the image will appear bigger, and may become blocky or blurry if increased too much. Decreasing the image size will shrink the image, and may cause some detail to be lost. When you change the image size, you can also modify the image resolution

7. For the use of gradient tool in Photoshop, refer to section 12.4.2. This section contains photo editing tools in different graphic softwares.

LESSON6: BASIC GRAPHICS ELEMENTS

Duration: 3 periods: 120 minutes

a. Prerequisites/revision/introduction:

The teacher invites students to visit the school computer lab and to draw any picture using lines and other types of shape.

b. Teaching resources:

Computers with Ms Office word installed, Internet and textbooks to facilitate the research

c. Learning activities

Guidance

- This lesson can be conducted in the computer lab.
- Teacher asks students to form pairs to do the Learning Activity 12.5
- The teacher asks the students to work independently for some while
- Teacher walks around and sees if students are doing Learning Activity in their respective pairs.
- Students present their answer to the rest of class.
- Students react on answers from other pairs.
- Teacher corrects false answers and completes the half correct answers
- Teacher summarizes the contents (Note in student book) and asks students to draw a house using lines only.
- Teacher gives the instructions on how to do Application activities 12.5

Answers of activity 12.5

1. On the picture there is a picture of a house

2. This picture is made by lines and shapes

3. You can draw the same image in Ms-Paint or you can match lines and shapes and make a picture. Basic graphic elements are discussed in Students Book.

d. Application activities 12.5

1. Refer to lesson 12.5 for answer the question 1

2. The section 12.5 contains the basic graphic elements

3. The difference between an oval and a circle is referred to section 12.5. This section contains other graphic elements which used to create graphics.

4. The use of brush in computer graphics is discussed in Section 12.5 which contains basic graphic elements.

12.6 Summary of the unit

Computer Graphics is an art of drawing pictures, lines, charts, etc, using computers with the help of programming. The term refers to computer-generated image data created with help from specialized graphical hardware and software.

Computer graphics can be classified into two categories:

- R**aster** or **Bitmap** which are graphics which are the pixel based graphics and the pixels can be modified individually. The images are easy to edit in memory and display on TV monitors due to the arrangement of the pixels in a rectangular array.

- **Vector** or O**bject-oriented** graphics; which are pixels based graphics and the pixels can be modified individually. The images are easy to edit in memory and display on TV monitors due to the arrangement of the pixels in a rectangular array.

  It is impossible to work with computer graphics without image (is a representation of an object in a 2 dimension)

Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space.

The determination of an image's file size and dimensions differs according to the Operating System being used; On MS Windows computers, Open the image in Windows Explorer to check dimensions and file size by clicking the Windows Start button on the taskbar. After opening the folder containing the image, right clicking the icon of the image file, and in the pop up menu, click on property and details.

Image file formats are standardized means of organizing and storing digital images. Image files are composed of digital data in one of the formats that can be rasterized for use on a computer display or printer.

Graphics file format; Graphic images are stored digitally using a small number of standardized graphic file formats, including bit map, TIFF, JPEG, GIF, PNG

- *JPEG* (pronounced "jay-peg") is a standardized image compression mechanism. *JPEG* stands for Joint Photographic Experts Group, is the most common image format used by digital cameras and other photographic image capture devices; along with JPEG/JFIF

- **GIF,** or **Graphic** Interchange *Format*, is a **file extension** for an often animated raster graphics file and is the second most common **image format** used on the World Wide Web after JPEG.

- *PNG* was created as an improved, non-patented replacement for *Graphics* Interchange *Format* (GIF), and is the most widely used lossless image compression

- **Tagged** *Image File Format,* abbreviated *TIFF* or *TIF*, is a computer *file format* for storing raster graphics images, popular among graphic artists, the publishing industry, and photographers.

The images or pictures are captured or taken by different tools such as digital camera, those mobile phones, scanners etc. ,But those tools are different according to their parts and function.

The images are taken by different devices such as digital camera, mobile telephone, scanner etc.

A digital camera and a mobile telephone are devices which produce digital images that can be stored in a computer and displayed on screen while a scanner is an electronic device which can capture images from physical items (printed text, handwriting, photographic prints, posters, magazine pages, and similar sources) and convert them into digital formats, which in turn can be stored in a computer, and viewed or modified using software applications.

Computer graphics can be applied in various areas such as:

Computer-Aided Design: In engineering and architectural systems, the products are modeled using computer graphics commonly referred as CAD (Computer Aided Design)

Computer Art: A variety of computer methods are available for artists for designing and specifying motions of an object

Entertainment: Computer graphics methods are widely used in making motion pictures, music videos and television shows. Graphics objects can be combined with live actions or can be used with image processing techniques to transform one object to another.

Education and training: Computer graphics can make better the understanding of the functioning of a system. In physical systems, biological systems, population trends, etc., models make it easier to understand.

Image processing: Image processing provides techniques to modify or interpret existing images

Graphical User Interface: GUI is commonly used to make a software package more interactive. There are multiple window systems, icons, menus, which allow a computer setup to be utilized more efficiently.

Logo: (Abbreviation of logotype, from Greek: is a graphic mark, emblem, or symbol used to aid and promote public recognition

Advertising: It is communicated through various mass media, including traditional media such as newspapers, magazines, television, radio, outdoor advertising or direct mail; and new media such as search results, blogs, social media, websites or text messages

An illustration: It is a decoration, interpretation or visual explanation of a text, concept or process, designed for integration in published media, such as posters, flyers, magazines, books, teaching materials, animations, video games and films.

A magazine: It is a publication, usually a periodical publication, which is printed or electronically published computer graphics is mostly mastered by practicing; such as by writing and testing programs that produce a variety of pictures. An environment that allows one to write and execute programs is required. The environment should generally include hardware for display of pictures, and software tools that written programs can use to perform the actual drawing of pictures. There is commonly used software for producing graphics.

Software examples are such as follows:

i. MICROSOFT PAINT

Microsoft Paint or 'MS Paint' is a basic graphics/painting utility that is used to draw, colour and edit pictures, including imported pictures from a digital camera.

ii. MICROSOFT OFFICE PICTURE MANAGER

Microsoft Office Picture Manager (code named Microsoft Picture Library) is a raster graphics editor. With Microsoft Office Picture Manager, you can manage, edit, share, and view your pictures from where you store them on your computer. There are picture editing tools to crop, expand, or copy and paste.

iii. ADOBE PHOTOSHOP

Adobe Photoshop is the predominant photo editing and manipulation software on the market. Its uses range from full featured editing of large batches of photos to creating intricate digital paintings and drawings that mimic those done by hand.

In computer graphic, there are pictures and other images that accompany a piece of text to improve its meaning for the reader, this is called graphic features. Some examples of graphic features include **photographs, drawing, maps, charts and diagrams.** While graphic features may sometimes be purely decorative, they are more often used to make the meaning of a text clearer

Graphic elements are the simplest building blocks of graphics. Graphic elements examples are:

- **Line** is probably the most fundamental of all the elements of design
- **The polygon** element defines a closed shape consisting of a set of connected straight line segments. The last point is connected to the first point.
- **The circle** is a perfect shape, meaning that it is the same no matter how you look at it
- **An oval** is a closed curve in a plane which "loosely" resembles the outline of an egg. The term is not very specific, but in some areas it is given a more precise definition, which may include either one or two axes of symmetry
- **A rectangle** is a plane figure with four straight sides and four right angles, especially one with unequal adjacent sides, in contrast to a square.

12.7 Additional information for teachers

Before starting teaching, teachers should make sure all needed materials are available for all students on time, which means that no student should be excluded during teaching and learning process. The teachers should be active by facilitating learners when students will be doing different activities be it learning or application activities.

The teacher should as well call upon to every learner to participate actively by giving views, ask questions where and when necessary. The teachers should apply different teaching techniques such as game, role play, etc. in order to encourage and bring all learners to attend the course.

Being motivated and being in good atmosphere; teachers should always appreciate every student's contribution and work and correct positively wrong answers by explaining, demonstrating and applying what would be the right ones.

12.8 END UNIT ASSESSMENT

Answer the questions of end unit assessment

1.Written assessment

1.

- **A brush** is a tool with bristles, wire or other filaments, used for cleaning, grooming hair, make up, painting, surface finishing and for many other purposes.

- **A shape** is the form of an object or its external boundary, outline, or external surface, as opposed to other properties such as color, texture or material composition

- **Lasso tool** it is used to create a selection area within or around a particular object

- **Bitmap; Bitmap) Graphics;** are pixel based graphics and can be modified individually.

- *Advertisement* is communicated through various mass media, including traditional media such as newspapers, magazines, television, radio, outdoor advertising or direct mail; and new media such as search results, blogs, social media, websites or text messages

  e) i b ;   ii e;   iii a;   iv d;   v c;

3. **The polygon** element defines a closed shape consisting of a set of connected straight line segments. The last point is connected to the first point. Example: hexagon

4. In decoration service, computer graphics can be used in photo of different ceremonies, in house decoration…

5. **-JEPG** Joint Photographic Experts Group; JPEG is compressed in a way that loses some of the image details during the compression in order to make the file small (and thus called "lossy" compression).

