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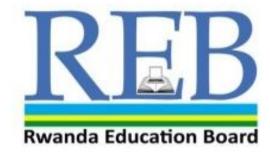
MINISTRY OF EDUCATION

Rwanda Education Board

COMPUTER SCIENCE SYLLABUS FOR COMBINATIONS

Computer –Economic-Mathematics(CEM)
Mathematics-Physics-Computer Science(MPC)

Kigali, 2015

COMPUTER SCIENCE SYLLABUS FOR COMBINATIONS

- **COMPUTER-ECONOMICS-MATHEMATICS (CEM)**

- **MATHEMATICS-PHYSICS-COMPUTER SCIENCE (MPC)**

Kigali, 2015

FOREWORD

The Ministry of Education of Rwanda is honoured to provide the syllabus which serves both as the official document and guide to competency-based teaching and learning and ensures that there is consistency and coherence in the delivery of the syllabus across all levels of general education in Rwandan schools.

The Rwandan education philosophy aims to ensure that young people at every level of education achieve their full potential in terms of relevant knowledge, skills and appropriate attitudes in order to prepare them to integrate into society and gain access to employment opportunities. In line with efforts to improve the quality of education, the government of Rwanda emphasises the importance of aligning the syllabus, teaching and learning and assessment approaches in order to ensure the system is producing the kind of citizens the country needs and desires. Many factors influence what children are taught, how well they learn and the competencies they acquire, particularly the relevance of the syllabus, the quality of teachers' pedagogical approaches, the assessment strategies and the instructional materials available. The ambition to develop a knowledge-based society and the growth of regional and global competition in the jobs market has necessitated the shift to a competency-based syllabus. With the help of the teacher, whose role is central to the success of the syllabus, learners will gain appropriate skills and be able to apply what they have learned in real life situations. Hence they will make a difference not only to their own lives but also to the success of the nation.

I wish to sincerely extend my appreciation to the people who contributed to the development of this document, particularly the REB and its staff who organised the whole process from its inception. Special appreciation goes to the development partners who supported the exercise throughout. Any comment or contribution would be welcome for the improvement of this syllabus.

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ACKNOWLEDGEMENT

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1. INTRODUCTION

1.1.Background to Curriculum review

The Computer science competence based curriculum is designed to develop learners' competences rather than just their knowledge. The syllabus focuses on what learners can do; to ensure their learning has greater purpose and is deeper than it would be otherwise. A competence-based curriculum is characterised by approaches that are largely learner-centred, criterion-referenced, constructivist, focused upon learning outcomes (rather than content definition) and have an emphasis on formative assessment.

The design of this competency based curriculum is to empower young Rwandans with solid foundation in Computing as well as to prepare future experts, engineers and specialists in Computer related fields by equipping them with relevant and modern computing competences through up-to-date technologies. Technology has developed and this has implication to update the syllabus to align the curriculum with recent technologies and different technological devices and their use in daily life. Learner are to develop computational competences earlier by learning knowledge, develop skills especially through practice in different tasks and projects as well as attitudes and values.

The design of this competency-based curriculum reflects recommendations and guides articulated in different government policies. Among others Education Sector Strategic Plan 2013 and Vision 2020 have been used to assist the elaboration of this curriculum. These policies both put emphasis on quality education and place further emphasis on science, technology and innovation, particularly in natural and applied sciences, and in ICT. Additionally, the ICT policy in Education 2014 prescribes making ICT available to all categories of learners. The curriculum is also designed with Economic Development and Poverty Reduction Strategy (EDPRSII) in mind, as well as NICI III plan, a strategic plan for ICT development in Rwanda in line with Vision 2020.

1.2.Rationale of teaching and learning of Computer Science

1.2.1. Computer science and society

Computer science is a powerful subject in modern life that has changed every aspect of human society. Through computer science different computing devices have been developed which help in daily life. Among such devices it is important to highlight inventions of computers, embedded systems, telephones for communication, and the automation of different human activities through different applications and facilities, as well as the usage of computing technologies in medicines, education, finance, socio-economic, military, security, spatial sciences, weather and forecast, etc.

In Rwandan society computing technologies drive the country's development through communication, corporate growth, economic development, financial transactions, job creation, investment, living standards, patterns of work and leisure, and by spurring competition.

1.2.2. Computer science and the learner

The purpose of the computer science curriculum for Advanced level is to give learners high level competencies and skills that enable them to be familiar with the computing techniques used as everyday life tools. The computer science curriculum for Advanced level Science combinations is built on a prerequisite of ICT curriculum and is intended to produce graduates with strong computational skills for technology development and automation of human activities that are important for both labor market and higher education.

1.2.3. Competences

The national policy documents, based on national aspirations, identify '**Basic Competencies'** alongside the '**Generic Competencies''** that will develop higher order thinking skills. Basic competencies are addressed in the stated **broad subject competences** and in objectives which highlight a year on year, scaffolded basis of learning. The selection of types of learning activities must focus on what the learners are able to demonstrate. Such competencies are built throughout the learning process.

The core competencies that must be emphasized and reflected in the learning process are briefly described below and teachers will ensure that learners are exposed to tasks that help the learners acquire such skills.

Generic competences

Critical and problem solving skills: The acquisition of such skills will help learners to think imaginatively and broadly to evaluate and find solutions to problems encountered in all situations.

Creativity and innovation: The acquisition of such skills will help learners to take initiatives and use imagination beyond knowledge provided to generate new ideas and construct new concepts.

Research: This will help learners to find answers to questions basing on existing information and concepts and to explain phenomena basing on findings from information gathered.

Communication in official languages: Teachers, irrespective of not being teachers of language, will ensure the proper use of the language of instruction by learners which will help them to communicate clearly and confidently and convey ideas effectively through speaking and writing and using the correct language structure and relevant vocabulary.

Cooperation, inter personal management and life skills: This will help the learner to cooperate with others as a team in whatever task assigned and to practice positive ethical moral values and respect for the rights, feelings and views of others. Perform practical activities related to environmental conservation and protection. Advocating for personal, family and community health, hygiene and nutrition and Responding creatively to the variety of challenges encountered in life.

Lifelong learning: The acquisition of such skills will help learners to update knowledge and skills with minimum external support and to cope with evolution of knowledge advances for personal fulfillment in areas that need improvement and development

Broad Computer science competences

After completing the computer science content for Advanced level, learner should be able to:

- Use computational competences to contribute significantly to GDP Growth by improving government services, business efficiency and productivity for long term and sustainable economic competitiveness.

- Develop life skills, practical and entrepreneurial skills

- Apply computational thinking, logical and algorithmic precision in problem solving and creativity.

- Do maintenance of computer hardware and install / uninstall software

- Use computer ergonomically to avoid health related risks

- Show respect of ethical issues related to Piracy, Software Licensing, Copyright, Individual Privacy

- Apply the stages of the software development life cycle (i.e., problem definition, analysis, design, testing, implementation, maintenance)

- Identify errors in a program and apply the principles of debugging

- Analyse cultural, legal, and ethical issues and responsibilities of digital citizens, organizations, and government entities (e.g., privacy issues related to internet use, data protection).

- Analyze issues related to malicious software, social engineering, and security awareness.

- Design small web based, desktop and mobile applications

- Design, install, maintain and administer a database

- Install and administer Windows and Linux kernel based operating systems

- Maintain common technological tools

- Design, maintain and administer a network

- Create and capture images, audio, videos; edit them using appropriate software

- Show the following skills in his/her everyday life: communication, research, practical problem solving, observation, creativity and innovation.

Computer Science and developing competences

Computer science aims to contribute to the learner's critical thinking, research and problem solving, creativity and innovation, communication, and cooperation. This will be achieved by conceptualising, analysing, synthesising, evaluating and applying various programming techniques, database management strategies and networking skills within the appropriate, real life contexts.

Through computer science, learners will identify problems and conduct analysis of these problems by considering relevant functional, practical, human and socio-economic factors. Learners will also: draw up specifications for the computer-based solutions of problems; use a range of resources which are most suitable for solving problems; evaluate and refine solutions systematically.

Computer science will contribute to the promotion of the self-reliance of Rwanda through provision of knowledge, skills, attitude and values. Computing solutions will enhance the nation's dignity and peace It will also develop the respect of others which is a key value for the development of the country.

Basic competencies are addressed in the stated broad subject competences and in objectives highlighted through a year on year basis and in each of the specified units of learning. The selection of types of learning activities must focus on how the learners are able to demonstrate such competencies both throughout and at the end of the learning process.

2. PEDAGOGICAL APPROACHES

Learners learn best when they are actively involved in the learning process through a high degree of participation, contribution and production. Learning activities indicated in this Competency – based curriculum are to enable learner-centered approach to motivate learner to be central element of learning environment.

At the same time, each learner is an individual with their own needs, pace of learning, experiences and abilities. Teaching strategies must therefore be varied but flexible within well-structured sequences of lessons: learner-centered education does not mean that the teacher no longer has responsibility for seeing that learning takes place.

2.1. Role of the learner

The activities of the learner are indicated in each learning unit and they all reflect appropriate engagement of the learner in the learning process. The teaching learning processes will be tailored towards creating a learner friendly environment basing on the capabilities, needs, experience and interests.

The learning activities will be organized in a way that encourages learners to construct the knowledge either individually or in groups in an active way. Learners work on one competency at a time in form of concrete units with specific learning outcomes broken down into knowledge, skills and attitude.

Learners in computer science are provided with hands on activities which enable them to put into practice computer system management, design of algorithms and their conversion to programming codes, design desktop application, design database solutions, develop web application, edit images, audio and video and make basic configuration of the network.

2.2. Role of the teacher

The change to a competency-based curriculum is about transforming learning, ensuring that learning is deep, enjoyable and habit-forming. The teachers ought to shift from the traditional method of instruction but rather plays the role of a facilitator and lets students experience Computer science learning content through the use of available resources in order to value learners' individual needs and expectations.

The teacher must identify the needs of the learners, the nature of the learning to be done, and the means to shape learning experiences accordingly.

The teacher's roles are to organize the learners in the classroom or computer laboratory and engage them through participatory and interactive methods through the learning processes as individuals, in pairs or in groups. This ensures that the learning is personalized, active and participative, co-operative

The teacher will design and introduce the tasks to the class to perform or for immediate discussion. The role of the teacher will be to guide the learners in constructing their own knowledge, skills and attitudes.

Learners are taught how to use the computing tools used in different technologies. The teacher must select and develop appropriate materials like teaching models, digital content, and simulators for the learners to use in their work.

The teacher must devise remedial strategies in and outside the classroom / computer laboratory to address the issue of low achievers and those with learning difficulties to ensure they keep pace with the rest in acquiring the required competences

2.3. Special needs education and inclusive approach

All Rwandans have the right to access education regardless of their different needs. The underpinning of this provision would naturally hold that all citizens benefit from the same menu of educational programs. The possibility of this assumption is the focus of special needs education. The critical issue is that we have persons/ learners who are totally different in their ways of living & learning as opposed to the majority. The difference can either be emotional, physical, sensory and intellectual learning challenged traditionally known as 'mental retardation'.

These learners equally have the right to benefit from the free and compulsory basic education in the nearby ordinary/mainstream schools. Therefore, the schools' role is to enrol them and also set strategies and intervention measures to provide relevant education for them. Learning environment and ICT tools, teaching materials and other resources should meet learners with special educational needs. Assessment strategies and conditions should also be standardised to the needs of these learners. Detailed guidance for each category of learners with special education needs is provided for in the guidance for teachers.

3. ASSESSMENT APPROACHES

3.1. Types of assessment

Assessment is the process of evaluating the teaching and learning processes through collecting and interpreting evidence of individual learner's progress in learning and to make a judgment about a learner's achievements measured against defined standards. Assessment is an integral part of the teaching learning processes. In the new competence-based curriculum assessment must also be competence-

based, whereby a learner is given a complex situation related to his/her everyday life and asked to try to overcome the situation by applying what he/she learned.

Assessment will be organized at the following levels: School-based assessment, District examinations, National assessment (LARS) and National examinations

3.1.1. Formative and continuous assessment (assessment for learning)

Continuous assessment involves formal and informal methods used by schools to check whether learning is taking place. 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

3.1.2. Summative assessment (assessment of learning)

When assessment is used to record a judgment of a competence or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner's competence or progress at any specific moment. The main purpose of summative assessment is to evaluate whether learning objectives have been achieved and to use the results for the ranking or grading of learners, for deciding on progression, for selection into the next level of education and for certification. This assessment should have an integrative aspect whereby a student must be able to show mastery of all competences.

It can be internal school based assessment or external assessment in the form of national examinations. School based summative assessment should take place once at the end of each term and once at the end of the year. School summative assessment average scores for each subject will be weighted and included in the final national examinations grade. School based assessment average grade will contribute a certain percentage as teachers gain more experience and confidence in assessment techniques and in the third year of the implementation of the new curriculum it will contribute 10% of the final grade, but will be progressively increased. Districts will be supported to continue their initiative to organize a common test per class for all the schools to evaluate the performance and the achievement level of learners in individual schools. External summative assessment will be done at the end of Form 3.