-TIFF; Tagged Image File Format. TIFF images create very large file sizes. TIFF images

are uncompressed and thus contain a lot of detailed image data (which is why the files are so big)

- **PNG** stands for Portable Network Graphics. It was created as an open format to replace GIF, because the patent for GIF was owned by one company and nobody else wanted to pay licensing fees. It also allows for a full range of color and better compression.

6.8-bit color graphics is a method of storing image information in a computer's memory or in an image file, such that each pixel is represented by one (8-bit) byte while **16-bit color graphics** also called High color is a method of storing image information in a computer's memory or in an image file where computerand monitors can display as many as 216=65,536 colors, which is adequate for most uses

7. **USB porton digital camera** is used to import pictures from digital camera to computer by using USB cable.

 8. **2D (2Dimensional)** images are objects that are rendered visually on paper, film or on screen in two planes representing width and height (X and Y) while3D computer graphics or three-dimensional computer graphics, (in contrast to 2D computer graphics) are graphics that use a three-dimensional representation of geometric data (often Cartesian) that is stored in the computer for the purposes of performing calculations and rendering 2D image

9. Adobe Photoshop is the predominant photo editing and manipulation software on the market. Its uses range from full featured editing of large batches of photos to creating intricate digital paintings and drawings that mimic those done by hand while The primary features of MS Paint are simple drawing tools that you can use to easily draw on a blank canvas or existing image.

2. Practical work

The practical work can be done in pairs. Students should have knowledge and skills of editing tools in those graphics software obtained in previous lessons. They must know how to use digital camera in taking photo and importing photo from digital camera to computers.

For doing the practical work, Ms- Paint, Ms Office picture manager and Photoshop must be installed in computers of school computer lab.

12.9 Additional activities

12.9.1 Remedial activities

1. Define computer graphic

> Answer of this question refer to section 12.1 in student book

2. What does mean computer resolution?

 Section 12.2 contains the definitions of computer graphic terms.

3. Differentiate digital camera to scanner

Answer of this question is referred to lesson 12.2

4. List examples where computer graphics is applied

Advertisement, entertainment, illustration, service decoration

12.9.2 Consolidation activities

1. Give the characteristic of bitmap graphic

Answer:

- The images are easy to edit in memory and display on TV monitors due to the arrangement of the pixels in a rectangular array.
- The image size is determined on the basis of image resolution.
- These images cannot be scaled easily; resizing do not work very well and can significantly distort the image.
- Bitmap graphics are used for general purpose images and in particular photographs.

2. What is the use lasso tool?

Answer:

Lasso tool it is used to create a selection area within or around a particular object.

3. Write in full words the following abbreviations:

-LCD : Liquid Crystal Display

-DSLR : Digital single-lens reflex

-PNG : Portable Network Graphics

-TIFF: Tagged Image File Format

-CAD: Computer Aided Design

4. Now days, youth like posting their nakedness pictures on social media. Discuss the inconvenient.

5. Use Paint to create the following effects:

Draw a picture of some people stick figures. Be creative! The figure bellow is an example:
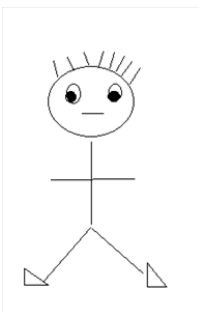
12.9.3 Extended activities

1. Complete the following picture

Answers is:

    1. Scanner cover

    2.Carriage

    3.Document table

UNIT 13: MULTIMEDIA

13. 1.Key unit competence:

To be able to explain the different use of multimedia and interactive multimedia applications and to use multimedia software to create audio and video

13.2. Prerequisite knowledge and skills:

Students should have some knowledge and skills related to computer Multimedia and to create audio and animated images or video.

13.3. Cross-cutting issues to be addressed:

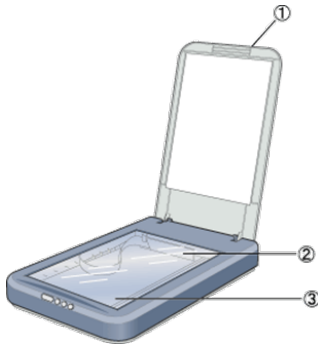- **Financial Education:** To be covered when the students know to use different software to edit audio/ video and by creating power point animation for being lose money when they want to record music or to edit any audio/ Video record.

- **Standardization Culture:** Students must be familiar with the culture of Rwandans presented in the industry of music.

- **Gender education:** Mixing boys and girls in groups when they do practical activity

- **Peace and Values Education:** They must also know that copying a video or audio song without the owner permission is prohibited and punishable by the law.

13.4 Guidance on the introductory activity

Instruction to do the introductory activity

- This activity takes place in the computer lab where each students responds to activity in introductory activity related to music, film.

- Teacher instructs students to view the page where figure 13.1 is in Student Book.

- The teacher asks students to do the introductory activity in their respective groups.

- The teacher moves around to see how students are working.

- The teacher may ask some questions to boost the students.

- The teacher guides students to list the different materials needed to do presentation

• The teacher guides students in the creation of power point presentation and inserting an audio sound.

13.5. List of lessons (including assessment)

#	Lesson title	Learning objectives (from the syllabus including knowledge, skills and attitudes):	Number of periods
1	Introduction to Multimedia	• Define what multimedia is with different types of Multimedia and their applications	2
2	Interactive Multimedia: PowerPoint Presentation	• Create an interactive power point presentation	3
3	Creating action Buttons	• In a created PowerPoint presentation, create different action buttons	2
4	Digital Audio recording	• Describe how to record an audio sounds by using different tools • Use different software to create an audio sounds	2
5	Digital audio editing	• Use different software to create an audio sounds and edit sound	2
6	Digital video recording	• Describe how to record a video by using different tools • Use different software to create an animated image and inserting an audio sound	2
7	Video editing	Describe different steps to edit video Define different tools to create animation in	3
8	Morphing	Use different software to reshape object, images or pictures	2

LESSON 1: INTRODUCTION TO MULTIMEDIA

(Periods: 80 minutes)

a) Prerequisites/Revision/Introduction:

By asking some questions from previous lesson "Computer graphics" and Learning activity 13.1, teacher introduces the lesson. Students visit the school computer lab and watch the music from computer. The teacher asks students to take notes of what they observed and reply to the questions in the activity. Teacher helps students to understand the definition of multimedia, the types of multimedia and their applications.

b) Teaching resources:

• Computer lab

• Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students in pairs in order to do learning activity.

- Learners observe the figure 13.1 and respond to questions asked in learning activity 13.1.

- Teacher walks around and sees if students are doing activity.

- Students share their answers in presentation.

- Students react on the finding/answers from others

- Teacher corrects false answers and completes the half corrected answers

- Teacher summarizes the contents (Note in students book)

- Teacher gives the instructions on how to do Application activity 13.1 at the end of the lesson

Answers of activity 13.1

1&2. In a group of five students, students discuss the definition asked in Question1 and applications of multimedia asked in question 2

3. Using internet connection, Students search from internet and discuss the different software used in multimedia.

d) Application activity

Answers of application activity 13.1

1.Refer to the student book 13.1 about introduction to multimedia, student provides the definition of multimedia.

2. Refer to the student book 13.1.3 about Hardware and software requirements students provide answers to the asked question.

3. Multimedia has many benefits in real life namely.

1. **Multimedia enables students to represent information using several different media.**

This proves to be helpful when students need to do their project. By using multimedia elements, they can present their project in a much more creative ways. Moreover, multimedia approach also provide flexibility of where and when can they learn. This is because by using multimedia approach such as audio and video, student can record or make connection with one another for discussion or listening to the previous topic that they have recorded. Multimedia approach also helps the students to develop a higher order thinking skills.

2. **Multimedia helps in deeper understanding**

According to research, a benefit of multimedia learning is that it takes advantage of the brain's ability to make connections between verbal and visual representations of content, leading to a deeper understanding, which in turn supports the transfer of learning to other situations.

3. Multimedia improves problem solving

A large percentage of the human brain dedicates itself to visual processing. Thus, using images, video and animations alongside a text stimulates the brain. Student attention and retention increase. Under these circumstances, in a multimedia learning environment, students can identify and solve problems more easily compared to the scenario where teaching is made possible only by textbooks.

4. Multimedia increases positive emotions

According to psychologist Barbara Fredrickson, experiencing positive emotions makes people see more possibilities in their lives. Using multimedia during instructions impacts student's mood during the learning process. With a positive attitude they learn better and tend to be more proactive.

5. It helps in accessing to a vast variety of information

With computers, tablets, smartphones and the internet, students are today better equipped than ever to search and find the information they need. Sharing the information and participating in class discussions is done in a more confident way when access to information is as easy as today.

6. It helps in World exploration

With the help of multimedia children can explore and learn about places they would never been to. In a geography class, students can explore different cities of the world, the tallest mountains and the most dangerous jungles. In a science class, space and planets exploration is now possible. In a biology class, the dissection of rare animals and different habitats exploration are like a walk in a park for students benefiting of a multimedia learning environment.