3.2. Record keeping

This is gathering facts and evidence from assessment instruments and using them to judge the student's performance by assigning an indicator against the set criteria or standard. Whatever assessment procedures used shall generate data in the form of scores which will be carefully be recorded and stored in a portfolio because they will contribute for remedial actions, for alternative instructional strategy and feed back to the learner and to the parents to check the learning progress and to advice accordingly or to the final assessment of the students.

This portfolio is a folder (or binder or even a digital collection) containing the student's work as well as the student's evaluation of the strengths and weaknesses of the work. Portfolios reflect not only work produced (such as papers and assignments), but also it is a record of the activities undertaken over time as part of student learning. The portfolio output (formative assessment) will be considered only as enough for three years of A level. Besides, it will serve as a verification tool for each learner that he/she attended the whole learning before he/she undergoes the summative assessment for the subject. The results from the portfolio will contribute 50% on summative assessment of each year.

3.3. Item writing in summative assessment

Before developing a question paper, a plan or specification of what is to be tested or examined must be elaborated to show the units or topics to be tested on, the number of questions in each level of Bloom's taxonomy and the marks allocation for each question. In a competency based curriculum, questions from higher levels of Bloom's taxonomy should be given more weight than those from knowledge and comprehension level.

Before developing a question paper, the item writer must ensure that the test or examination questions are tailored towards competency based assessment by doing the following:

- Identify topic areas to be tested on from the subject syllabus.
- Outline subject-matter content to be considered as the basis for the test.
- Identify learning outcomes to be measured by the test.
- Prepare a table of specifications.
- Ensure that the verbs used in the formulation of questions do not require memorization or recall answers only but testing broad competences as stated in the syllabus.

Structure and format of the examination

Computer science is new discipline on the basis of computational thinking for high school students. Computational competences are practical oriented subject for hands on skills. For this reason, there will be two (2) papers in accessing computer science competences in Advanced Level. The first paper will be theoretical testing knowledge, skills and attitudes. Students will be assessed their competences for topic areas namely computer system and maintenance, Data structure and algorithm, programming, database, networking, Computer graphics and multimedia identified in this syllabus.

The practice will be arranged towards the same topics areas; computer system and maintenance, programming, database, networking, Computer graphics and multimedia to ensure their hands on skills. The practical paper will have questions to transform a algorithm into computer program using C, C++, VB and JAVA programming language, database questions related to design and creation of database through Database Management System (DBMS). For programming, database and networking the student will be tasked to develop a project using specified criteria and this project will be part of the practical assessment of the syllabus. This project may be carried out simultaneously or separately with the general practice. Students' projects in Visual Basic Project and Java Enterprise application will link user interface to a developed database. In Networking they will configure physical network devices or network devices through network simulators. The content distribution table will assist to make choice of the content to be assessed and not all topic areas and subtopic areas are to be covered or covered at the same level.

Topic Areas	Theory	Practice
Topic Area-1	X%	Z%
Topic Area-2	Y%	T%
Topic Area-3	K%	P%(Project)
	50%	50%

Computing tools required for practical assessment

Assessment of Computer science competences will require a number of equipments to ensure straight development of the ability of students. The computer will be the main equipment used to test computer science during practical examinations. Simulators will be used for networking project. During national examinations, for both computer and simulators, the practice will be conducted **at one student to one device ratio.**

3.4. Reporting to parents

The wider range of learning in the new curriculum means that it is necessary to think again about how to share learners' progress with parents. A single mark is not sufficient to convey the different expectations of learning which are in the learning objectives. The most helpful reporting is to share what students are doing well and where they need to improve. A simple scale of Meeting expectations very

well, Meeting expectations, and not meeting expectations for each of knowledge/understanding, subject skills and competences in a subject will convey more than a single mark. For school based assessments these scores do not need to be added up.

4. RESOURCES

4.1. Materials needed for implementation

The successful implementation of this computer science syllabus will require to have computers which are standard main equipments for this subject. Alongside computers other computing tools and applications software have been identified and are indicated in this syllabus where they will be needed. Various ICT resources for the implementation of computer science competency based curriculum to preserve its nature of being most likely practical scientific subject are the following:.

1. **Computer laboratory**: One computer for one student . It is recommended to school to explore the available technologies in market to minimise the cost of laboratory equipments.
2. Printer and scanner, Digital Camera, Headphone, Microphone, Speakers
3. **Telephony systems:** Smartphone during Android Operating System's lessons
4. **Projectors**: Presentation is the key element of the competency based curriculum where students works, teaching materials will be mostly displayed using projector for computer science content.
5. **Laptops per teacher**: Teachers needs to prepare learning and teaching materials, organise content so as to use classroom time effectively. One laptop per teacher is required.
6. **Internet connectivity :**Wired or Wireless in School for research

7. **Network devices**: Switch, Router, Wireless Access Point, server, , CAT6 cables, Networking tool kit (Crimping tools, cable striper, Cable tester etc), Cabling duct

8. **Softwares**: In most cases skills expected from this competency based curriculum do not rely on any version of operating system or any version of application software, however the latest version of the most softwares at the time of implementation will be used.

   8.1. **Operating system**: Licensed copies of Windows Operating System, LINUX

   8.2. ERD Commander, Paragon Recovery Software

   8.3. Ms-Office (Word,Excel,Powerpoint)for Research, Producing notes and Presentation

   8.4. **Visual studio 2015** for Visual Basic and C++

   8.5. Turbo C++

   8.6. Database Platform: Access(Licensed copy of MS Access) and MYSQL(XAMPP)

   8.7. Java Netbean IDE

   8.8. **Browsers**: one or more of Internet, chrome, Mozilla Firefox, Epiphanie, opera

   8.9. Boson Network Simulator, Cisco packet tracer simulator

   8.10. Adobe Photoshop image editor, GoldWave Sound Editor, Windows Movie Maker/Corel Video Studio, Macromedia Flash , Adobe Creative Suite

4.2. Human resource

The effective implementation of this curriculum requires a joint collaboration of educators at all levels. Given the material requirements, teachers are expected to accomplish their noble role as stated above. School head teachers and directors of studies are required to follow-up and assess the teaching and learning of Computer science . These combined efforts will ensure bright future careers and lives for learners as well as the contemporary development of the country.

In a special way, a teacher of Computer science at ordinary level should have a firm understanding of Computer science concepts at the level he/she teaches. He/she should be qualified in **Information Technology/Computer Science or related fields** with Education and have firm ethical conduct. The teacher should possess the qualities of a good facilitator, organiser, problem solver, listener and adviser. He/she is required to have basic skills and competency of guidance and counseling because students may come to him/her for advice.

Skills required for the Teacher of Computer Science

The teacher of Computer science should have the following skills, values and qualities:

- Inspire children and community the devotion of learning and use of Computer science
- Engage learners in variety of learning activities.
- Use multiple teaching and assessment methods.
- Adjust instruction to the level of the learners.
- Use creativity and innovation in the teaching and learning process.
- Be a good communicator and organiser.
- Be a guide/facilitator and a counselor.
- Manifest passion and impartial love for children in the teaching and learning process.
- Link the use of Computer science with other subjects and real life situations.
- Have good mastery of Computer science content and devotion to be lifelong learner.
- Have good classroom management skills.

5. SYLLABUS UNITS

5.1. General presentation

Computer Science subject is taught in upper secondary education level i.e. S4, S5 and S6 respectively; in Mathematics, Physics Computer (MPC) and Computer Economics Mathematics (CEM) combinations. At every grade where it is taught, Computer Science syllabus is structured in Topic Areas. Topic Areas are themselves broken down into Sub-Topic Areas while Sub-Topic Areas are in their turn made up of Units. As for units following are the features they are characterised with:

1. Each unit is aligned with the number of lessons it is expected to be taught in.

2. Each unit has got a key unit competency whose achievement is pursued by all teaching and learning activities undertaken by both the teacher and the learners.

3. Each unit's key competency is broken down into learning objectives that are of the following three types:

   - Learning objectives relating to knowledge and understanding
   - Learning objectives relating to skills
   - Learning objectives relating to attitudes and values

   Learning objectives relating to knowledge and understanding are known as lower order thinking skills. They are actually considered to be prerequisites to learning objectives relating to skills, attitudes and values.

   Learning objectives relating to skills, attitudes and values are also known as higher order thinking skills. These learning objectives are actually considered to be the ones targeted by the present reviewed curriculum.

4. Each unit is assorted with a detailed content.

5. Each unit is provided with learning activities that are expected to engage learners in the learning process as interactively as possible (learner-centered and participatory approach).

6. Finally, each unit shows its links to other subjects, its assessment criteria and the materials (or resources) that are expected to be resorted to in its teaching and learning.

The following table indicates the distribution of the content by topic areas and sub-topic areas as well as number of periods allocated:

Topic area	Sub-topic area	Number of periods(period=40 min)					
		S4	S5	S6	TOTAL	%	%
Computer system, Arithmetic &maintenance	Computer System	16	8		42	6%	16%
	Computer arithmetic	36			36	5%	
	Maintenance	46		12	40	5%	
Data structure and algorithms	Algorithm	36	18	0	54	7%	7%
Programming	Procedural programming	72	20	0	92	12%	47%
	Object Oriented Programming	0	36	18	54	7%	
	Event Oriented Programming	0	48	34	82	11%	
	Web Programming	28	60	36	124	16%	
Operating system	Operating System concepts	18	0	0	18	2%	7%
	Process Management	0		12	12	2%	
	File and Memory Management	0	0	26	26	3%	
Networking	LAN Technology	0	26	16	42	6%	9%
	Network protocol	0	0	24	24	3%	
Database	Relational database concept and design		36	36	72	10%	10%
Graphics and multimedia				38	38	5%	5%
Total		252	252	252	756	100%	100%

5.2. Secondary four

5.2.1 Key competences at the end of Secondary 4

- Explain the computer system and its evolution, role, architecture and classification,
- Identify different numbers base systems and perform conversion between them,
- Identify different logic gates, theorems of Boolean algebra and evaluate Boolean expressions,
- Utilize the laws of Boolean algebra on Boolean expressions and draw a simple logic circuit using logic gates,
- Integrate safety guidelines, ergonomics and ethical issues to have a good working environment,
- Dissemble and assemble a computer, do minor maintenance,
- Identify different computer ports and connectors,
- Derive a suitable algorithm for a computational problem using variables, expressions, reading and writing functions, and loops ,
- Describe programming paradigms ,
- Transform an algorithm in C ++   and apply functions, arrays and control statements in C++ program
- Explain the evolution, role, types and function of the Operating System,
- Build standards compliant web pages using XHTML and CSS,

5.2.2 Computer Science Units for secondary four (S4)

TOPIC AREA: COMPUTER SYSTEM AND MAINTENANCE SYSTEM			SUB-TOPIC AREA: COMPUTER SYSTEM	
S.4 Computer Science		**Unit 1:** Computer fundamental.		**No. of lessons:** 16
Key Unit Competency: To be able to explain characteristics and evolution of computers and detect the impact of computer in **society**.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		

• State and explain characteristics of computers
• Identify the impact of computers in society.
• Explain the evolution of computers.
	• Detect the impact of computers in society.
	• Classify computers according to their size, processing power, their functions and the data to be processed.
	• Differentiate different computer generations, technology used in each generation.
		• Appreciate the evolution and the importance of a computer in:
		  o Education
		  o Business
		  o Governance
		  o Health
		  o Communication
		  o Entertainment.
			• **Define:**
			  o Computer
			  o Computer science
			• **Computer characteristics:** Reliability, speed, accuracy, diligence, versatility, power of remembering, no feeling, no intellectual quotient.
			• **Classification of computers:** Based on size and processing power (Supercomputers,
				• The teacher will ask students to write an essay on the role and evolution of a computer by searching on internet and through books.
				• In group discussions students detect the impact of computers in their school and outside the school. They also classify the computers that are available in their school.