LESSON 2: Interactive Multimedia: PowerPoint Presentation

(periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Learning activity 13.2 is used to introduce the lesson. In computer Lab, Teacher asks students to create PowerPoint presentation and try to create Hyperlinks in the same presentation. By using technical explanations teacher helps students to understand Hyperlink and how to create it in PowerPoint presentation.

b) Teaching resources:

- Computer lab and audio and video editing software
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- • Teacher organizes students in pairs in order to do learning activity.
- • Learners open PowerPoint, and create different presentations in their computers
- • Students in pairs, discuss the processes of inserting sound in the PowerPoint presentation and hyperlinks.
- • Teacher walks around and sees if students are doing activity.
- • Students share their answers in presentation.
- • Students react on the finding/answers from others
- • Teacher summarizes the contents (Note in students book)
- • Teacher gives the instructions on how to do Application activity 13.2.
- • Teacher corrects false answers and completes the half corrected ones
- • Students do Application activity 13.2

Answers of activity 13.2

i. In a group of five, students discuss how to define Hyperlinks

ii. After discussing the definition of hyperlinks, students try to find out the steps to create hyperlinks in PowerPoint presentation. They can also refer to 13.2.1.

d) application activity 13.2

Answer: 1. all students will try to provide answers to the Application activities 13.2 referred to the different steps discussed in the student book, subtitle 13.2.1 PowerPoint presentation. By guidance of the teacher, students try to create Hyperlink in the same power point presentation, in another presentation and hyperlink to an email and how to protect hyperlinks from hacking

LESSON 3: CREATING ACTION BUTTONS

2periods: 80minutes

a) Prerequisites/Revision/Introduction:

Learning activity 13.3 introduces the lesson. They have also prerequisites acquired in lesson 2. Teacher asks students what they have learnt in previous lessons 1 and 2. From answers given by students, teacher introduce the activity, the objective of the activity is to help the students to understand how to create different action buttons in PowerPoint presentation.

b) Teaching resources:

- • Computer lab and flash disk, CD, DVD
- • Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher asks students to form groups and to do the Learning Activity 13.3
- Students elect the group leader to create action buttons
- The teacher lets the students work independently on the activity.
- Teacher walks around and sees if students are doing activity in their respective groups.
- The teacher guide students by showing different steps to create action buttons in power point.
- Teacher summarizes the contents (Note in students book)
- Teacher gives the instructions on how to do Application activities 13.3

Answers of activity 13.3

In this activity, students provide answers to question 1, 2 and 3. By defining action button and where it can be used, teacher guide students to follow different steps to create different action button in power point presentation where there is attachment of audio sound.

d) Answers of application activity 13.3

By following different steps listed in student book, 13.3, students provide answers to the asked questions in the application activity 13.3

LESSON 4: DIGITAL AUDIO RECORDING

periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Introduce the lesson using what students have seen in previous lesson. By using the learning 13.4, facilitate students to understand the process of digital audio recording.

b) Teaching resources:

- Computer lab, flash disk, CD, DVD, Digital camera, smartphone,
- Internet

c) Learning activities

Guidance

- Teacher organizes students to form groups of five students and record an audio sound using smart phone or digital camera.
- In computer lab, teacher guides students to export a recorded audio sound from camera/ smartphone to the flash disk/CD/DVD, etc.
- In groups, students listen to an imported audio sound and identify where it is sounding well and wrong.
- Teacher walks around and sees if students are doing activity in their respective group.

- The teacher may ask some questions to boost the students.
- Teacher corrects false answers and completes the half corrected ones
- Teacher summarizes the contents.

Answer of learning activity 13.4

Let students do activity by defining a Digital audio and help them to different audio sound formats after recording the sound in Question 1 and 2. In this activity, by guidance of the teacher, students will discuss how to record a video sound by using Digital Camera, Smart phone and other related available materials.

d) Application activity 13.4

Question1:

All formats of audio sound are the best for specific role, the following are audio formats with their specific roles.

- Use WAV for uncompressed audio and when you are working with audio.
- Use OGG for compressed audio and for distributing audio over the net.
- Use FLAC for personal music collections or alternatively lossless audio distribution over the net.

Question2: The five musical instruments are:

Trumpet, French horn, Indefinite pitch, Bowed Strings. Students search for the function of each of these instruments.

LESSON 5: DIGITAL AUDIO SOUND EDITING

periods: 120minutes

a) Prerequisites/Revision/Introduction:

Introduce the lesson using what students have seen in previous lessons. Take students in the computer lab. By using the answers of activity 13.5, teacher asks the students to record an audio sound using Digital Camera or Smartphone etc.

b) Teaching resources:

- Computer lab, CD, flash disk, Digital Camera, Smartphone
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students in groups in order to do learning activity.
- Students in groups, discuss the technic and processes used to record an Audio sound.
- Teacher walks around and sees if students are doing activity.

- Students share their answers in presentation.

- Students react on the finding/answers from others

- Teacher corrects false answers and completes the half corrected

- Teacher summarizes the contents (Note in students book)

- Teacher gives the instructions on how to do Application activity 13.5

Answer of learning activity 13.5

Let students do activity and help them to define what audio sound editing is in question 1.

In Question 2, students try to list different software used to edit video sound.

In question 3, student open one software editor and import a recorded audio sound. Teacher guides them to follow different steps when editing audio sound.

d) Answer of Application Activity 13.5

Following different steps discussed in Sub-unit **13.3.3**, students provide answers to the questions of activity **13.5**. this will be done in different points such as Fad in/ Out, crop, echo, increasing/decreasing volume, Reducing Noise, humming, remove vocals and Equalization as it is discussed in different steps in student book **13.3.3** point **a, b,c,d,e f,g, h,and i**

LESSON 6: DIGITAL VIDEO RECORDING

periods: 80 minutes

a) Prerequisites/Revision/Introduction:

Learning activity 13.6 is used to introduce the lesson. By recalling the previous lesson, students try to find out different Video formats and softwares used to edit video. With examples, students suggests some elements which can be based on in the preparation of video recording such as noise avoiding, camera with high definition, etc

b) Teaching resources:

- Computer lab, CD , DVD, Digital camera, Smart Phone
- Internet and textbooks to facilitate research

c) Learning activities:

Guidance

- Teacher organizes students in pairs in order to do learning activity.

- Students in groups, discuss the different format of Digital video

- Students in group discuss the appropriate area to shut up video recording

- Teacher walks around and sees if students are doing activity.

- Students share their answers in presentation.

- Students react on the finding answers from others and sharing ideas to additional
- Teacher corrects false answers, completes the half corrected answers and explains the process to shut up video.
- Teacher summarizes the contents (Note in student's book)

Answer of learning activity 13.6

Let students do activity and help them to list out different format of video sound in Question 1 and as it is asked in question 2, they discuss in groups how environment is prepared when shooting video sound.

d) Answer of application activity 13.6

Question1:

List of Video editing software and their functions:

1. OpenShot (Windows, Mac, and Linux)

OpenShot can create stunning videos, films, and animations with an easy-to-use interface and rich set of *features*

2.VideoPad (Windows & Mac): It supports drag-and-drop, effects, transitions, 3D video editing, text and caption overlay, video stabilization, easy narration, free built-in sound effects, and color control.

VideoPad can also change the video speed, reverse the video, burn DVDs, import music, and export movies to YouTube (and other similar sites) and a variety of resolutions (like 2K and 4K).

3.Freemake Video Converter (Windows): It is simple and easy to use editing features; it is what sets it apart from some of the more complex and confusing editors.

The program can be used to convert between video formats, rip video DVDs, create photo slideshows and music visualizations. It can also burn compatible video streams to DVD or Blu-ray Discs or upload them directly to YouTube

4.VSDC Free Video Editor (Windows): Some of things you can do is add lines, text, and shapes, as well as charts, animations, images, audio, and subtitles. Plus, as any good video editor should, VSDC can export videos to a variety of file formats.

5.iMovie (Mac: It offers many options for editing video and audio plus adding photos, music, and narration to your videos.

6.Movie Maker (Windows): Movie Maker was Window's free video editing software that comes pre-installed on a number of versions of Windows. You can use it to create and share high-quality movies.

LESSON 7: DIGITAL VIDEO EDITING

(Periods: 120 minutes)

a. Prerequisites/Revision/Introduction:

Learning activity 13.7 is used to introduce the lesson. With the help of previous lessons, students review what they learn in previous lesson related to format and software to edit video recorded. In computer lab students open editing software such as Adobe flash and observe the interface and try to define frame, Layers and video clips. Teacher helps students to create a video clip by animating a static image.

b. Teaching resources:

- Computer lab, flash disk, digital camera
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance

- Teacher organizes students in groups in order to do learning activity.
- Learners open adobe flash in computers and animate a static object
- Teacher walks around and sees if students are doing activity.
- Students share their answers in presentation by projecting the project they did.
- Students react on the findings/answers from others.
- Teacher corrects false answers and completes the half corrected answers
- Teacher summarizes the contents (Note in students book)
- At the end of this lesson, the teacher gives the instructions on how to do Application activity 13.7

Answer activity 13.7

Let students do activity 13.7. By doing research from internet students provide answers to the asked questions

In Question1, Students try to provide different answers about digital Video formats

In question 2, students provide definitions of the term Frame, Layer and video clips.

In question3, students provide the preparation which can be made before shooting a video sound. By guidance of the teacher, they open Adobe Flash and follow different steps to do animation of a static image.

d. Answers of application activity 13.7

Question 1: Refer to the student book 13.4.3 Introduction to Multimedia, student follow different steps listed and create animation of static objects. Create unwanted sound by setting different frames and layers using After effect software

LESSON 8: Morphing

(3 Periods: 120 minutes)

a. Prerequisites/Revision/Introduction:

Learning activity 13.8 is used to introduce the lesson. With help of previous lesson, students recall video format and software to edit video recorded. In computer lab students open editing software such as Adobe flash and observe the interface and try to define frame, Layers and video clips. By using technical explanations in steps teacher helps students to create a video clip by animating a static image.

b. Teaching resources:

- Computer lab, flash disk, digital camera
- Internet and textbooks to facilitate research

c. Learning activities:

Guidance

- Teacher organizes students in groups in order to do learning activity.
- Learners open after effect software in computers and reshape two different images in different layer.
- Teacher walks around and sees if students are doing activity.
- Students share their answers in presentation by projecting the project they did.
- Students react on the finding answers from others
- Teacher corrects false answers and completes the half corrected answers
- Teacher summarizes the contents (Note in students book)
- At the end of this lesson teacher gives the instructions on how to do Application activity 13.8 by guiding them on different steps to create morphing of an image
- Students do application activity 13.8

Answer of Activity 13.8

In **question 1,** students search from internet or provide the definition morphing in their own word.

Question2: by guidance of the teacher, students try to morph image of people or other image to an image of animal.

d. Answers of application activity 13.8

Question 1: Referred to the definition provided in student book, students suggest different definition of morphing.

Question2: Following different steps in student book in 13.4.4, teacher guides students to download two different images and change/ swap image of people to an image of animal using After effect software.

13.6. Summary of the unit:

Multimedia is the content that uses a combination of different content forms such as text, audio, images, animations, video and interactive content. Multimedia contrasts with media that uses only rudimentary computer displays such as text-only or traditional forms of printed or hand-produced material. Multimedia can be recorded and played, displayed, interacted with or accessed by information content processing devices, such as electronic devices, but can also be part of a live performance. **Multimedia devices** are electronic media devices used to store and experience multimedia content.

There are many types of multimedia as video games, print media, television and movies which applied in different domains like medicine, education, creative industries, entertainment and fine arts, journalism, mathematical research and in engineering. Hardware and software requirements are needed in multimedia see in student book **13.1.3a. and 13.1.3b**

Multimedia can be interacted using PowerPoint in Microsoft office package by creating different Hyperlinks such as H**yperlink in the same documents, Hyperlink in different documents, creating Hyperlink to the file** and **creating Hyperlink to email address** see different steps in student book 13.2.

In power point there is an option to add an audio sound which can be presented and to watch it, it is necessary to create an action buttons; different steps are discussed with their screenshot in student book **13.3, there is action button for playing, stopping, next and previous.**

There are two kind of multimedia which are audio sound and Video sound

13.7 Additional Information:

Multimedia is an industry of money making if it is done in legal conditions, the talented younger Ladies and gentlemen are benefit from this industry. But it can be done legally to human culture particularly to the Rwandan culture

13.8. End unit assessment

Question one: Advantages and disadvantages of Multimedia

1. This is a very user-friendly.

2. It is a multi-sensory. It uses the senses of many users, while the use of multimedia, such as hearings, sees and talk.

3. It is a comprehensive and interactive.

4. It is flexible. Digitalization, this media can easily be changed to adapt to different situations and audiences.

5. It can be used for a variety of audiences, ranging from one person to the whole group.

6. Creative Industries: the creative industries, including advertising, media and news, they use multimedia fun and interactive way to express their thoughts.

7. Marketing

8. Telecommunications industry

9. It can be used in the entertainment industry.

Disadvantages

1. Information overload. Because it is so easy to use, it can contain too much information only once.

2. It takes time to compile. Even if it is flexible, it needs time with the original draft.

3. It can be expensive.

Question two: A, multimedia production team may require as many as 18 discrete roles, including:

Executive Producer, Producer/Project Manager, Creative Director/Multimedia Designer, Art Director/Visual Designer, Artist, Interface Designer, Game Designer, Subject Matter Expert, Instructional Designer/Training Specialist, Scriptwriter, Animator(2-D/3-D), Sound Producer, Music Composer, Video Producer, Multimedia Programmer, HTML Coder, Lawyer/Media, Acquisition, Marketing Director.

Question Three: Answer

Follow different steps in student book 13.4.3

Question Four	How 2–D animations are classified?
	2–D animations are classified into two categories: They are
	1. Cel based animations
Answer	Cel–based animation consists of multiple drawings, each one a little different from the others. When displayed in rapid sequence, these drawings appear to move.
	13 Object based animation
	Object based animation is a form of stop motion **animation** that involves the **animated** movements of any non-drawn **objects** such as toys, blocks, dolls, etc. which are not fully malleable, such as clay or wax, and not designed to look like a recognizable human or animal character.
Question Five	What are the uses of hyperlinks?
Answer	The use of hyperlinks in multimedia makes it easier to search for and view related content.
	Such non–linear access to information definitely speeds–up the learning process and makes it more rewarding.
Question Six	What are the uses of Morphing and Warping?

	Most modern multimedia applications, particularly games, combine these techniques with virtual reality to create an environment in which gives the viewer the feeling that he is part of that environment.

13.9 ADDITIONAL ACTIVITIES

13.9.1Consolidation activities

- **Consolidation activities:** Suggestion of questions and answers for deep development of competences.

Question1: Explain different types of media.

Answer: types of media

1.Print Media

The term **'print media'** is used to describe the traditional or "old-fashioned" print-based media, including newspapers, magazines, books, and comics or graphic novels.

2. Television

Television (TV) is a telecommunication medium used for transmitting moving images in monochrome (black and white), or in colour, and in two or three dimensions and sound. The term can refer to a television set, a television program ("TV show"), or the medium of television transmission. Television is a mass medium for advertising, entertainment and news.

3. Movies

Movies, also known as **films**, are a type of visual communication which uses moving pictures and sound to tell stories or inform (help people to learn). People in every part of the world watch movies as a type of entertainment, a way to have fun.

4. Video Games

A **video game** is an electronic game that involves interaction with a user interface to generate visual feedback on a video device such as a TV screen or computer monitor

Question2: Define Hyperlink and state different steps to create Hyperlink in the same document

Answer:

A **hyperlink,** or simply a link, is a reference to data that the reader can directly follow either by clicking, tapping, or hovering. A **hyperlink** points to a whole document or to a specific element within a document. Hypertext is text with hyperlinks.

Steps to create Hyperlink

Step1: Select the image or text you want to make a hyperlink.

Step2: Right-click the selected text or image, then click **Hyperlink.**

Step3: The **Insert Hyperlink** dialog box will open. You can also get to this dialog box from the Insert tab by clicking **Hyperlink.**

Step4: If you selected text, the words will appear in the **Text to display** field at the top. You can change this text if you want.

See screenshot in **student book 13.2.1**

Question 3: What is action button? List different action buttons to play a CD

Action buttons are built-in button shapes you can add to a presentation and set to link to another slide, play a sound, or perform a similar action. When someone clicks or moves over the button, the selected action will occur.

Action buttons to play a CD

1. Action button for Previous media
2. Action button for next media
3. Action button for start or begin or play
4. Action button for end or stop

Question 4: What is Morphing?

A technique by which we can blend two or more images to form a new image is called as morphing.

13.9.2 Remedial activities

Remedial Activities: Suggestion of Questions and Answers for remedial activities for slow learners.

Question1: What is a multimedia device?

Multimedia devices are electronic media devices used to store and experience multimedia content.

Question 2.   What is multimedia?

 Answer   Multimedia is a technique that incorporates text, graphics, sound, animations and video elements.

Question 3.   What are the types of video compressions available?

 Answer   There are two types of video compressions. They are:

> Lossless compression: Retains the exact image throughout the compression.

> Lossy compression: Provides a comparatively higher ratio of compression but results in some loss of quality.

Question 4.   What is interactive multimedia?

   Answer   Multimedia applications that allow users to actively participate instead of

just sitting by as passive recipients of information are called interactive multimedia.

Question 5   **Mention the major uses of Multimedia?**

Answer   Multimedia is heavily used in the entertainment industry, especially to develop special effects in moves and animation for cartoon characters.

Multimedia games are a popular pastime and these are software programs available either as CD ROMs or online.

Some video games also use multimedia features.

Question 6.   **What is sound forge?**

Answer   We can add special effects, such as echo, fade in, and fade out effects, by using sound editing programs such as sound forge.

Question 7   **How is video recorded?**

Like sound, Video is also is also recorded and played back as an analog signal.

So, we have to convert the video signal into a digital format before including it in a multimedia application.

13.9.3 Extended activities answers
Extended activities: Suggestion of Questions and Answers for gifted and talented students.