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| | | | Mainframe, Minicomputers, Microcomputers/ Personal Computers).Based on their functions (Servers,Workstations, Embedded computers).Based on the data to be processed(analogue, digital).
• **Role of computers in society:** Medicine, Education, Entertainment, Economic, Communication, Security and Social, Financial, etc.
• **History of computers:** Invention and evolution in generations of computers. | |

Link to other subjects: *Physics (*electronics*).Related to the generation of computers: vacuum tubes, transistors, ICs, etc.*

Assessment criteria: *Students can explain the role and evolution of computers; type and classification of computer.*

Materials: *Computer, projector, internet.*

TOPIC AREA: COMPUTER SYSTEM AND MAINTENANCE	SUB-TOPIC AREA: COMPUTER MAINTENANCE	
Senior 4 : Computer Science	**Unit-2:** Computer Architecture, Assembling and Disassembling a Computer	**No. of Periods:** 18

Key Unit Competency

To be able to:

- Identify computer components and their functions(input, output, processing and storage)
- Assemble and disassemble a computer, do minor maintenance

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Identify computer system, components and function of each component. • Identify computer peripherals , ports and connectors	• Attach and de-attach computer peripherals • Clean internal and external computer components and protect the environment from contamination.	•Appreciate the guideline of attaching and disconnecting each component of a desktop computer properly	**Computer system:** User ,Hardware, Software, Data **Computer functions**: Input, Processing, Output and storage **Computer hardware:** • **Computer peripherals** o Input	• Teacher provides computer peripherals and asks students to identify their functions and later students connect them to the computer desktop. • Students follow guidelines from teacher to clean internal and external computer

• Differentiate types and purpose of computer case • Identify different components inside computer case and their functions	• Compare different computer case form factors • Identify elements inside computer cases • Assemble and disassemble desktop computer		○ Output ○ **Port and Connectors** Serial , Parallel ,Universal Serial Bus(USB), FireWire , SCSI ,Network ,PS/2,Audio and Video ports (VGA) **Plug and unplug computer peripherals** • **Computer case (** Role, function and types(Tower, Desktop) of computer • **Components inside computer case :** ○ Power supply(types of Power connectors) ○ Motherboard ○ Central Processing Unit **(**ALU, CU, registers) ○ Computer memory ▪ Primary memory (RAM, ROM, registers, Cache memory) ▪ Secondary memory:	components. • Students explore internal environment of the desktop computer, identify each component, detach it and re-attach it. • Students disassemble available computer desktop and reassemble it.

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			structure of hard disk ○ Hard disk and CD/DVD drives ○ Adapter cards ○ CPU Fan **Cleaning procedures of computer components:** ○ External components ○ Internal components ○ • **Elements attached to the motherboard** 　　CPU sockets, RAM sockets, Chipset, Expansion slots, BIOS chip, CMOS battery, Data connectors(Data buses), **Assembling a computer desktop** ○ Install the power supply ○ Attach the components to the motherboard ○ Install the	

			motherboard ○ Install internal drives ○ Install adapter cards ○ Connect all internal cables **Disassemble a computer desktop**	

Link to other subjects: *Physics(Electronics)*

Assessment criteria: *Students can identify the internal components of a computer and properly fix them . They can diagnose the cause of the problem associated with each component.*

Materials: *Computers ,projector, some spare computers and their parts for dissembling practice, ESD belt, screwdriver set, magnifier glass, digital multimeter, electric blower, isopropyl alcohol and brush to clean motherboard, dust free cloth, first-aid kit*

TOPIC AREA: COMPUTER SYSTEM AND MAINTENANCE			SUB-TOPIC AREA: COMPUTER MAINTENANCE	
Senior 4 : Computer Science		Unit-3: Safe and ethical use of computer		No. of periods:12
Key Unit Competency To be able to integrate safety guidelines, ergonomics and ethical issues to have a good working environment				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Identify safety procedures at working place environment and procedures to protect the environment from contamination • Identify procedure to protect equipments from physical damage • Identify Ergonomic Concept and associated Health Problem • Identify Ethical	• Integrate general computer use safety procedures • Able to protect equipments from physical damage	• Show the concern about to work in safe environment to protect computer against physical damage • Identify ergonomic issues and health related risk due to improper use of computer	• **General safety guidelines** o Ergonomics o Common health problems (back pain, eye strain etc) o Correct sitting position o Ergonomic furniture and equipments • **Fire safety guidelines** • **Climate** • **Protect equipment against physical damage :** o Electrostatic discharge(ESD), ESD protection and Recommendations o Power fluctuation (Blackout ,Brownout ,Noise)	• Teacher give examples of Health related problems and learners try to find cause and solution • Students identify problems arise in their school computer lab which can cause physical damage and with the help of teacher they provide solutions • Teacher provides power protection devices; students connect computers and other equipments to them. • Teacher ask user to list some software and to identify if they are open source or commercial and

Issues, Software Licensing, Anti-Piracy, Form of software license agreement (licensed, freeware, shareware, open source)			• **Power protection devices:**
			  o Surge Suppressor
			  o Uninterruptible Power Supply (UPS)
			• **Protect the environment from contamination :**
			  o Proper disposal of batteries ,
			  o CRTs , LCDs monitors
			  o Toner kits, cartridges,
			  o Chemical solvents and aerosol cans
			
			• **Ethical Issues:** Software licensing, anti-piracy, form of software license agreement (licensed, freeware, shareware, open source), individual privacy
				belong to which company

Link to other subjects: *Physics(Electricity, electronics)*

Assessment criteria: *Students can apply safety guidelines during computer use and repair, keeping health precautions, respecting legal and ethical issues*

Materials: *Computers, Projector, UPS, Repair tool kit, Example of Some Commercial and Open-Source Software, Some samples of Ergonomics equipments like mouse, keyboard, screen, chair*

TOPIC AREA:COMPUTER SYSTEM AND MAINTENANCE		SUB-TOPIC AREA: COMPUTER MAINTENANCE		
S.4 COMPUTER SCIENCE	**UNIT 4:** Computer software installation			**No. of lessons:** 16
Key Unit Competence: To be able to install operating systems and other application software and to use disk management tools.				

Learning Objectives				
Knowledge and understanding	**Skills**	**Attitudes and values**	**Content**	**Learning Activities**

• Explain and differentiate types of computer software.
• Identify form of software license agreement.
• Identify system required to install any software.
	• Create partitions on hard disk and format a disk.Use disk management tools to manage a disk.
	• Install some system and application software.
		• Be aware of how to install a piece of software and how to manage a disk.	• **Computer Software**
			  o System software(operating system, utility, library and translator software)
			  o Application software(general purpose, special purpose, custom application software.
			
			• **System requirement** RAM capacity, hard disk capacity, CPU speed.
			• **Disk preparation**
			  o Disk partitioning
			  o Disk formatting (hard disk , flash disk , memory card)
				• Teacher demonstrates all steps of Windows Operating System installation and gives a similar task to groups of students.
				• Teacher provides a computer and a copy of any necessary software. Individually students identify the system requirements to install any available software and proceed to install it.
				• Teacher demonstrates how a computer goes through several steps from switching on to when the desktop screen appears.
				• Teacher demonstrates how to partition, format, defrag a disk and learners do similar hands-on practice.

| | | | | • **Disk management tools:**
  o Disk cleanup
  o **Scandisk/Chkdsk**
  o **Defragmentation**
  o System File Checker (SFC).
• **Booting order:**
  o Bootable CD/DVD
  o Hard Disk
  o Network
  o Removable devices.
• Steps starting from computer switch on until Windows desktop screen appears.
• **Software installation**
  o System software installation **(**operating system, drivers, anti-virus).
  o Application software installation (Office, browsers, games). | |

Links to other subjects:

Assessment criteria: *Students can install and troubleshoot software.*

Materials: *Computers, projector, repair tool kit, software, external hard disk, network connection, flash disk, Windows Genuine installation DVD, any application software necessary for installation.*

TOPIC AREA: COMPUTER SYSTEM AND MAINTENANCE			SUB-TOPIC AREA: COMPUTER ARITHMETIC	
Senior 4: Computer Science		**Unit5:** Number system.		**No. of lessons:** 18
Key Unit Competency: To be able to compute numbers in different base systems and to do arithmetic operations based on **binary** numbers.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Differentiate number base systems.
• Explain the conversion and use of arithmetic operations in different base systems.
	• Convert a given positive number from one base system to another.
	• Convert fractional numbers.
	• Convert a given negative decimal number to binary base.
	• Apply arithmetic operations to binary numbers.
		• Appreciate number base conversion and the use of arithmetic operators in binary base systems.	• Bit, Byte, Base, Weight-by-Position.
			• Number Base Systems: Decimal base ,binary, octal , hexadecimal
			• Least significant bit, most significant bit
			• Counting in binary up to 15
			• Conversion between base systems:
			• Repeated division by-N method
			• Weight-N Method
			• Replacing 3 bit in binary to octal conversion
			• Replacing 4 bit in binary to hexa-decimal conversion
			   o Positive decimal to binary, octal hexadecimal
			   o Binary to decimal, octal, hexadecimal
				• Teacher provides numbers from one base system and asks students to convert it into other base systems.
				• Teacher provides exercises in which students apply arithmetic operations in different base systems.

			- Octal to binary, decimal, hexadecimal - Hexadecimal to binary, octal, decimal - Conversion of fractional numbers: - Decimal fraction to binary - Binary fraction to decimal -Conversion of negative decimal numbers to binary: - One's complements - Two's complements **Arithmetic operators on binary numbers** - Addition - Subtraction - Division - Multiplication	

Link to other subjects: *Mathematics (arithmetic)*

Assessment criteria: *Students can correctly compute numbers in different base systems, and do arithmetic operations on binary numbers.*

Materials: *Computers, projector, scientific calculators*

TOPIC AREA: COMPUTER SYSTEM AND MAINTENANCE			SUB-TOPIC AREA: COMPUTER ARITHMETIC	
Senior 4:COMPUTER SCIENCE		**Unit6:** Boolean algebra and logic gates.		**No. of lessons:** 18

Key Unit Competency: To be able to
- Identify different logic gates, theorems of Boolean algebra and evaluate Boolean expressions
- Utilise laws of Boolean algebra on Boolean expressions and draw a simple logic circuit using logic gates.

Learning Objectives			Content	Learning activities
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Identify logic operators, truth tables and evaluate Boolean expression using Boolean laws.
 • Describe the use of logic gates and apply Boolean laws on logic gates.
	• Apply laws of Boolean algebra on Boolean expressions.
	 • Draw graphical representation of different logic gates and construct and evaluate a logic circuit.
		• Appreciate the logical reasoning while using Boolean operators and laws applied on Boolean numbers.
		 • Appreciate logic gates and laws applied on logic circuit.
			• Logic operators and truth tables:
			   ○ AND,OR,NOT,NAND,NOR,XOR,XNOR
			 • Logic Gates
			   ○ NOT,AND, NAND, OR, NOR, XOR,XNOR
			   ○ Graphical representation and truth tables.
			 • Boolean Algebra:
			   ○ Laws (commutative, associative, distributive, identity, redundancy, De Morgan's).
			   ○ Boolean expression simplification.
			 • Build a simple circuit and its truth table
			 • Sum-of-product form, Product-of-sum form and represent their logic circuit
			 NAND and NOR as universal gate to make other
				• Teacher provides exercises containing Boolean expression and students provide results.
				 • Students generate truth tables of a given Boolean operator and Boolean expression.
				 • Teacher provides a logic circuit containing different logic gates and students provide the output.
				 • The teacher provides a Boolean expression and asks students to

			gates.	construct a corresponding logic circuit.

Link to other subjects: *Mathematics (logic).*

Assessment criteria: *Students utilise laws of Boolean algebra on Boolean expressions, draw logic circuit from given expression, derive correct expression from given circuit.*

Materials*: Computers, projector, digital material.*

TOPIC AREA: DATA STRUCTURE AND ALGORITHMS			SUB-TOPIC AREA: ALGORITHMS	
Senior 4 : Computer Science		**Unit-7:** Introduction to Computer Algorithm		**No. of periods: 24**

Key Unit Competency

To be able to:

- Identify appropriate steps to solve a problem.
- Identify an appropriate algorithm for a given problem
- Represent graphically algorithm using Flowchart

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
•Identify and explain the role, characteristics and structure of computer algorithm •Identify Flowchart symbols and their meaning •Distinguish between variable	•Trace an algorithm and predict output for a given input •Represent graphically the logic for a computer problem using Flowchart •Use variable ,constant and reading, writing functions in computer	•Show concern in understanding steps to resolve computer problem using algorithm	**Algorithm concept :** •Definition, role and characteristics **Expressing algorithm** Natural language, pseudo-code and flowchart **Variables** Definition, declaration, data type, identifier, rules of naming	•Teacher provides an simple problem ,students provide appropriate steps to resolve it and draw flowchart for it •The teacher provides written algorithm and ask students to determine the different variables , constants and their data types present in each

and a constant
 	
•Differentiate different data type used in computer algorithm and identify memory size for each data type
 	
•Identify how data is stored in computer memory
•Manipulate expressions in algorithm writing
 	
•Use reading and writing functions in algorithm writing
	algorithm
	•
	•Able to evaluate an expression
			variables and key words, variable initialization
			Constants
			  Definition and declaration
			
			Expression and operators
			Unary operators(
			minus (-),increment(++)/
			decrement(--), size of(),
			&(address of))
			Binary operators (Arithmetic ,Relational /comparison operators, Logical operator ,Bitwise operators,)
			Precedence of operators
			Reading and writing functions
			  •Read function
			  •Write/ display function
				algorithm and to precise the size of each
				
				•Teacher provide an simple exercise that require the use of variables , and ask students to write the corresponding algorithm

Link to other subjects: *Mathematics*

Assessment criteria: *students can derive the solution logic for a computational problem, represent it using flowchart, and write algorithm, utilize variables and expressions in an algorithm correctly*

Materials: *Computers ,projector, digital material, network connection*

TOPIC AREA: DATA STRUCTURE AND ALGORITHMS			SUB-TOPIC AREA: ALGORITHMS		
Senior 4 : Computer Science		Unit-8: Control statements and one dimension array			No. of periods: 12
Key Unit Competency: To be able to **d**erive logic in algorithm which include Control Statements and to handle one dimension array in algorithm					
Learning Objectives			Content	Learning Activities	
Knowledge and understanding	**Skills**	**Attitudes and values**			

•Identify and explain control statement in algorithm
 	
•Explain the use of one dimension array data structure in algorithm
	•Able to use control statements in algorithm
	
	•Able to use one dimension array data structure in algorithm
		•Appreciate the use of and control statement in writing an algorithm	**Control structure**
			• Conditional logic,
			• simple condition, compound condition, logical operators (Not, Or, And) statements:
			   o If statement
			   o If...else
			   o nested if
			   o switch case
			Iteration/ Loops statement
			
			For loop, while loop, do...while loop, nested loop (outer loop, Inner
				•Teacher provides written algorithm containing control statement and one dimension array and students analyze it and provide output.
				