UNIT 14: FILE HANDLING IN C++

14

14.1. Key unit competence:

Open, close, create a data file in C++ and read, write and append data to Files

14.2. Prerequisite knowledge and skills

Students should ideally have some knowledge and skills related to C++ programming language.

14.3. Cross-cutting issues to be addressed:

- **Inclusive education:** All students must get involved in class activities regardless of any kind of disability they may have.

- **Peace and value education:** Teacher insert this crosscutting in the program, projects or oral questions he/she asks in class especially when they have displaying opportunity.

- **Genocide studies:** Teacher insert this crosscutting in the program, projects or oral questions he/she asks in class especially when they have displaying opportunity.

14.4. Guidance on the introductory activity

Teacher will give introductory activity as homework to work for at least 3 days. Teacher must motivate learners to use library, internet or any other available resource to them that can help in coming up with adequate solutions.

14.5. List of lessons

#	Lesson title	Number of Periods
1	Introductory activity and Understanding files	1
2	Types of files	1

3		Introduction to file streams	1
4		Functions of File stream classes	1
		components of C++ to be used with file handling	
5		Text file operations: Reading operation	3
6		Text file operations: Writing operation	2
7	File	Binary file operations: Writing class object to binary file	2
8	streams	Binary File operations: Reading a binary file	2
		Functions for manipulating file pointers	
		Closing a file	
9		Application activities	3
10	End unit assessment		2
Total periods			18

Guidance on different lessons outlined above

LESSON 1: INTRODUCTION AND UNDERSTANDING FILES

Periods: 1

a) Prerequisites/Revision/Introduction:

Teacher will guide the student to recall files and how they are stored as learnt in senior six, unit 8.

b) Teaching resources, technics and methods

Student books, digital content, Projector

Teaching technics and methods:

- Learning activities can be done in groups (form group considering available resources, space and class size).
- Application activities should be done individually
- Teacher should ask flash questions to check if learners understand

c) Learning activities:

Guidance:

Learners will do activity 14.1 in group under teacher's guidance and facilitation and present the results.

Answers to learning activities:

1. Explain the types of files, see section 14.1.2
2. Provide one example of each file type, see section 14.1.1

3. Discuss the role of file name, see section 14.1.1

4. Differentiate text file from binary files, see section 14.1.2

d) Answers to application activities:

The assessment will be covered through carrying out the Application activity 14:1 and the teacher will help learners find appropriate answers by referring them to corresponding sections in the student book

LESSON 2: TYPES OF FILES

Periods: 1

a) Prerequisites/Revision/Introduction:

Teacher will guide the student to revise on text files as taught in previous lesson about the basic concepts of files.

b) Teaching resources, technics and methods

Student books, digital content, Projector

Teaching technics and methods:

- The corresponding application activity should be done individually
- Teacher should ask flash questions to check if learners understand

c) Learning activities:

Guidance:

Some Learning activities Learning activity 14.2 can be done in groups (form group considering available resources, space and class size).

Teacher will ask oral question about the concepts covered in class focusing on binary and text files.

Answers

Answers to application activity 14.1.:

The assessment will be covered through carrying out the Application activity 14:1 . For answers students look in the student book sections 14.1.1 and 14.1.2

LESSON 3: INTRODUCTION TO FILE STREAMS

Periods: 1

a) Prerequisites/Revision/Introduction:

Binary and text files as discussed in previous topics of this Unit

b) Teaching resources:

Books, Computers, C++ compiler, Projector

Teaching technics and methods: Individual work, Group work and Assignment

c) **Learning activities 14.2.:**

For answers to these activities from question 1 to 5 see section 14.2

LESSON 4: FUNCTIONS OF FILE STREAM CLASSES, COMPONENTS OF C++ TO BE USED WITH FILE HANDLING

Periods: 1

a) **Prerequisites/Revision/Introduction:**

Revision will be carried on **ifstream, ofstream, fstream**concepts as discussed in previous lesson.

b) **Teaching resources:**

Books, Computers, C++ compiler, Projector

Teaching technics and methods:

- Some learning activities can be done in group while others can be done individually.
- All application activities must be done individually.

c) Learning activities:

Students will discuss Four classes of IO and basic file operations, under 14.2.5

Assessment:

To internalize this concept, learner will do Application activity 14.3, Question 1-5

LESSON 5: TEXT FILE OPERATIONS: READING OPERATION

Periods: 3

a) **Prerequisites/Revision/Introduction:**

Revision can be done on writing programs involving ifstream, ofstream, fstream and others concepts covered before in this unit

b) **Teaching resources:**

Books, Computers, C++ compiler, Projector

Teaching technics and methods: Individual activities and Oral questions on insert syntax

Assessment:

See application activity 14.3, Question 6-12

LESSON 6: TEXT FILE OPERATIONS (WRITING OPERATION)

PERIOD: 2

a) **Prerequisites/Revision/Introduction:**

Teacher will guide the student to recall files using lesson 5 of this course

b) Teaching resources:

Library, student books, digital content, C++ compiler, Projector

Teaching technics and methods:

- Learning activities can be done in groups (form group considering available resources, space and class size).
- Application activities should be done individually
- Teacher should ask flash questions to check if learners understand

c) Learning activities:

There are activities given as examples in student book, which will be done under teachers supervision

d) Application activity:

See Application activity 14.4, Question 1-4

LESSON 7: BINARY FILE OPERATIONS

PERIOD: 2

a) Prerequisites/Revision/Introduction:

Teacher will guide the student to recall files concepts covered in lesson 6 of this topic

b) Teaching resources:

Library, student books, digital content, C++ compiler, Projector

Teaching technics and methods:

- Learning activities can be done in groups (form group considering available resources, space and class size).
- Application activities should be done individually
- Teacher should ask flash questions to check if learners understand

c) Learning activities:

There are activities given as examples in student book, which will be done under teachers supervision

d) Application activity

See Application activity 14.4, Question 5-9

LESSON 8: BINARY FILE OPERATIONS

(Reading a binary file functions for manipulating file pointers + closing file)

PERIOD: 2

a) Prerequisites/Revision/Introduction:

Teacher will guide the student to recall files concepts covered in lesson 7 of this topic

b) Teaching resources:

Library, student books, digital content, C++ compiler, Projector

Teaching technics and methods:

- Learning activities can be done in groups (form group considering available resources, space and class size).
- Application activities should be done individually
- Teacher should ask flash questions to check if learners understand

c) Learning activities:

There are activities given as examples in student book, which will be done under teachers supervision

Assessment:

See Application activity 14.4, Part 2: Question 1-6

LESSON 9: APPLICATION ACTIVITIES

PERIOD: 4

Application activity 14.2.:

1. Program to read text character by character in C++

```
#include<iostream>
#include<fstream>
usingnam-espacestd;
int main()
{
    charch;
    constchar *fileName="test.txt";

    //declare object
    ifstream file;

    //open file
    file.open(fileName,ios::in);
    if(!file)
    {
```

```
                cout<<"Error in opening file!!!"<<endl;
                return -1; //return from main
        }

        //read and print file content
        while (!file.eof())
        {
                file>>noskipws>>ch;     //reading from file
                cout<<ch;         //printing
        }
        //close the file
        file.close();

        return 0;
        }
```

Output

Hello friends, How are you?

I hope you are fine and learning well.

Thanks.

2. Write and read text in/from file

```
//C++ program to write and read text in/from file.
#include <iostream>
#include <fstream>
usingnamespacestd;
int main()
{
fstream file; //object of fstream class
  //opening file "sample.txt" in out(write) mode
file.open("sample.txt",ios::out);

if(!file)
  {
cout<<"Error in creating file!!!"<<endl;
return 0;
  }

cout<<"File created successfully."<<endl;
  //write text into file
file<<"ABCD.";
  //closing the file
```

```
file.close();

    //again open file in read mode
file.open("sample.txt",ios::in);

if(!file)
    {
cout<<"Error in opening file!!!"<<endl;
return 0;
    }

    //read untill end of file is not found.
charch; //to read single character
cout<<"File content: ";

while(!file.eof())
    {
file>>ch; //read single character from file
cout<<ch;
    }

file.close(); //close file

return 0;
    }
```

Output

File created successfully.

File content: ABCD.

3. Write and read variable's values in the file.

```
    //C++ program to write and read values using variables in/from file.
#include <iostream>
#include <fstream>
using namespace std;
 int main()
{
   char name[30];
   int age;
   fstream file;

   file.open("aaa.txt",ios::out);
   if(!file)
   {
```

```
        cout<<"Error in creating file.."<<endl;
        return 0;
    }
    cout<<"\nFile created successfully."<<endl;

    //read values from kb
    cout<<"Enter your name: ";
    cin.getline(name,30);
    cout<<"Enter age: ";
    cin>>age;
    //write into file
    file<<name<<" "<<age<<endl;

    file.close();
    cout<<"\nFile saved and closed succesfully."<<endl;

    //re open file in input mode and read data
    //open file
    file.open("aaa.txt",ios::in);
    if(!file){
        cout<<"Error in opening file..";
        return 0;
    }
    file>>name;
    file>>age;

    cout<<"Name: "<<name<<",Age:"<<age<<endl;
    return 0;
}
```

OUTPUT

File created successfully.

Enter your name: Mike

Enter age: 21

File saved and closed successfully.

Name: Mike, Age: 21

4.Write and read object values in the file using read and write function.

```
//C++ program to write and read object using read and write function.
#include <iostream>
#include <fstream>
using namespace std;
//class student to read and write student details
```

```cpp
class student
{
private:
char name[30];
int age;
public:
voidgetData(void)
{ cout<<"Enter name:"; cin.getline(name,30);
cout<<"Enter age:"; cin>>age;
    }
voidshowData(void)
    {
cout<<"Name:"<<name<<",Age:"<<age<<endl;
    }
};
int main()
{
student s;
ofstream file;
   //open file in write mode
file.open("aaa.txt",ios::out);
if(!file)
   {
cout<<"Error in creating file.."<<endl;
return 0;
   }
cout<<"\nFile created successfully."<<endl;
   //write into file
s.getData();   //read from user
file.write((char*)&s,sizeof(s));   //write into file
file.close();  //close the file
cout<<"\nFile saved and closed succesfully."<<endl;

   //re open file in input mode and read data
   //open file1
ifstream file1;
   //again open file in read mode
file1.open("aaa.txt",ios::in);
if(!file1){
cout<<"Error in opening file..";
return 0;
   }
   //read data from file
```

```
file1.read((char*)&s,sizeof(s));
   //display data on monitor
s.showData();
   //close the file
file1.close();
return 0;
}
```

Output

```
File created successfully.
Enter name:Mike
Enter age:21

File saved and closed succesfully.
Name:Mike,Age:21
```

5.tellg() and tellp() example in c++
```
//C++ program to demonstrate example of tellg() and tellp() function.
#include <iostream>
#include <fstream>
using namespace std;
int main()
{
fstream file;
   //open file sample.txt in and Write mode
file.open("sample.txt",ios::out);
if(!file)
   {
cout<<"Error in creating file!!!";
return 0;
   }
   //write A to Z
file<<"ABCDEFGHIJKLMNOPQRSTUVWXYZ";
   //print the position
cout<<"Current position is: "<<file.tellp()<<endl;
file.close();

   //again open file in read mode
file.open("sample.txt",ios::in);
if(!file)
   {
cout<<"Error in opening file!!!";
return 0;
```

```
    }
cout<<"After opening file position is: "<<file.tellg()<<endl;
    //read characters untill end of file is not found
charch;
while(!file.eof())
    {
cout<<"At position : "<<file.tellg();   //current position
file>>ch;  //read character from file
cout<<" Character \""<<ch<<"\""<<endl;
    }
    //close the file
file.close();
return 0;
    }
```

Output

```
    Current position is: 26
    After opening file position is: 0
    At position : 0 Character "A"
    At position : 1 Character "B"
    At position : 2 Character "C"
    At position : 3 Character "D"
    At position : 4 Character "E"
    At position : 5 Character "F"
    At position : 6 Character "G"
    At position : 7 Character "H"
    At position : 8 Character "I"
    At position : 9 Character "J"
    At position : 10 Character "K"
    At position : 11 Character "L"
    At position : 12 Character "M"
    At position : 13 Character "N"
    At position : 14 Character "O"
    At position : 15 Character "P"
    At position : 16 Character "Q"
    At position : 17 Character "R"
    At position : 18 Character "S"
    At position : 19 Character "T"
    At position : 20 Character "U"
    At position : 21 Character "V"
    At position : 22 Character "W"
    At position : 23 Character "X"
    At position : 24 Character "Y"
    At position : 25 Character "Z"
```

Application Activity 14.3.:

```
1. #include <iostream.h>
#include <fstream.h>
void main(void)
{
   fstreamdataFile; // Declare file stream object
   charfileName[81];
   cout<< "Enter the name of a file you wish to open\n";
   cout<< "or create: ";
   cin.getline(fileName, 81);
   dataFile.open(fileName, ios::out);
   cout<< "The file " <<fileName<< " was opened.\n";
}
```

Output:

Enter the name of a file you wish to open

or create: **mystuff.dat [Enter]**

The file mystuff.dat was opened.

```
2. #include <iostream.h>
#include <fstream.h>
void main(void)
{
   fstreamdataFile("names.dat", ios::in | ios::out);
   cout<< "The file names.dat was opened.\n";
}
```

Output:

The file names.dat was opened.

```
3.#include <iostream.h>
#include <fstream.h>
void main(void)
{      fstreamdataFile;
       dataFile.open("testfile.txt", ios::out);
       if (!dataFile)
       {
              cout<< "File open error!" <<endl;
              return;
       }
       cout<< "File was created successfully.\n";
       cout<< "Now closing the file.\n";
       dataFile.close();
}
```

Output:

File was created successfully.

Now closing the file.

```
4.#include <iostream.h>
    #include <fstream.h>
    void main(void)
    {
       fstreamdataFile;
       char line[81];
       dataFile.open("demofile.txt", ios::out);
       if (!dataFile)
       {
               cout<< "File open error!" <<endl;
               return;
       }
    cout<< "File opened successfully.\n";
       cout<< "Now writing information to the file.\n";
       dataFile<< "Jones\n";
       dataFile<< "Smith\n";
       dataFile<< "Willis\n";
       dataFile<< "Davis\n";
       dataFile.close();
       cout<< "Done.\n";
    }
5.#include <iostream.h>
   #include <fstream.h>
   void main(void)
   {
       fstreamdataFile;
       dataFile.open("demofile.txt", ios::out);
       dataFile<< "Jones\n";
       dataFile<< "Smith\n";
       dataFile.close();
       dataFile.open("demofile.txt", ios::app);
       dataFile<< "Willis\n";
       dataFile<< "Davis\n";
       dataFile.close();
   }
```

Output to Filedemofile.txt:

```
    Jones
    Smith
    Willis
    Davis
```

6. Program to create a binary file 'student.dat' using structure.

```
    1.#include<fstream.h>
    struct student
```

```
{
char name[15];
float percent;
};
void main()
{
ofstreamfout;
charch;
fout.open("student.dat", ios::out | ios:: binary);
clrscr();
student s;
if(!fout)
{
cout<<"File can't be opened";
exit(0);
}
do
{ cout<<"\n
enter name of student";
gets(s);
cout<<"\n enter percentage";
cin>>percent;
fout.write((char *)&s,sizeof(s)); // writing a record in a student.dat file
cout<<"\n more record y/n";
cin>>ch;
}while(ch!='n' || ch!='N');
fout.close();
}
```

7. Program to read a binary file 'student.dat' display records on monitor.

```
#include<fstream.h>
struct student
{
char name[15];
float percent;
};
void main()
{
ifstream fin;
student s;
fin.open("student.dat",ios::in | ios:: binary);
fin.read((char *) &s, sizeof(student)); //read a record from file 'student.dat'
while(file)
{
```

```
    cout<<s.name;
    cout<<"\n has the percent: "<<s.percent;
    fin.read((char *) &s, sizeof(student));
    }
    fin.close();
    }
```

8. // **This program writes information to a file, closes the file,then reopens it and appends more information.**

```
    #include <iostream.h>
    #include <fstream.h>
    void main(void)
    {
        fstreamdataFile;
        dataFile.open("demofile.txt", ios::out);
        dataFile<< "Jones\n";
        dataFile<< "Smith\n";
        dataFile.close();
        dataFile.open("demofile.txt", ios::app);
        dataFile<< "Willis\n";
        dataFile<< "Davis\n";
        dataFile.close();
    }
```

Output:

```
    Jones
    Smith
    Willis
    Davis
```

iv. Program to write, read time in from binary file in C++

```
    #include <iostream>
    #include <fstream>
    #include <iomanip> //for setfill() and setw()

    usingnamespacestd;

    #define FILE_NAME "time.dat"

    //function to write time into the file
    voidwriteTime(int h, int m, int s){
        charstr[10];
        fstream file;
        file.open(FILE_NAME, ios::out|ios::binary);

        if(!file){
```

```cpp
            cout<<"Error in creating file!!!"<<endl;
            return;
    }
    //make string to write
    sprintf(str,"%02d:%02d:%02d",h,m,s);

    //write into file
    file.write(str,sizeof(str));
    cout<<"Time "<<str<<" has been written into file."<<endl;

    //close the file
    file.close();
}
//function to read time from the file
voidreadTime(int *h,int *m, int *s){

    charstr[10];
    intinH,inM,inS;

    fstreamfinC;
    finC.open(FILE_NAME,ios::in|ios::binary);
    if(!finC){
            cout<<"Error in file opening..."<<endl;
            return;
    }
    if(finC.read((char*)str,sizeof(str))){
            //extract time values from the file
            sscanf(str,"%02d:%02d:%02d",&inH,&inM,&inS);
            //assign time into variables, which are passing in function
            *h=inH;
            *m=inM;
            *s=inS;
    }
    finC.close();
}
int main(){
    intm,h,s;

    cout<<"Enter time:\n";
    cout<<"Enter hour: ";    cin>>h;
    cout<<"Enter minute: "; cin>>m;
    cout<<"Enter second: "; cin>>s;
```

```
    //write time into file
    writeTime(h,m,s);

    //now, reset the variables
    h=m=s=0;

    //read time from the file
    readTime(&h,&m,&s);

    //print the time
    cout<<"The time is
  "<<setw(2)<<setfill('0')<<h<<":"<<setw(2)<<setfill('0')
<<m<<":"<<setw(2)<<setfill('0')<<s<<endl;
    return 0;
    }
```