				•Teacher will provide an simple exercise that require the use control statements and one dimension array and ask students to write the corresponding algorithm

			Loop),Infinite (Endless loop), Jump statement, Break ,Continue ,go to , exit ( ) **One dimension table/ array :** • Definition • Declaration • Accessing arrays elements • Initializing arrays	

Link to other subjects:

Assessment criteria: *Students can reasonably derive logic where conditional statements, iterative statements (loops) and one dimensional arrays can be used in solution algorithm*

Materials: *Materials:* *Computers , projector, network connection, digital material*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: PROCEDURAL PROGRAMMING	
S.4 COMPUTER SCIENCE		**Unit9:** Introduction to computer programming**.**		**No. of lessons:**6
Key Unit Competency: To be able to explain programming paradigms				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
-Classify different programming language generations. - Outline different programming language paradigms.-Point out features of good programming language.	- Differentiate levels characteristics of programming language. - Classify programming languages according to their generations. - Explain features of programming language paradigms. - Outline characteristics of good programming languages.	Understand different perspectives of programming techniques.	**Programming language** - Definition, role, features of a good programming language. **Evolution of programming languages** - Low level language, - high level language. **Programming Paradigms** - Imperative, - procedural/functional, - logical, - object oriented	- Teacher will ask students to write an essay on evolution/history of programming languages. - Teacher will ask students to compare features of the different programming paradigms.
Links to other subjects:				
Assessment criteria: Students are able to explain programming paradigms.				
Materials: Computers, projector, digital material Internet connection.				

TOPIC AREA: PROGRAMMING				SUB-TOPIC AREA: PROCEDURAL PROGRAMMING	
Senior 4 : Computer Science			**Unit-10:** Introduction to C++ programming		**No. of periods:** 12
Key Unit Competency: To be able to write and execute a given algorithm into C ++ programming language					
Learning Objectives			Content		Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**			
• Describe the evolution of C++ language • Familiarize with C++ compiler environment • Identify steps followed to write a C++ program • Identify the use of input/ output streams in C++ program	• Apply the syntax of C++ language while writing a C++ program • Use cout and cin streams • Utilize variables and constants in C++ program • Write a sample C ++ program and run it	• Derive algorithm for a given problem and implement the solution logic into C++ programming language • Read and interpret a simple C++ program containing input/output stream, variables and constant and provide the intended results	**C++ programming language** Introduction to C++ and its features Examples of a C ++ program Syntax of C++ program :comments ,header lines ,main function ,statement definition ,block definition ,block delimitation({ and}) ,closing statement **Input/output streams** cout ,cin ,insertion and extraction		• Teacher will provide a written program and ask students to identify different parts of the program and variables with their type and constants. • Teacher will provide a program and ask students to interpret it and give the output of it • Teacher will ask students to write a program according to a given

				operators (<<, >>)	exercise and execute.
• Differentiate different data type used in C++ program • Differentiate variable and constant in C ++ program • Recall steps to execute a C++ program				**Output formatting** **Variables :** Variable definition ,variable declaration, data types(int ,char, float, double), identifier and rules of naming variables, key words ,memory size of data type, variable initialization **Constant** Constant definition ,constant declaration ,single character **Steps in executing a C++ program** Edit source code ,compilation ,linkage ,run/execution	

Links to other subjects: *Mathematics (Arithmetic) related to data type and calculation of space consumed in memory*

Assessment criteria: *students can write and execute a given algorithm into C ++ programming language*

Materials: *Computers, , projector, internet connection, C++ compiler, digital material*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: PROCEDURAL PROGRAMMING	
Senior 4 : Computer Science		Unit- 11-: Expression and Operator in C++ language		**No. of periods: 12**
Key Unit Competency: To be able to apply expressions and operators in C++ language				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Use different operators in C++ program • Understand the use of operators into expression and their precedence order	• Utilize arithmetic, logical, assignment, relational, CAST ,conditional ,bitwise and comma operators in C++ program • Apply precedence of operators in C ++ program • Interpret an expression in C ++	• Derive algorithm for a given problem and implement the solution logic into C++ programming language using operators in correct place and in correct order • Read and interpret a simple C++ program containing expressions and	**Operators** • **Arithmetic operators** Unary : ("– "), Increment (++) , Decrement (--) Binary : ("+","-","*","/","%") • **Logical operators** :("!", "&&", "//") • **Assignment operator : (=)** , • **Compound assignment operators (+=, -=, *=, /=, %=)** • **Relational or Comparison**	• Teacher will provide a written program and ask students to identify different operators used in the program • Teacher will provide a program containing operators and expressions and ask students to interpret it and give the output of it • Teacher will ask students

		program	operators and provide the intended results	**operators: (==, !=, >, <, >=, <=)** • **CAST operator , sizeof ( ) operator ,& (address of operator),** • **Conditional operators : (? :),** • **Bitwise operators :(&, |, ^, ~, <<, >>) , comma operators : (,)** • Operators precedence in C ++ language • Expression in C++ language • Evaluation of expression ,Type conversion :Implicit ,Explicit	**to** write a program according to a given exercise requiring use of different operators and execute it
Links to other subjects: *Mathematics (Arithmetic, Boolean Algebra)*					
Assessment criteria: *Students can apply operators in C++ language in correct place and in proper order to get intended result*					
Materials: *Computers, projector, internet connection, C ++ compiler, digital material*					

TOPIC AREA: PROGRAMMING		SUB-TOPIC AREA: PROCEDURAL PROGRAMMING	
Senior 4 : Computer Science	Unit-12: Control Statements in C++		No. of periods: 16

Key Unit Competency: To be able to use control statements in C++ program to implement branching and iterations

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
Describe various control statements used to implement conditions and iterations in C++ program	Apply control statement in C ++ program	• Derive algorithm for a given problem and implement the solution logic into C++ programming language using operators in correct place and in correct order • Read and interpret a simple C++ program containing conditional branching and looping statements and provide the intended results	• **Branching** If statement ,if...else statement ,nested if...else statement ,Switch case statement • **Looping** While loop ,do...While loop ,For loop,nested loop (outer loop, inner loop) • **Jumping statement** Break ,continue , goto ,exit ()	• Teacher will provide a written program and ask students to identify different control statements used in the program • Teacher will provide a program containing conditional branching and looping statements and ask students to interpret it and give its output • Teacher will ask students to write a program according to a given exercise requiring the use of control statements and

				execute it • Teacher describes example where nested loops can be used. For example, to print following pattern - 1 12 123 1234 12345 1234 123 12 1 • -Learners also calculate the total number of times in which the loop was executed.

Links to other subjects: *Mathematics (Arithmetic and Boolean algebra)*

Assessment criteria: *Students can use control statements in C++ program to effectively implement conditional branching and iterations*

Materials: *Computers, projector, digital material, internet connection, c ++ compiler*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: PROCEDURAL PROGRAMMING		
Senior 4: Computer Science		Unit-13: Function in C++ language		No. of periods: 14	
Key Unit Competency: To be able to define and use functions in C++ program					
Learning Objectives			Content	Learning Activities	
Knowledge and understanding	Skills	Attitudes and values			
• Describe different predefined function in C ++ programming language Describe the steps of using functions in C++ program	• Define a function in C++ language • Declare a function in C++ language • Call a function in C++ language	• Appreciate the importance of functions for reusability and modular design • Solve a given algorithm and apply the solution into C++ programming language using function • Read and interpret a simple C++ program containing function and provide the	• Definition of functions in C ++ program • **Advantages of functions:** Reusability, modular design, shortening the program length, easy troubleshooting • **Type of functions** :in built functions(libraries ,main () function), user defined functions: Syntax ,steps of using a function , function declaration , function call, function definition	• Teacher will provide a written program and ask students to identify different functions used in the program • Teacher will provide a program containing functions and ask students to interpret it and give its output • Teacher will ask students to write a program according to a given exercise requiring the use of functions and execute it

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		intended results	• **Scope of variables:** local variables , global variables • **Functions with no arguments and no return value.** • **Functions with arguments and no return value.** • **Functions with arguments and return value.** • **Functions with no arguments and return value.** • **Recursive functions examples(**Factorial, GCD)	

Links to other subjects: *Mathematics (arithmetic related to functions)*

Assessment criteria: *Students can define and use functions in C++ program*

Materials: *Computers, projector, internet connection, C ++ compiler, digital material*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: PROCEDURAL PROGRAMMING	
Senior 4 : Computer Science		Unit-14: Arrays in C++		**No. of periods:** 12
Key Unit Competency: To be able to use arrays and strings in a C++ program.				

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Describe use of Array and Strings and their memory representation	• Define , declare and use arrays in C++ programming language • Define , declare and use a string in C++ programming language • Manipulate array in a C++ program • Manipulate a strings in a C++ program	• Appreciate the importance of arrays and string • Solve a given algorithm and apply the solution into C++ programming language using array and strings • Read and interpret a simple C++ program containing arrays and strings and provide the intended results	**Array** Definition, declaration ,type of elements ,size of an array, initialization of an array ,read elements of an array ,use elements of an array ,display elements of an array **String** Definition of a string, declaration of a string, string as an array of one dimension ,initialization of a string, string constant ,read	• Teacher will provide a written program and ask students to identify type arrays and their sizes used in the program • Teacher will provide a program containing array and ask students to interpret it and give out its output • Teacher will ask students to write a program according to a given exercise requiring the use of arrays and execute it

			elements of a string ,use elements of a string ,display elements of a string , string.h library	

Links to other subjects: *Mathematics(arithmetic related to subscript counting)*

Assessment criteria: *students can use arrays and strings in a C++ program*

Materials: *Computers, projector, internet connection, C ++ compiler, digital material*

TOPIC AREA: OPERATING SYSTEM		SUB-TOPIC AREA: OPERATING SYSTEM OVERVIEW	
Senior 4 : Computer Science	**Unit-15:** Introduction to Operating System		**No. of periods:** 18

Key Unit Competency: To be able to explain the role, types and the evolution of computer operating system ,use Ms-Dos commands and use mobile operating system

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Explain functions, characteristics and components of the operating system • List and explain different operating system • Identify different type of operating system • Describe the use of different MS-	• Define operating system • Enumerate common computer operating systems • Explain different types of operating system • Use MS DOS commands • Use GUI and commands in	• Appreciate the operating system running in any electronic device • Appreciate the touch screen interface of Android on Smartphone and tablets • Appreciate the Linux as open source and more resistant against viruses	• **Operating System** Definition , functions, characteristics • **Components of the operating system:** kernel, shell, file system • **system resources** : CPU, memory, I/O • **Common operating systems**: MS DOS, Unix, Linux, MAC OS, Microsoft windows, etc. • **Smartphone Operating System :**	• Through a homework teacher will ask students to make a research on operating system • Teacher provides a list of MS- DOS Commands to students and learners use command prompts to write commands and become familiar • Teacher demonstrate Android operating system interface on Smartphone or tablet and learners do hands on exercise

DOS and Linux commands	Linux		Windows OS, BADA OS , Palm OS, Blackberry OS, Android , Apple IOS	• Learners use Linux GUI and practise commands with teacher
			• Difference between Computer Operating system ,firmware ,mobile phone operating system	
			• Evolution of Computer Operating Systems	
			• **Types of operating systems:** Batch, network, Multiuser, Multiprogramming, multiprocessor, distributed, real time system (hard real time and soft real time)	
			• Basic MS DOS commands and its main features	

Links to other subjects:

Assessment criteria: *students can explain the role, the types and the Evolution of Computer Operating Systems, use GUI in Linux, Use commands in Ms-Dos and Linux*

Materials: *Computers ,digital material, Projector, internet connection, Windows, Linux Operating System Interface on computer, Android Interface on Smartphone*

TOPIC AREA: PROGRAMMING		SUB-TOPIC AREA: WEB TECHNOLOGY AND JAVA PROGRAMMING	
Senior 4 : Computer Science	Unit-16: HTML		No. of Periods: 20
Key Unit Competency: To be able to build standards compliant web pages using HTML,			

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Explain HTM, XHTML, HTML5 web technologies • Differentiate open/empty and closed tags in HTML • Explain the use of XHTML entities • Differentiate POST and GET method in HTML form • Identify	• Create a static web site using HTML web technologies by formatting text, images and page using HTML tags and their attributes, linking pages • Use appropriately open/empty tags and closed tags • Load and format images, audio, and video to a web page	• Design a web page and arrange correctly HTML elements • Be able to manage open/empty tags and closed tags • Evaluate the use of POST and GET when choosing a correct method to send data.	• **HTML** Definition, invention and evolution(Tim Berners Lee, www),HTML syntax • **Types of HTML elements** (Structural, presentational, hypertext) Web page Frames, tags • **HTML attributes** (Definition, samples) • **HTML Versions** Strict, transitional,frameset • **XHTML** Definition, XHTML Versions XHTML Styling(Deprecated elements, new elements in XHTML) • **Design HTML pages**	• Students write HTML page and use the formatting features (bold, italic, superscript, subscript, strike through, heading, blockquote and text alignment and break tags) • Format text and page background using color • Design a table in HTML and using <table>, table header<th>, table data<td>colspan and rowspan features. • Students load different

deprecated elements in migration of HTML4 to HTML5	• Use form controls to design a well organized HTML form
	
	• Use HTML5 tags and attributes to validate a form using input restrictions.
			Headings, paragraphs, formatting elements, images, lists, hyperlinks,tables
			• **XHTML Entities** (ampersand, greater than, less than, copyright, quotation mark)
			• **HTML forms**
			  o Introduction,
			  o form attributes(action, method),form control(input[text, password, radio, checkbox, hidden], select, textarea), readonly and disabled attributes,
			  o Build a form with GET,
			  o Build a form with POST,
			  o Difference between GET and POST
			• **HTML5**
			  o Definition, doctype,
			  o **New inputs** (color,date, datetime ,datetime-local, email, month, number, range, search, tel, time,url,week)
			  o **New Input Restrictions** (max, min, required, step, pattern)
			  o **New attributes for Inputs**
				images on HTML page, Write using ordered and unordered lists the items indicated.(Examples: List of provinces and their respective districts).
				