Output

```
Enter time:
Enter hour: 10
Enter minute: 15
Enter second: 5
Time 10:15:05 has been written into file.
The time is 10:15:05
```

10. Program to write and read an object in, from binary file using write() and read() in C++

```
#include <iostream>
#include <fstream>
#define FILE_NAME "emp.dat"

usingnamespacestd;
//class employee declaration
class Employee {
private :
  int      empID;
  char     empName[100] ;
  char     designation[100];
  int      ddj,mmj,yyj;
  int      ddb,mmb,yyb;
public  :
  //function to read employee details
  voidreadEmployee(){
        cout<<"EMPLOYEE DETAILS"<<endl;
        cout<<"ENTER EMPLOYEE ID : " ;
        cin>>empID;
```

```cpp
        cin.ignore(1);
        cout<<"ENTER  NAME OF THE EMPLOYEE : ";
        cin.getline(empName,100);

        cout<<"ENTER DESIGNATION : ";
        cin.getline(designation,100);

        cout<<"ENTER DATE OF JOIN:"<<endl;
        cout<<"DATE : "; cin>>ddj;
        cout<<"MONTH: "; cin>>mmj;
        cout<<"YEAR : "; cin>>yyj;

        cout<<"ENTER DATE OF BIRTH:"<<endl;
        cout<<"DATE : "; cin>>ddb;
        cout<<"MONTH: "; cin>>mmb;
        cout<<"YEAR : "; cin>>yyb;
  }
//function to write employee details
voiddisplayEmployee(){
        cout<<"EMPLOYEE ID: "<<empID<<endl
        <<"EMPLOYEE NAME: "<<empName<<endl
        <<"DESIGNATION: "<<designation<<endl
        <<"DATE OF JOIN: "<<ddj<<"/"<<mmj<<"/"<<yyj<<endl
        <<"DATE OF BIRTH: "<<ddb<<"/"<<mmb<<"/"<<yyb<<endl;
  }
};

int main(){

  //object of Employee class
  Employee emp;
  //read employee details
  emp.readEmployee();

  //write object into the file
  fstream file;
  file.open(FILE_NAME,ios::out|ios::binary);
  if(!file){
        cout<<"Error in creating file...\n";
        return -1;
  }

  file.write((char*)&emp,sizeof(emp));
```

```cpp
        file.close();
        cout<<"Date saved into file the file.\n";

        //open file again
        file.open(FILE_NAME,ios::in|ios::binary);
        if(!file){
                cout<<"Error in opening file...\n";
                return -1;
        }

        if(file.read((char*)&emp,sizeof(emp))){
                        cout<<endl<<endl;
                        cout<<"Data extracted from file..\n";
                        //print the object
                        emp.displayEmployee();
        }
        else{
                cout<<"Error in reading data from file...\n";
                return -1;
        }

        file.close();
        return 0;
}
```

Output

```
EMPLOYEE DETAILS
ENTER EMPLOYEE ID : 1001
ENTERNAME OF THE EMPLOYEE :Priya Kaushal
ENTER DESIGNATION : Student
ENTER DATE OF JOIN:
DATE : 21
MONTH: 11
YEAR : 2016
ENTER DATE OF BIRTH:
DATE : 15
MONTH: 09
YEAR : 1999
Date saved into file the file.
Data extracted from file..
EMPLOYEE ID: 1001
```

EMPLOYEE NAME: Priya Kaushal
DESIGNATION: Student
DATE OF JOIN: 21/11/2016
DATE OF BIRTH: 15/9/1999

11.

i) Statement 1 to position the file pointer to the appropriate place so that the data updation is done for the required item.

    File.seekp(File.tellg()-sizeof(stock);

    OR

    File.seekp(-sizeof(stock),ios::cur);

ii) Staement 2 to perform write operation so that the updation is done in the binary file.

      File.write((char *)&s, sizeof(s)); OR

      File.write((char *)&s, sizeof(stock));

2. Write C++ program that uses the file stream object's eof() member function to detect the end of the file.

Application Activity 14.4.

Part 1:

1. C++ program to write number 1 to 100 in a data file NOTES.TXT

```
#include<fstream.h>
int main()
{
    ofstreamfout;
    fout.open("NOTES.TXT");
    for(inti=1;i<=100;i++)
            fout<<i<<endl;
    fout.close();
    return 0;
}
```

2. C++ program, which initializes a string variable and outputs the string to the disk file

```
#include<fstream.h>

int main()
{
    ofstreamfout;
    fout.open("out.txt");
    charstr[300]="Time is a great teacher but unfortunately it kills
    all its pupils. Berlioz";
    fout<<str;
    fout.close();
    return 0;
}
```

3. User-defined function in C++ to read the content from a text file OUT.TXT, count and

---

display the number of alphabets present in it

```
void alphabets()
{
    ifstream fin;
    fin.open("out.txt");
    charch;
    int count=0;
    while(!fin.eof())
    {
            fin.get(ch);
            if(isalpha(ch))
                    count++;
    }
    cout<<"Number of alphabets in file are "<<count;
    fin.close();
}
```

4. User defined function in C++ to count the number of blank present in a text file named "OUT.TXT".

```
voidblankspace()
{
    ifstream fin;
    fin.open("out.txt");
    charch;
    int count=0;
    while(!fin.eof())
    {
            fin.get(ch);
            if(ch==' ')
                    count++;
    }
    cout<<"Number of blank spaces in file are "<<count;
    fin.close();
}
```

5. User defined function in C++ to count number of words in a text file named "OUT.TXT"

```
void countwords()
{
    if stream fin;
    fin.open("out.txt");
    char word[30];
    int count=0;
    while(!fin.eof())
```

```
{
        fin>>word;
        count++;
}
cout<<"Number of words in file are "<<count;
fin.close();
}
```

6. User defined function in C++ to print the count of word the as an independent word in a text file STORY.TXT

```
voidcountword()
{
  ifstream fin;
  fin.open("STORY.TXT");
  char word[30];
  int count=0;
  while(!fin.eof())
  {
        fin>>word;
        if(strcmpi(word,"the")==0)
                count++;
  }
  cout<<"Number of the word in file are "<<count;
  fin.close();
}
```

7. Function in C++ to count and display the number of lines not starting with alphabet 'A' present in a text file "STORY.TXT"

```
void countlines()
{
        ifstream fin;
        fin.open("STORY.TXT");
        charstr[80];
        int count=0;
        while(!fin.eof())
        {
                fin.getline(str,80);
                if(str[0]!='A')
                        count++;
        }
        cout<<"Number of lines not starting with A are "<<count;
        fin.close();
}
```

8. User defined function in C++ named copyupper(), that reads the file FIRST.TXT and creates a new file named SECOND.TXT contains all words from the file FIRST.TXT in

uppercase

```
voidcopyupper()
{
        ifstream fin;

        fin.open("FIRST.TXT");
        ofstreamfout;
        fout.open("SECOND.TXT");
        charch;
        while(!fin.eof())
        {
                fin.get(ch);
                ch=toupper(ch);
                fout<<ch;
        }
        fin.close();
        fout.close();
}
```

9. A C++ function, that reads the file FIRST.TXT and creates a new file named SECOND.TXT, to contain only those words from the file FIRST.TXT which start with a lowercase vowel

```
voidvowelwords()
{
        ifstream fin;
        fin.open("FIRST.TXT");
        ofstreamfout;
        fout.open("SECOND.TXT");
        char word[30];
        while(!fin.eof())
        {
                fin>>word;
                if(word[0]=='a'||word[0]=='e'||word[0]=='i'||word[0]=='o'||word[0]=='u')
                        fout<<word<<" ";
        }
        fin.close();
        fout.close();
}
```

Part 2:

1.i.

```
voiddrink_write(){
DRINKS DRI; // Declares the class object
fstreamafile; //Declare the file object
```

```
afile.open("Drink.dat",ios::app| ios::out| ios:: binary);// Open the data file
char ch='Y';
while(ch=='Y'){
DRI.getdrinks(); //Call the member function to input data
afile.write((char*)&DRI,sizeof(DRINKS));// write the data values
cout"*Do you enter more drinks <Y/N>:";
ch=toupper(getchar());
fflush(stdin);
}
afile.close();
```
ii.

```
DRINKS DRI; // Declares the class object
fstreambfile
bfile open("Drink.dat",ios::in | ios::binary); // open the data file
bfile.seekg(0,ios::beg); // pointed at the 0th location in data file
if(bfile) {
cout<<"File does not exist";
exit(1);
}
```

2. void display() { student s; ifstreami("stud.dat"); while(i.read((char*)&s,sizeof(s)))
{ if(s.retpercent()>=75) s.showdetails();
}
i.close();
}