				• Write character entities: Less than, greater than, copyright, ampersands(&) and card suites
				• Students link more pages related to their root page.
				
				Students create pages containing music both audio and video using appropriately **<embed>** attributes like autostart, height, width and loop.
				
				Students build a form for a person identification and teacher emphasize on the use of inputs, radio, check boxes, select, textarea and file form control
				
				• Analyze the difference between GET and POST after

			Autocomplete, autofocus, form, formaction, formenctype, formmethod, formnovalidate, formtarget, height and width,list, min and max, multiple,pattern (regexp), placeholder,required, step • **Migration from HTML4 to HTM4** • Deprecated elements	form submission. • Students design a form using HTML5 emphasizing on the use of new tags not available in HTML4 • Students conduct research on internet to improve their pages with more HTML features and to identify deprecated elements in HTML5**(http://www.w3schools.org)** • Students conduct research on the internet on deprecated elements in HTML5

Link to other subjects:

Assessment criteria : Students can Build standards compliant web pages using HTML

Materials: computers ,Net bean IDE, HTML editor, projector, internet

TOPIC AREA: PROGRAMMING		SUB-TOPIC AREA: WEB TECHNOLOGY AND JAVA PROGRAMMING	
Senior 4 : Computer Science		**Unit-17:** Cascading style sheet	**No. of Periods:** 8
Key Unit Competency: To be able to build standards compliant web pages using CSS			

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Differentiate html styling and CSS styling.
 	
• Identify the correct use of a given selector, how to set a selector and how to name different elements to match one CSS selector.
 	
• Differentiate priorities of styles in a web page namely external
	• Create a inline styles to style specific elements inside a web page , internal elements using selectors and external cascading style sheet to differentiate content and its presentation
	
	• Give selectors to html elements(classes, ID) and use html tags to set up their styles.
	
	• Use appropriately
		• Differentiate the content and its presentation using cascading style sheets	• **Introduction to CSS**
			• **HTML Styling and disadvantages**
			• **Advantages of CSS** (presentation, content)
			• **Comparison of CSS and HTML styling**
			• **CSS Syntax**
			  ○ selector { property: value }
			  ○ CSS grouping
			  ○ HTML elements,
			  ○ classes
			  ○ ID selectors
			  ○ Comments
			  ○ Units
			  ○ Color
				• Students create an internal style sheet and use font styles, text decoration, class, background images and colors, borders and grouping to html elements.
				
				• Students discuss advantages of CSS over html styles
				
				• Students create an external CSS file and use layers(div and span in a document and apply margins, borders, padding and background styles
				
				• Use float to div and images to

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CSS, internal CSS and inline CSS
 	
• Identify basic properties for different selectors
	these attributes (font, margins, display, background, positioning , floating , border, padding) to magnify the presentation of html elements		• **Add CSS to web pages**
			  o External CSS,
			  o internal CSS,
			  o inline CSS (Meaning of Cascading from 3 levels)
			• **Styles**
			  o Font
			  o Margins
			  o Display
			  o Background
			  o Positioning
			  o Floating
			  o Border
			  o Padding
				allow text wrapping
				
				• Students in a html page set classes and ID selectors to html elements[div, span, images, paragraph, tables] and apply styles suggested by teacher
				
				• Students apply styling events to html links(Focus, hover, visited)
				• Use float/display to lists to make horizontal menus
				
				• After individual use of each styles to html elements students are given tasks to design a homepage having header, navbar, content, sidebar and footer to their school.

Link to other subjects:

Assessment criteria : *Students can build standards compliant web pages using HTML and CSS*

Materials: *computers ,Netbean IDE, HTML and CSS Editor, projector, digital material*

5.3.Secondary Five

5.3.1Key competences at the end of secondary 5

- Identify, use and maintain laptops and other portable devices

- Use complex data structure in algorithm

- Apply pointers for dynamic memory allocation and structure as user defined data type in C ++ program

- Explain common concepts of Object Oriented Programming(OOP) and implement them in C++

- Use visual basic programming language to build standard desktop applications

- Explain process cycle life and scheduling in Operating System

- Explain principles, standards and purposes of computer network

- Identify concepts of database and differentiate database models

- Design conceptual, logical and physical levels of a database

- Create, build and run a java program to the console

- Use objects to manipulate data in Java Program

- Use streams, readers and writers in Java program

5.3.2 Computer Science units for Secondary 5

TOPIC AREA: COMPUTER SYSTEM AND MAINTENANCE			SUB-TOPIC AREA: COMPUTER SYSTEM		
Senior 5 : Computer Science		**Unit-1:** Fundamental of laptop and portable devices			**No. of Periods: 8**
Key Unit Competency: To be able to identify, use and maintain safely laptops and other portable devices					
Learning Objectives			**Content**		**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**			

• Identify common uses of laptops, tablets and smart phones.
• Differentiate portable device and cell phones
• Explain the difference between laptops and desktop components
• Identify internal and external components of laptop and explain their cleaning procedures
	• Describe the use and functions of laptops, tablets, PDAs and Smart phones.
	
	• Compare and contrast desktop and laptop components.
	
	• Configure
		• Be aware of possible Synchronization between PC, laptops, PDAs and smart phones	• **Portable devices**
			  o Definition
			  o Type :Laptops, smartphones, PDAs, tablets
			• **Laptop**
			  o common uses,
			  o Features
			  o Evolution
			  o components (External and Internal)
			  o Compare and contrast desktop components
			  o Motherboard
			  o Processor
			  o Expansion capabilities
				• Through group work, teacher provides a laptop ,PDA, mobile cell phone and students will identify and describe parts of them
				
				• Through group work, the teacher provides a desktop computer and laptop, students compare components.
				
				• Through teacher's guidance students configure laptop power settings

				o Power management	• Through teacher's guidance
	power management on laptop			**Smartphone, PDAs, tablets**	students clean up laptop components
				o Common use	
				o Features	
	• Clean laptop and portable device			o Evolution	
				o standards service	
				Laptop and portable devices cleaning procedures	
				o Keyboard	
				o Ventilation	
				o LCD screen	
				o Touch Pad	

Link to other subjects:

Assessment criteria: *students can describe laptops and other portable devices*

Materials: *Computers, projector, laptop, smartphone, tablet, digital material*

TOPIC AREA: DATA STRUCTURE AND ALGORITHMS			SUB-TOPIC AREA: ALGORITHM	
Senior 5 : Computer Science	**Unit-2:** Complex data structure in algorithm			**No. of periods:** 18
Key Unit Competency:To be able to utilize complex data structure in algorithm				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Identify the use of two-dimension array in algorithm
 	
• Identify and explain abstract data structures
 	
• Identify appropriate steps to resolve a complex mathematical problem
	• Use Two-dimension array in algorithm
	
	• Write an algorithm that require the use of complex data structures
	
	• Design an algorithm and flowchart to resolve complex mathematical problem
		Appreciate the use of abstract data type in an algorithm	• **Two dimensional Arrays**
			  o Declaration
			  o Accessing array elements
			  o Initialization
			• **Abstract data structure**
			  o List
			  o Queue
			  o Stack
			  o Tree
			• **Search and Sorting using complex data structure** (list ,Queue ,Stack ,Tree)
			• **Apply algorithm to solve complex**
				• Teacher will give exercise to learners related to 2-dimensional array
				
				• The teacher will provide written algorithm and ask students to determine the different complex data types present in each algorithm
				
				• Teacher will provide an exercise that require the use of complex data types and ask students to write the corresponding algorithm

			mathematical functions	
			Quadratic equation	• Teacher will present any mathematical problem relate to Quadratic equation, Sum, Factorial, GCD etc and learners will write programs using complex data structure
			Recursive function(summing a list of numbers, factorial function ,Fibonacci series function ,sorting, palindrome	
			Euclid's GCD (greatest common denominator)	
			Fourier Transform	

Link to other subjects: *Mathematics (related to numerical functions)*

Assessment criteria: *students can utilize two dimensional array, link list, stack, queue and tree in algorithm. Students can be able to search and sort element in these structures. Students can perform complex mathematical functions like Factorial, GCD*

Materials: *Computers ,projector, network connection, digital material*

TOPIC AREA: NETWORKING		SUB-TOPIC AREA: NETWORKING TECHNOLOGY	
Senior 5 : Computer Science	**Unit-3:** Introduction to computer network		**No. of periods: 26**
Key Unit Competency: To be able to explain principles, standards and purposes of computer network			

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes an d values**		

• Explain properties ,advantage /disadvantages and types of computer network
• Identify Network devices, UPT and Optical Fiber as guided media, Radio waves as unguided media
• Identify network concepts and technology
	• Identify properties ,advantage /disadvantages and types of computer network
	• Differentiate network concepts and technology
	• Categorize Local Area Network Networks
	
	• Install NIC card ,configure it and connect RJ45
		Appreciate the use of NIC ,network devices , network peripherals and connection between them	• **Computer Network**
			  o Definition
			  o Properties
			  o Advantages/ Disadvantages
			  o Type (PAN ,LAN ,MAN ,WAN)
			• **Computer network concept and technology**
			  o Latency
			  o Bandwidth
			  o Data flows / transmission (frame , packets , simplex , half duplex, full duplex)
			  o Internetwork (Internet , Intranet , Extranet)
			• **Local Area network**
			  o Definition
				• The teacher asks students to write an essay on computer networks importance in our daily life
				
				• Teacher provides NIC card, UTP cat 6 cables and RJ 45 connectors, crimping tools and asks students to install NIC Card to the motherboard and make network cables both cross over and straight using UTP cable

• Identify different Local Area Network • Compare Client-Server and Peer 2 Peer networks • Explain function of hub and switch and give difference between them • Differentiate static IP address and dynamic IP address • Explain advantage and disadvantage of using working group • Differentiate LAN topologies and technologies used	connector • Connect USB modem to computer and install • Configure Smartphone and Laptops for tethering to use as wireless hotspot • Configure Wireless router for access control, DHCP • Configure a computer as host for Internet Connection Sharing (ICS) • Install and configure hub /switch and connect hosts to them • Make straight cable and crossover using untwisted pair cable (UTP) • Assign IP address to a host using dynamic and static assigning		o Categories o peer to peer (advantages , disadvantages) o Server /client (advantages , disadvantages) • **Physical components** o Nodes/ Computers/ Hosts o NIC Card installation and configuration o MAC address o Modem o RJ 45 connector and port • **Network devices** o Hub, o Switch and o Bridge (frame) • **Network transmission medium** **Guided** o Coaxial cable o Twisted pair cable (categories , UTP/ STP) o Cable Making (cross-over and straight through) **Unguided** o Radio waves o Wi-Fi o Bluetooth o Infrared to be added	• Teacher provides UTP straight cables ,switch /Hub and ask students to connect computers/host to the switch /Hub assign them IP address ,check connectivity using ping and ipconfig command attach network peripherals to the hosts and share files, folders and peripherals • The teacher presents different graphics representing different topologies and ask students to identify them • Teacher provides UTP straight and crossover cables ,switch /Hub and ask students to connect computers/host to the switch /Hub and make star and extended start topology

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	method • Check connectivity between two nodes/hosts • Create a working group ,join ,change working , and share files and network peripherals		o GSM, Cellular technology, 2G, 3G, 4G o Location tracking through GPS • **IP address** o Definition o Type (IPV4, IPV 6) o IP assignment (static ,DHCP) o ping, ipconfig command o IP packets • **Data and device sharing** o Working group o Network peripherals (Printer, Scanner , Storage Devices) o Connect network peripheral to host o Sharing file , folder and peripherals • **LAN topology** star ,extended star ,ring ,mesh ,bus , tree	

Link to other subjects:

Assessment criteria: *Students can explain all kind of transmission medium, devices, topology and related networking technologies confidently*

Materials*: Computers, projector, digital material, network connection, CAT-6 Cable, Cabling Duct, RJ-45, Optical Fiber, networking tool kit, Switch, USB Wireless Modem, Wireless Access Point, Wireless Router, Cisco Packet Tracer simulator software*

TOPIC AREA: DATABASE			SUB-TOPIC AREA: RELATIONAL DATABASE DESIGN	
Senior 5 : Computer Science		**Unit-4:** Introduction to Database		**No. of periods:** 12
Key Unit Competency: To be able to identify concepts of database and differentiate database models				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
Describe database concepts, data independence, database models	• Explain data independence, access level and user management • Differentiate between logical independence and physical independence • Differentiate among database models	Appreciate the role of database and its management	• **Database Concepts** Definition, Areas where database is used, Database approaches (Traditional File Processing (TFP),Database management system (DBMS)) Database access levels and users • **Data independence** Logical independence, Physical independence • **Database models** Definition, roles and	• Teachers will ask students to research and write an essay on database concepts and DBMS • Learners discuss in group about differences between logical independence and physical independence

			components of Hierarchical model ,Network model an Relational model	

Links to other subjects:

Assessment criteria: *Students can identify concepts of database, differentiate among different types of database models*

Materials: *Computers, Projector, Internet Connection, digital material*

TOPIC AREA: DATABASE			SUB-TOPIC AREA: RELATIONAL DATABASE DESIGN	
Senior 5 : Computer Science		Unit-21: Database design		No. of periods: 24
Key Unit Competency: To be able to define conceptual, logical and physical levels of a database with database creation and manipulation				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		

• Describe each levels of database design
 	
• Describe table, record, field, cell, value, domain, Null, field data types and field size, constraints, table structure, degree, ,cardinality, candidate key ,primary key ,alternate key,
	• Identify important Entities and their Attributes from a given real life situation
	
	• Draw an Entity and their associated Attributes
	
	• Draw an Entity Relationship Diagram
	
	• Integrate conceptual ,logical and physical theory to design a
		• Have a good understanding on design levels to make a functional database
		
		• Identity appropriate database for a given situation
		
		• Enumerate database design steps starting from Investigation up to Data base management
		
		• Appreciate use of
			• **Database design levels**
			  o Conceptual level
			  o Logical level
			  o Physical Level
			• **Database design steps** –
			  o Investigation / Analysis of Situation
			  o Identification of Important Entities and their Attributes
			  o Identification of relationship among entities
			  o Representation of Entity Relationship (E-R) Diagram with
				• Teacher and students will identify areas where database can be applied and students will design conceptual , logical and physicals levels of the database
				
				• Students will do Individual exercises on Entity Relationship Diagram
				
				• Student work on creating tables by defining structure, setting simple or

composite key , foreign key, Relationship in tables, base table, base key, foreign table, foreign key, referential integrity rule • Describe meaning and steps of Normalization and various Normal form (1NF, 2NF,3NF, 4NF)	database • Create a database with several table • Create a relationship between different tables • Create queries using Design View	design view to graphically create new queries	symbols ○ Database creation with tables ○ Database optimization through normalization ○ Data Entry and Manipulation • **Types of Relationship** (1-to-1, 1-to-Many, Many-to-Many) Definitions table, record, field, cell, value, domain, Null, field data types and field size, constraints, table structure, degree, ,cardinality, candidate key ,primary key ,alternate key, composite key ,foreign key, Relationship in tables, base table, base key, foreign table, foreign key, Referential integrity rule, queries in design view, dynamic queries using parameter	composite primary key, creating relationship among tables, use foreign tables and foreign keys, enforcing referential integrity rule, create query using design view

			• **Database optimization through Normalization,** Definition , Normal form (1NF,2NF,3NF, 4NF)	

Links to other subjects: *Mathematics(Arithmetic)*

Assessment criteria: *students can differentiate conceptual ,logical and physical levels of a database and suggest a suitable database solution for a real life situation with queries*

Materials: *Computers,, Projector, Internet Connection, digital material*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: PROCEDURAL PROGRAMMING	
Senior 5 : Computer Science			**Unit-27:** Pointers and Structure in C++	**No. of periods: 20**
Key Unit Competency: To be able to apply pointers for dynamic memory allocation and structure as user defined data type in C ++ program				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Describe the use of pointers for dynamic memory allocation with graphical representation • Describe the use of Structure as user defined data type and its memory allocation	• Define , declare and use pointers in C++ programming language • Define , declare and use structures in C++ programming language	• Appreciate the use of Pointers for dynamic memory allocation • Appreciate the structure as user defined data type • Read and interpret a simple C++ program containing pointer and provide the intended results • Read and interpret a simple C++	Dynamic memory allocation and its advantages over static memory allocation **Pointers :** Definition ,& (reference operator),* (dereference operator), Declaration ,initialization Graphical representation of pointer for referencing memory location Increment / Decrement a pointers	• Teacher will provide some written programs and ask students to identify pointers and structures used in those program • Teacher will provide a program containing pointer and ask students to interpret it and give out its output • Teacher will provide a program containing structure and ask students

		program containing structure and provide the intended results	Name of array as a pointer **Operation on pointers**: Comparison of pointers, Subtraction of pointers ,Assignment of pointers **Structure as user defined data type:** Definition, Declaration ,Initialization, Calculate Memory consumption by structure **Use of structure** : Use members of a structure ,Global use a structure Pointer to structure Nesting structure :Structure containing array, Array of structures, Structure containing other structure	to interpret it and give out its output • Teacher will ask students to write a program according to a given exercise requiring the use of pointers and structures and execute it

Links to other subjects: Mathematics (Arithmetic related to address calculation in pointers and memory consumption by a structure)

Assessment criteria: students can apply pointers for dynamic memory allocation and structure in C ++ program

Materials: Computers, projector, digital material, internet connection, C ++ Compiler

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: OBJECT ORIENTED PROGRAMMING	
Senior 5 : Computer Science			**Unit-28:** Object Oriented Programming in C++	**No. of periods: 36**
Key Unit Competency: To be able to explain common concepts of Object Oriented Programming(OOP) and implement them in C++				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Describe basic Object Oriented Programming concepts • Describe different object oriented syntaxes applied in C++ program	• Explain basic Object Oriented Programming concept • Define a class with data members and some function members defined inside or outside class definition • Derive a new class from base class in various mode of derivation: public, protected, private	• Appreciate the contribution of object oriented programming paradigms in software development in terms of reusability, reduced cost of software development • Appreciate the use of classes and objects in programming	**Definition of Object Oriented Programming** **Basic concepts of Object Oriented Programming** **Encapsulation:** binding data and function together in a class **Defining Class in C++** Data hiding through access specifiers (private, protected , public)	• Teacher will ask students to do research and write an essay on Object Oriented concepts and principles • Teacher will provide a written program and ask students to identify classes and objects used in the program • Teacher will provide a program containing classes and objects and ask students to interpret it and give out its output

			Data members	• Teacher will ask students to write a program according to a given exercise requiring the use of classes and objects and execute it
	• Define constructor and destructor		Function Members	
			Defining member function Inside or Outside the class definition	
	• Create objects in main program from a class and access object data and object functions, constructor and destructor and friend function		**Object :**Definition, Characteristics (attributes as data member and methods and member function)	• Teacher will give several C++ program exercises to students to implement Constructor, Destructor and Inheritance
			Objects in C++	
			Creating single object, Creating array of objects	
			Object data and functions in main program	
			Passing object to function	

			Friend Function	
			Polymorphism in C++	
			Operator overloading	
			function overloading	
			Constructors in C++	
			Syntax	
			Characteristics Parameterized Constructors(Implicitly ,Explicitly)	
			Overloading constructors	
			Default Constructor	
			Destructors in C++	
			Syntax	
			Characteristics	
			Use of destructors	
			Inheritance in C++	

| | | | Advantages of Inheritance, Reusability, selling classes as building blocks to derive new classes

Inheritance rules related to Public derivation, Protected derivation and Private derivation

Multi-level inheritance

Multiple inheritance

Hybrid inheritance | |
|---|---|---|---|---|

Links to other subjects: *Mathematics (Arithmetic) related to functions*

Assessment criteria: *students can explain common concepts of Object Oriented Programming and use Classes, Objects, Constructor, Destructor, Polymorphism and Inheritance in C++ program*

Materials: *Computers, Projector, Digital material, Internet connection, C++ compiler*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: EVENT ORIENTED PROGRAMMING	
Senior 5 : Computer Science		Unit-29: introduction to Visual basic		No. of periods: 24
Key Unit Competency: To be able to describe a Visual Basic Integrated Development Environment (VB-IDE) and write a program in Visual Basic.				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	Skills	Attitudes and values		
• Describe Visual Basic and its Integrated development environment(IDE) features • List components of Visual basic IDE such as Form, Label, Input Box, Radio Button,	• Work in Visual Basic environment (open , write codes ,compile, close) • Drag and drop control from a tool box on a form(Form designing) • Write Visual Basic code on various events of controls dragged on form	Appreciate contribution of visual basic programming to create software with Graphical User Interface(GUI) over Command User Interface(CUI)	**Definitions** o Graphical User Interface, o Desktop Application, o Event oriented programming using Visual Basic **Visual Basic Integrated Development Environment (VB-IDE),**	• Using a printed out screenshot of the main interface of Visual Basic environment allow learners to identify each component of the Visual Basic interface • Teacher sets a practical work of designing a form using various controls such as labels, textbox and

| Check Box, Command Button, DAO, ADO, File and Folder, Image, Timer, Calendar, ComboBox, ListBox control | • Run and debug a program in Visual Basic

• Solve a problem by writing a program in Visual Basic by using components of Visual basic IDE such as Form, Label, Input Box, Radio Button, Check Box, Command Button, DAO, ADO, File and Folder, Image, Timer, Calendar, ComboBox, ListBox control | | Design a form using controls

Visual basic features, IDE features, New project window,

Visual Basic environment (Tool Box, Form Window, Code Window, Project Window, Properties Window, Form Layout Window, Menu Bar and Tool Bar)

Visual Basic Controls

Form, Label, Input Box, Radio Button, Check Box, Command Button, DAO, ADO, File and Folder, Image, Timer, Calendar, ComboBox, ListBox control | command buttons etc

• Teacher provides written program containing bugs/errors and ask students to run and debug it

• Teacher will provide problems to student and ask students to provide solutions using VB language by creating a user friendly interface using some components of visual basic IDE.

• Teacher provides practical questions(problems) by |

			Setting Properties of various controls Planning and Developing a VB program, Running, Testing and Debugging a VB program, Building an Executable file, deploying a VB project, **Developing a User Interface with menus and Sub-menus using Visual Basic**	which students design a form containing menus, submenus and write a programs

Links to other subjects:

Assessment criteria: *Students can Describe a Visual Basic Integrated Development Environment (VB-IDE), design graphical user interface with several controls on forms and write required VB code for different events of control*

Materials: *Computers , Projector, Internet connection, Visual Basic IDE, digital material*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: EVENT ORIENTED PROGRAMMING	
Senior 5 : Computer Science		**Unit-30:** Variables, Operators, Expressions and Control structures		**No. of periods: 24**
Key Unit Competency: To be able to use variables, operators, expressions and control structure in a Visual Basic program				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Explain the role and importance of variables in Visual Basic program • Describe the use of operators and evaluate expression in Visual Basic program • Explain the use of	• Declare, Analyze and manipulate variables in Visual Basic program • Use operators and evaluate expression in Visual Basic program • Write a program in Visual Basic using different types of decision structures	• Appreciate the use of variables, operators, expressions and control structure in Visual Basic Program	• **Types of Visual Basic Data:** Numeric, Non-numeric, Suffixes for Literals • **Variables:** Variable names, Variable declaration (implicit and explicit, Type declaration characters), Variable initialization	• With the help of a written program in Visual Basic, teacher asks students to list and describe variables and operators used in the program • Teacher gives an exercise in Visual Basic requiring students to apply operators and evaluate expression • Students creates a simple

control structures in Visual Basic program	• Write a program in Visual Basic using different types of loop structures		Constant • **Scope of a variable:** ○ Private (or Local)Scope ○ Module (Global) Scope ○ Public Scope • **Operators:** Arithmetic , Relational, Logical operators, concatenation, bitwise operators, Operator precedence • **Decision structures**: Definition and Role if……then statement, if …then…else statement, Nested if ….else statement, , Select case statement • **Repetition structures:** Definition and Role An indeterminate loops(do	arithmetic calculator using operators and expressions • With the help of a written program containing control structure, teacher asks students to analyze the program and generate an output • Teacher gives exercise requiring students to apply decision and repetition structures

			while ....loop, do until ...loop, do ....loop while, do ...loop until) Determinate loops (For ....Next, For Each... Next)	

Links to other subjects:

Assessment criteria: *Students can use variables, operators, expression and control structure in a Visual Basic program*

Materials: *Computers , Projector, Internet connection, Visual Basic IDE, digital material*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: WEB PROGRAMMING	
Senior 5 : Computer Science		**Unit-31:** Introduction to Java		**No. of Periods: 24**
Key Unit Competency: To be able to create, build and run a java console program				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Describe local and global identifiers, constants and variables in Java program
 	
• Describe integer, floating point, character, Boolean, and object data types.
 	