3. void ONOFFER()
{
TOYS T;
ifstream fin; fin.open("TOYS.DAT", ios::binary); while(fin.read((char*)&T, sizeof(T)))
{ if(strcmp(T.SeeOffer(),"ON OFFER")==0)
T.View();
} fin.close(); //Ignore
}

4. void COSTLY()
{   GIFTS G;
ifstream fin("GIFTS.DAT",ios::binary);
while (fin.read((char *)&G,sizeof(G)))
    { if(G.GetPrice()>2000)
G.View();
    }   fin.close();
}

5. void Search ( ) {
Phone P; fstream fin;
fin. open ("phones. dat", ios: :binary| ios: :in); whi1e (fin.read((char*) &P, sizeof (P)))

```
{
if(P.GetCa11s () > 800)
P.Billing () ; }
fin.c1ose () ; // Ignore
}
```

6. *voidDisplayActive ( )*

```
{
USER U;
ifstream  fin;  fin.open ("USER.DAT",  ios::binary);        //OR  ifstream  fin ("USER.DAT",
ios::binary); while(fin.read((char*)&U, sizeof(U)))
{
if(U.Getstatus()=='A')
U.show( ); } fin.close( );
}
OR
voidDisplayActive()
{
USER U;
ifstream fin; fin.open ("USER.DAT", ios::binary);  //OR ifstream fin ("USER.DAT", ios::binary);
if (fin) {
fin.read((char*)&U, sizeof(U)); while(!fin.eof())
{ if (U.Getstatus( )=='A')
U.show( ) ;  fin.read((char*)&U, sizeof(U))
} fin.close( );
}
```

14.6 END UNIT ASSESSMENT

Periods: 2

1.

```
void Search()
{
Phone P;
fstream fin;
fin.open( "Phone.dat", ios::binary| ios::in);
while(fin.read((char *)&P, sizeof(P)))
{
if(p.GetCalls() >800)
p.Billing();
}
Fin.close(); //ignore
}};
```

2.

voidsearchbook(intbookno)

```
{ifstreamifile("BOOK.DAT",ios::in|ios::binary);
if(!ifile)
{cout<<"could not open BOOK.DAT file"; exit(-1);}
else
{BOOK b; int found=0;
while(ifile.read((char *)&b, sizeof(b)))
{if(b.RBno()==bookno)
{b.Display(); found=1; break;}
}
if(! found)
cout<<"record is not found ";
ifile.close();
}
}
```

3.

```
void TRANSFER()
{
fstream File1,File2;
Phonelist P;
File1.open("PHONE.DAT", ios::binary|ios::in);
File2.open("PHONEBACK.DAT", ios::binary|ios::OUT)
while(File1.read((char *)&P, sizeof(P)))
{ if( p.CheckCode( "DEL"))
File2.write((char *)&P,sizeof(P)); }
File1.close();
File2.close();
}
```

4. `voidAthletsList( )`
```
{   ifstream    fin("SPORTS.DAT',ios::in,  ios::binary););   ofstreamfout("ATHLETIC.DAT",
ios::out|ios::binary);
Sports S;
while(fin)          // or while(!fin.eof( ))
{   fin.read((char*)&S,sizeof(Sports));       if(strcmp(S.Event,"Athletics")= = 0)      fout.
write((char*)&S,sizeof(S));
}    fin.close( );    fout.close( );
}
```

5.

```
void COPYABC( )
{     ifstream     fin("TELEPHON.DAT',ios::in|ios::binary);     ofstreamfout("TELEBACK.
DAT",ios::out,ios|binary);
 Directory D;
```

while(fin) // or while(!fin.eof( ))
{
fin.read((char*)&D,sizeof(D));   if(D.CheckCode("123")= = 0)   fout.
write((char*)&D,sizeof(D));
} fin.close( ); fout.close( );
}

14.7. Additional activities

14.7.1 Remedial activities

1. Write a user defined function word_count() in C++ to count how many words are present in a text file named **"opinion.txt"**.

For example, if the file opinion.txt contains following text: Co-education system is necessary for a balanced society. With co-education system, Girls and Boys may develop a feeling of mutual respect towards each other.

The function should display the following:

Total number of words present in the text file are:

24 Ans) *void word_count()*
{ ifstreami;charch[20];int c=0;
i.open("opinion.txt "); while(!i.eof()) { i>>ch; c=c+1;
}
cout<<" Total number of words present in the text file are: "<<c;
}

2.Write function definition for DISP3CHAR() in C++ to read the content of a text file KIDINME.TXT, and display all those words, which have three characters in it.

Example:

If the content of the file KIDINME.TXT is as follows: When I was a small child, I used to play in the garden with my grand mom. Those days were amazingly funful and

I remember all the moments of that time

The function DISP3CHAR() should display the following:

was the mom and all the

Ans)

{   ifstream Fil;
Fil.open("KIDINME.TXT");
char W[20];   Fil>>W;   while(!Fil.eof()) // OR while(Fil)
*   { if (strlen(W)) == 3)   cout<<W<< " ";   Fil>>W;*
*   }*
Fil.close(); //Ignore
}

3. Write a function in C++ to count the no. of "He" or "She" words present in a text file

"STORY. TXT". If the file "STORY. TXT" content is as follows:

He is playing in the ground. She is Playing with her dolls.

The output of the function should be

Count of He/She in file: 2

Ans void COUNT ( )
```
{
ifstream Fil ("STORY.TXT");      char STR [10];      int count = 0;      while (!Fil.eof ( ))      {
Fil>>STR ;
if (strcmp (STR, "He") ==0 || strcmp (STR, "She") = =0)               count++;
    }
cout<<"Count of He/She in file : "<<count<<end1;
Fil.close( ); //Ignore
}
```

14.7.2 Consolidation activities

1.Write a definition for function COSTLY() in C++ to read each record of a binary file GIFTS.DAT, find and display those items, which are priced more than 2000. Assume that the file

GIFTS.DAT is created with the help of objects of class GIFTS, which is defined below:

```
class GIFTS {
intCODE;char ITEM[20]; float PRICE; public:
void Procure()
{ cin>>CODE; gets(ITEM);cin>>PRICE;
}
void View()
{ cout<<CODE<<":"<<ITEM<<":"<<PRICE<<endl;
} float GetPrice() {return PRICE;}
};
Ans) void COSTLY()
{    GIFTS G;
ifstream fin("GIFTS.DAT",ios::binary);      while (fin.read((char *)&G,sizeof(G)))
    {  if(G.GetPrice()>2000)
G.View();
    }     fin.close();
}
```

2. Assuming the class ANTIQUE as declared below, write a function in C++ to read the objects of ANTIQUE from binary file ANTIQUE.DAT and display those antique items, which are priced between 10000 and 15000.

```
class ANTIQUE {
int ANO;   char Aname[10]; float Price; public: void BUY( ) { cin>>ANO; gets(Aname);
cin>>price;
```

```
}
void SHOW( ) {cout<<ANO<<endl; cout<<Aname<<endl; cout<<Price<<endl;
} float GetPrice( )
{  return Price;
}
Answer)
void Search(float pr)
{
ifstreamifile("ANTIQUE.DAT",ios::in|ios::binary);    if(!file)
  {
cout<<"Could not open ANTIQUE.DAT file";      exit(0);   }
else
  {  ANTIQUE A;      int found=0;
while(!file.read((char *)&A,sizeof(A)))
    {        pr=A.GetPrice( );
if(pr>=10000 &&pr<=15000)
    {
A.SHOW( );
found=1;          break;
    }
    }
  }
if(found= =0)    cout<<"Given Price not Match";
}
```

14.7.3 Extended activities:

1.Given a binary file SPORTS.DAT,containg records of the following structure type:

```
struct Sports
{
char Event[20] ;   char Participant[10][30] ;
};
```

Write a function in C++ that would read contents from the file SPORTS.DAT and creates a file named ATHLETIC.DAT copying only those records from SPORTS.DAT where the event name is "Athletics".

Solution:

```
voidAthletsList( )
{   ifstream     fin("SPORTS.DAT',ios::in,  ios::binary););   ofstreamfout("ATHLETIC.DAT",
ios::out|ios::binary);
Sports S;
while(fin)         // or while(!fin.eof( ))
{  fin.read((char*)&S,sizeof(Sports));      if(strcmp(S.Event,"Athletics")= = 0)      fout.
write((char*)&S,sizeof(S));
```

```
}    fin.close( );    fout.close( );
}
```

2. Write a function in C++ to search for a BookNo from a binary file "BOOK.DAT", assuming the binary file is containing the objects of the following class. (MP108-09)

```
class BOOK
{intBno; char Title[20];
public:
intRBno( )
{   returnBno; } void Enter( )
{ cin>>Bno;gets(Title);
} void Display( ) {
cout<<Bno<<Title<<endl;
}};
Answer:
voidBookSearch()
{ fstream FIL;
FIL.open("BOOK.DAT",ios::binary|ios::in);
BOOK B;
intbn,Found=0; cout<<"Enter Book Num to search…"; cin>>bn;
while (FIL.read((char*)&S,sizeof(S)))  if (B.RBno( )==bn)
{        B.Display( );
         Found++;
}
if (Found==0) cout<<"Sorry! Book        not found!!!"<<endl;
FIL.close( );
}
```

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