• Describe data structures or types (e.g.,
	• Transform an algorithm into a java program
	
	• Write, compile and run a java program
	
	• Predict the output of a given program containing sequential, conditional, or iteration statements.
	
	• Complete a program segment involving only
		Appreciate how Java program are strongly typed	**JAVA**
			• **Introduction**(Definition and invention)
			• **Platforms**(Java Runtime Environment-JRE, Java Development Kit-JDK)
			• **Advantages of JAVA Program.**
			• **Compile and run a java Program**
			• **Elements of Java source file**
			  o **Class**,
			  o **Method**[method name, arguments],
			  o **Statement**[Definition, application],
			  o **Expressions**[Definition and application],
				• Students write a program that prints a word, concatenated words, sentences and values of different variables to the console.
				
				• Write a program in which two integer values are declared and basic calculator operators are used to print the sum, difference, product and division to the console
				
				• Students execute a requested program using suggested key elements such as kind of data types, methods, methods with arguments and print the result to the console

| arrays, strings, linked lists, trees, hash tables, records, files, stacks, queues, sets, maps). | sequential execution when given an incomplete program with a specified output.

• Complete a program segment for a specified output given an incomplete program containing conditionals.

• Debug a program containing an error involving conditional and iteration statements. | | o **Keyword**s[access modifier, data types],
o **Variable**(Definition and example, variable data type, variable name and value, instance variable, method parameter and local variable)
• **Primitive Types** (Boolean, byte, short, char, int, long, float and double) Declaration and casting
• **Objects**[Predefined or user defined]
• **Equality**[Reference and Object Equality]
• **Naming convention in Java** Class, method, variable, constant, package
• **Flow control** if-else, while, do-while, for, break, continue, switch | • Students write programs that contains flow controls and print the result to the console

• Students predict the output of a given program or a section of program.
• Students evaluate errors in a given section of code or the entire program

• Students use EQUALITY(==)to compare two objects to see if the variables reference the same object in memory.
• Students are to convert a given algorithm into a program using flow control, predict the result of a program and conduct corrections when a program has errors. |

Links to other subjects: Mathematics (Arithmetic) related to functions

Assessment criteria : Students can create, build and run a standard Java console program

Materials: computers , projector, digital material, NETBEANS/HTML editor, internet connection

TOPIC AREA: PROGRAMMING	SUB-TOPIC AREA: WEB PROGRAMMING AND JAVA ENTERPRISE APPLICATION	
Senior 5 : Computer Science	Unit-32: OOP and Java	No. of Periods: 24

Key Unit Competency: To be able to use objects to manipulate data in Java program

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Describe instance, class, and local (method) variables in an object-oriented program.
 	
• Describe components of class declarations for an object-oriented program (i.e., instance and class variables, constructors, methods).
 	
• Describe public and private
	• Create and instantiate a class using main method.
	
	• Use constructor to initialize instance variable of a given object
	
	• Store elements and retrieve them in array.
	
	• Create a parent class that is being inherited by child classes and instantiate both parent and child classes(eg. triangle, square, rectangle as children of shape class)
	
	• Predict the output of a given
		• Appreciate the use of objects in programming languages.	**JAVA**
			• **Class vs. Objects**
			  Java Virtual Machine(JVM)
			• **Constructor**(explicit, implicit, default)
			• **"*new*" and *"this"*** keywords
			• Reference variable
			• **Arrays vs. Objects**
			Definition, declaration, initialization and access
			
			• **Inheritance**
			
			  ○ **Extend**s a class
			  ○ **Casting** primitive and Objects
			  ○ **Access Modifiers**
				• Create a class with a method that print a given message and create the another with main method to instantiate objects and call the method of first class to print the message.
				
				• Student extends a class with another class and call the method objects of parent and child classes.
				
				• Override the method in child class and print again result of two classes

methods in an object-oriented program. • Describe key features of object-oriented programs (i.e., encapsulation, inheritance, polymorphism). • Describe the strengths or weaknesses of object-oriented and procedural languages.	program containing arrays, encapsulation and inheritance • Complete a program segment involving use of objects when given an incomplete program with a specified output. • Complete a program segment for a specified output given an incomplete program containing conditionals. • Debug a program containing an error involving arrays, objects		(Public, protected, private, package-private) ○ **Overriding** methods and variables, **final and super** keywords ○ **Encapsulation[Getter and setter)** ○ **Abstract classes and methods**	objects. • Create a class that have more than one properties, encapsulate these properties by creating getters and setters, constructors then create a class with main method to instantiate the first class using constructor and use getter and setter to access values of class properties.

Links to other subjects:

Assessment criteria :*Students can use objects to manipulate data in Java Program using Object oriented features especially encapsulation and inheritance.*

Materials: *computers , projector, digital material, NETBEANS/HTML Editor internet connection*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: WEB PROGRAMMING	
Senior 5 : Computer Science		**Unit-33:** IO and Java		**No. of Periods: 12**
Key Unit Competency: To be able to use streams, readers and writers in Java				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Describe streams, readers and writers • Describe the importance of streams, readers and writers in manipulation of files	• Read , manipulate and display user inputs to the console . • Catch Input/Output Exceptions while reading data to the console. • Read and display data of text file	Appreciate the manipulation user's inputs and of files using streams, readers and writers	**IO streams** Definition of IO streams Role of IO streams **InputStream and OutputStream** **FileStreams**(FileInputStream,FileOutputStream) **Readers** Definition and role of readers FileReader,bufferedReader InputStreamReader PrintStream(System.out) Println	• Students write a program that prompt their name, read it from the console, and then display it in a message • Create a program which allows to input two values (x and y) and then calculate the sum, difference, product and division • Students write a program which evaluate prime numbers and quit if a specific letter is pressed. • Students build a program that read a .text file and display the content to the console.
Links to other subjects: *Mathematics (Arithmetic) related to calculation of sum, prime numbers*				
Assessment criteria : *students can use streams, readers and writers in manipulation of user's inputs and files*				
Materials: *computers , projector, digital material, NETBEANS/HTML Editor, internet connection*				

5.4. Secondary six

5.4.2. Key competences at the end of Secondary 6

- Enumerate various security threats and ensure security of computers

- Resolve complex mathematical problem using C++ programming language

- Open, close, create a data file in C++ and read, write and append data to Files

- Link Visual Basic Program to a Database and develop a short project in Visual Basic

- Describe role of operating system in file management and memory management

- Build a peer to peer computer network

- Use SQL commands and Create a small database project

- Use collections to store and manipulate data

- Design and run a Java dynamic web application

- Describe computer graphics terminology, capture graphics images and edit them using software

- Explain the different use of multimedia and interactive multimedia applications and use multimedia software to create video.

5.4.2. Units table for Secondary 6

TOPIC AREA: COMPUTER SYSTEM AND MAINTENANCE			SUB-TOPIC AREA: MAINTENANCE	
Senior 6 : Computer Science		**Unit-34:** Computer Security		**No. of periods: 12**
Key Unit Competence: To be able to enumerate various security threats and ensure security of computers				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Describe various kinds of attacks and security threats • Describe physical and logical security • Describe various security mechanism and tools	• Set physical security for computers • Identify and distinguish among various security threats such as virus, trojans, worms, spyware, shoulder surfing, back door attack, denial-of-service attack, spoofing, eavesdropping, social engineering, website	• Show concern on computer threats prevention and develop awareness on hardware and software security	• **Why computer security? Computer threats** o Physical vs logical • **Computer attacks :** Virus, Trojans, worms, Spyware, Shoulder Surfing, Back door attack, Denial-of-Service attack, spoofing, eavesdropping, Social Engineering, Website Hacking, Cyber crime, Unwanted content, Pornography and Violence, Hate Media • **Source of virus and other**	• Teacher will provide a computer infected by virus and ask students to detect and remove them • The teacher will ask students to write an essay on computer threats and their solutions

	hacking • Apply computer security mechanism against computer threats and configure them properly		**attacks:** o Computer network o Internet o removable media • **Damage caused by threats** o For home users o For corporate network • **Threats protection and precaution:** o Antivirus o Anti spyware o Firewall o Parental Control o Access Control through Username and Password o Identification/ Authentication, Authorization o Bio-metric authentication o Encryption/ decryption o Backup and Recovery point	

Links to other subjects:

Assessment criteria: *students can enumerate several kinds of attacks and ensure security of data in computers and in network*

Materials: *Computers, projector, digital material, computer repair tool kit, anti virus, firewall and related security software, external hard disk,*

TOPIC AREA: NETWORKING			SUB-TOPIC AREA: NETWORK MODELS	
Senior 6 : Computer Science		**Unit-35:** LAN architecture, Network protocols and models		**No. of periods: 24**
Key Unit Competency: To be able to identify computer network models, protocols and configure network devices				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Explain Ethernet LAN architectures • Describe cable Ethernet standard • Identify wireless Ethernet standard • Explain token ring architecture	• Explain IEEE 802.3 and carrier sense multiple access with collision detection • Differentiate among various cable Ethernet standard • Differentiate among various wireless Ethernet standards • Describe multi - station access unit	Appreciate the role of LAN architecture ,Network protocols and models in computer network	• **LAN architecture** Ethernet(IEEE 802.3 standard , CSMA/CD) • **Cable Ethernet standard** o 10BASE-T ,100BASE-T, 1000 BASE-T o Advantages/ disadvantages o Wireless Ethernet Standards o Types (,802.11a,802.11b ,802.11g ,802.11g) o Range ,Bandwidth ,Frequency o Advantages /disadvantages o Token ring(MSAU) • **Fiber Distributed Data Interface** Fiber optic cables	• Students look at their school's Local Area Network, physical devices if available. Teacher facilitates learners to identify the LAN architecture, different cables and wireless standard being used in school or nearby locations • Teacher provides wireless NIC to students and ask student to physically install the card in computer, download driver and

			Fiber-Optic Ethernet Technologies (10BASE-FL, 100BASE-FX, 1000BASE-SX)	configure it
• Explain Fiber Distributed Data architecture • Explain steps to install and configure wireless NIC, connect it to access point • Explain steps to install and configure access point and set up security • Explain different computer network models and protocols • Identify network layers, differentiate various protocols and devices user on each layer • Differentiate packets switching and circuit switching	• Describe Fiber Distributed Data architecture • Install wireless NIC and configure it • Connect a host /computer to access point • Install and configure router and connect a switch/ hub to a router with Physical router or in Network Simulator software • Install and configure multi function device and connect computers to it • Configure email using POP,IMAP and SMTP and perform file transfer using FTP • Identify network model, use protocol		**Network devices** o Access points, Function o Wireless NIC card installation and configuration o Connecting Host to Access Point o Access point installation and configuration o SSID and encryption o Modes (AP , AP with Bridge) o Router ,Function o Default gateway o Public and private IP o Installation and configuration o Multi function device ,Function o Default gateway o Installation and configuration **Computer Network protocols** o Definition ,Role and function o Most used protocol and application(TCP ,DHCP, IP, UDP, NETBEUI NETBIOS, HTTP and HTTPS, FTP, SSH, Telnet, POP, IMAP , SMTP) **OSI and TCP/IP data models** o Open Source Interconnection o Application layer(role, function	• Teacher provides access point ,he shows students how to configure it and he asks students to configure in group work • Students connect host /computer to the access point • Teacher provides router ,he shows students how to configure it and he asks students configure it in group work Teacher provides multiple function device ,he shows students how to configure it and he asks students configure it in group work students draw network model layers, allocate protocols and devices to their corresponding layer they are used

	and devices found in each layer • Describe different layers associate with each network model		and protocols used) ○ Presentation layer (role, function and protocols used) ○ Session layer(role, function and protocols) ○ Transport layer (role, function, and protocols), ○ Network layer (role, function, devices and protocols ○ Data link layer (role, function, devices and protocols) ○ Physical layer (role, function, devices) • **TCP/IP model** ○ Application layer(role, function and protocols) ○ Transport layer (role, function, and protocols) ○ Internet layer (role, function, devices and protocols) ○ Physical layer (role, function, devices) ○ OSI vs. TCP/IP models • **Network Switching** Packets switching, Circuits switching	

Links to other subjects: Mathematics (Arithmetic), Electronics

Assessment criteria: Students can identify computer network models and protocols, install network devices and configure them

Materials: Computers , Projector, Digital material, Network connection with Internet, CiscoPacket tracer Network simulator

TOPIC AREA: NETWORKING			SUB-TOPIC AREA: NETWORK TECHNOLOGY	
Senior 6 : Computer Science		Unit-36: Networking Project		No. of periods: 16
Key Unit Competency: To be able to Build a computer wired and wireless network				

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Explain and develop step by step process of making peer to peer network and client/ server network • Explain steps of making a wireless network using Wireless Access Point	• Recognize use of various networking tools to create network safely avoiding cuts, wounds and electrical shock • Install and configure network devices –sub, switch, routers, wireless access point • Use cabling ducts to properly secure and hide network cables • Configure Wi-fi to	Appreciate the creation and configuration of computer wired and wireless network	**Transmission medium** Guided and Unguided medium Cabling : creation of cables (cross-over and straight) **Networking tools** (CAT6 cable, RJ-45 connectors, Cable cutter, Crimping tool, cable stripper, cable tester, screw driver, hammer, drilling machine, cabling ducts, flasher clips, screws	• Teacher will provide network cables, computers, network devices and ask students to build a computer network • Learners with help of teacher will create Wireless network using Wireless Access Point • Teacher will bring a laptop with in-built wireless and learners will configure Wi-fi to connect this Laptop to

	connect a Laptop to a network and access wireless internet • Allocate IP addresses to computers in network • Share files, folders and printers in the network		etc) **Network devices**(Hub, Switch, modem, Router, Access Point , multiple function devices) installation and configuration **IP address allocation** (static and dynamic) **Data sharing** (File,Folder,printer etc) Build peer to peer network Build Client / Server network	wireless internet • Teacher will provide a document copied in one computer and a printer connected on that computer. He asks students to share document and printer so that it can be accessible from remaining computers

Links to other subjects: *Physics (Electricity and Electronics)*

Assessment criteria: *students can build a computer wired or wireless network*

Materials: *Computers, Projector, digital material, Network connection with internet, network cable CAT6, cable cutter, cable stripper, crimping tool, cable tester, screwdriver, hammer, screws, flasher clips, drilling machine, cabling ducts, network devices, RJ 45 connectors*

TOPIC AREA: DATABASE			SUB-TOPIC AREA: RELATIONAL DATABASE DESIGN	
Senior 6 : Computer Science		**Unit-37: SQL and Database Project**		**No. of periods: 36**
Key Unit Competency: To be able to apply Structured Query Language in RDBMS and create a short database project				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Identify and explain different operations of relational algebra and calculus • Differentiate among various queries used on data definition, data manipulation and data control languages • Describe steps to develop a database	• Create a database using data definition language using CREATE DATABASE Query • Create a new table using CREATE TABLE query • Delete an existing table using DROP TABLE query • Modify an existing table using ALTER	Appreciate the use of SQL queries to define, manipulate and control database	**Relational algebra and relational calculus** **Unary operations :** Selection ,projection operations **Binary operations** : Union ,intersection, difference, division and join operations **Structured Query language** **Data Definition Language** (DDL) : CREATE DATABASE, USE DATABASE, CREATE TABLE	• Teacher will suggest tables of a real life database and ask students to implement it using one of RDBMS • Using tables of database created above, teacher gives many questions and ask students to write down corresponding SQL commands and implement them using the computer • Practical exercises on the use of relational algebra

project	TABLE query		,DROP TABLE , ALTER TABLE	and relational calculus
	• Insert new record into the database using INSERT query		**Data Manipulation** Language (DML) : INSERT ,SELECT (Aggregate functions , String expression), DELETE , UPDATE	• Individual work on SQL queries manipulation setting of a practical exercises on database security
	• Delete existing record from the database using DELETE query		**Data Control Language** (DCL) : GRANT , REVOKE	• Teacher will ask students to look around to find a real life situation where database is needed, then plan and develop a short database project for this and present to teacher as individual or group work.
	• Updated the existing record from the database using UPDATE query		**Database security concept:** Integrity ,availability , privacy ,confidentiality ,backup, remote access, concurrent access	
	• Display records from the database using SELECT query		**Database threats** : Unauthorized users ,Physical damage, Data corruption	
	• Identify Database requirement for a real life situation, plan and develop a short database project for this situation		**Database protection**: Access control, Data encryption **Database planning, designing and Management**	

Links to other subjects: *Mathematics (Arithmetic, Boolean Algebra, relational calculus)*

Assessment criteria: *Students can apply Structured Query Language in RDMBS and create a short database project*

Materials: *Computers , projector , digital material, internet, RDBMS software*

TOPIC AREA: PROGRAMMING		SUB-TOPIC AREA: EVENT ORIENTED PROGRAMMING	
Senior 6 : Computer Science	**Unit-38:** Arrays, functions and procedures		**No. of periods: 18**
Key Unit Competency: To be able to use array, functions and procedures in Visual Basic program.			

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Identify the importance of using array in the program • Identify the role of using each category of the function in the program • Give the syntax and step to write a function	• Differentiate Inbuilt function from user-defined function and their usage • Design and write a Visual Basic program using an array • Design and write a Visual Basic Program using a user defined and in-built functions	Appreciate the use of Arrays and Functions in Visual Basic Program	**Arrays:** Definition, Declaration ,Initialization, Entering and accessing array elements **Functions** Definition **Inbuilt functions:** MsgBox(), InputBox(), Mathematical functions, Formatting functions and string manipulation	• Student is asked to interpret and generate output of a visual basic program containing arrays and functions concepts • Practical work on array declaration, initialization, entering and accessing array elements • Teacher gives exercise requiring students to apply arrays and functions concepts • Student is given the

			functions,	practical work related to user-defined function by converting different types of data one into another one and vice-versa
			Graphical functions (Line and Circle Drawing Methods).	
			User-defined functions(	• Teacher sets an exercise by which students declare, define and call a user function or a procedure
			General definition and Syntax , Inline function, Function prototype (Function declaration), function definition and calling), passing by value and by reference in VB	
			Procedure	
			Definition	
			Syntax of a procedure	

Links to other subjects: *Mathematics (Arithmetic) related to Arrays and Functions*

Assessment criteria: *Students are able to use arrays and functions in Visual Basic program*

Materials: *Computers , Projector, digital material, Internet connection, Visual Basic IDE*

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: EVENT ORIENTED PROGRAMMING	
Senior 6 : Computer Science		**Unit-39:** Visual Basic project		**No. of periods: 16**
Key Unit Competency: To be able to connect Visual Basic interface to database and create a simple Visual Basic standard desktop applications for a real life situation				
Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
Describe Data Access Object (DAO), Remote Data Object (RDO) and Advanced Data Object (ADO) to establish connectivity between VB user interface and database Describe Requirement Analysis and Project Planning Describe steps of developing a visual	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 Write code to insert, delete, update, search and display records from database through Visual Basic Interface	Appreciate Visual Basic programming as strong tool to develop standard desktop applications with database connectivity.	Requirement Analysis and Project Planning Front end user interface in Visual Basic Back end database in Ms-Access , MySQL or any suitable RDBMS ODBC configuration DAO, RDO and ADO objects in Visual Basic ADODC, RECORDSET, ADDNEW, DELETE, UPDATE, MOVENEXT, MOVELAST,	Teacher asks students to look around for a real life situation for which a project in Visual Basic can be developed. Learners do requirement analysis and develop a short Visual Basic project with database connectivity

| basic project | Analyze real life situation to plan and develop a short VB project with appropriate database connectivity | | MOVEFIRST, MOVEPREVIOUS code in VB for data manipulation

Principals for designing a friendly and ergonomic user interface | |
|---|---|---|---|---|

Links to other subjects:

Assessment criteria: Students can use DAO or ADO object to create connectivity between VB interface and database and make a simple Visual Basic project for a real life situation

Materials: Computers, Projector, digital material, Internet connection, ODBC in Operating System, Visual Basic IDE

TOPIC AREA: OPERATING SYSTEM			SUB-TOPIC AREA: PROCESS MANAGEMENT	
Senior 5 : Computer Science		**Unit-40: Process Management and scheduling algorithm**		**No. of periods: 12**
Key Unit Competency: To be able to explain how processes are managed by Operating System and to understand process scheduling algorithms				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Describe how operating system manages processes
 	
• Describe the role of threads in operating system management
 	
• Describe the process scheduling of Operating System
 	
• Describe different
	• Identify states of a process
	
	• Differentiate a
	• process, a program and a thread
	
	• Explain the different process scheduling algorithms
		Appreciate the role of operating system in process management and scheduling	• **Process**
			  o Definition of a process
			  o Process execution requirement
			  o Process vs. program
			  o Process states
			  o Process control block (PCB)
			• **Thread**
			  o Definition of thread
			  o Difference between thread and process
			  o Types of threads
			  o Advantages and disadvantages of
				• Teacher will give students a diagram illustrating process management and ask student to interpret it.
				
				• Students will be asked to write an essay on Operating System Process Scheduling through research on internet and in books.
				
				• Students will be asked to interpret and comment

scheduling algorithms			threads • **Process Scheduling** Definition, scheduling Queue Process State Model (running and non – running), Schedulers (Long Term , Short Term , Medium Term) • **Process Scheduling Algorithms:** First Come First Serve (FCFS), Shortest-Job-First (SJF), Priority, Round Robin(RR), Multilevel Queue	on the different process scheduling algorithms

Links to other subjects:

Assessment criteria: *Students can explain role of Operating System in process management and scheduling algorithms*

Materials: *Computers, projector, digital material, internet connection*

TOPIC AREA: OPERATING SYSTEM			SUB-TOPIC AREA: FILE MANAGEMENT	
Senior 6 : Computer Science			**Unit-41:** File Management	**No. of periods: 12**
Key Unit Competency: To be able to describe role of operating system in file management and explain file management				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		

Describe structure of file, type of files, mechanism of accessing files, and space allocation of a file in memory	• Explain how file system manages computer hardware and computer software.
	
	• Explain type of files, mechanism of accessing files, and space allocation of a file in memory
		Appreciate file management done by operating system.	• **File**
			  o Definition
			  o File structure
			  o File systems (FAT, NTFS, …)
			  o File manipulation functions: creating and deleting files, reading and writing data, creating and deleting directories(folders)
			
			• **File types :** ordinary file ,directory file, special files
			
			• **File Access Mechanism :** Sequential access,
				• Teacher will give exercises where students are required to manipulate files.
				
				• Students will be asked to write an essay about file types, file access mechanism and space allocation of files.

| | | | Direct/Random access, indexed sequential access

• **Space allocation:** Contiguous allocation, Linked allocation, Indexed allocation | |

Links to other subjects: *Mathematics (Arithmetic)*

Assessment criteria: *Learner can explain how files are managed by Operating System*

Materials: *Computers, projector, digital material, internet connection*

TOPIC AREA: OPERATING SYSTEM			SUB-TOPIC AREA: MEMORY MANAGEMENT	
Senior 6 : Computer Science		**Unit-42: Memory Management**		**No. of periods: 14**
Key Unit Competency: To be able to explain the role of operating system in Memory Management				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Explain characteristics of computer memory • Identify different mechanisms of memory management	• Describe main memory characteristics • Explain the techniques of memory management	Appreciate how computer memory is managed by Operating System.	• **Memory Type:** Magnetic, Semiconductor, Optical, Flash • **Definition and characteristics of memory:** capacity ,access time, cycle time, on-volatility, speed, flow • **Dynamic loading, dynamic linking** • **Logical versus physical address space** • **Techniques of memory**	In a group, students will be asked to discuss about characteristics of memory and techniques of memory management**.**

			management: Swapping , paging , segmentation • **Memory Allocation and release :** Single-partition allocation, Multiple-partition allocation • **Fragmentation:** External fragmentation, Internal fragmentation • **Concepts of virtual memory, demand paging**	

Links to other subjects: Mathematics (Arithmetic), Physics (Electronics)

Assessment criteria: Learner can explain the role of operating system in memory management.

Materials: Computers, projector,   digital material, internet connection

TOPIC AREA: PROGRAMMING		SUB-TOPIC AREA: WEB PROGRAMMING AND JAVA PROGRAMMING	
Senior 6: Computer Science	**Unit-43:** Collections in Java		**No. of Periods: 18**
Key Unit Competency: To be able to use collections to store data in Java			

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Describe data structures or types (e.g. linked lists, trees, stacks, queues, sets, maps).
 	
• Differentiate algorithms used different collection classes
	• Create a collection using Set, List, Queue and Map collection classes and iterate elements stored in collection
	
	• Put a list of a given elements in a tree nodes.
	
	• Use appropriate methods to access objects stored in Queue, Stack and Tree
		Choose appropriate collection to store objects	• **Collections**
			  o Definition
			  o Collection classes(List, Queue,
			  o Set, Map)
			  o Difference between Set and List
			• **Creation of List instances using ArrayList**
			  o Declaration, instantiation, Access stored elements, boxing
			• **Hashset**
			  o Declaration,
				• Students create classes and encapsulates their instance variables by making them private and create their respective getter and setter then create another class with main method to create instance and add these objects to a collection(List, map, set).
				
				• Simultaneously, students create instance of various objects and add them to collections and access

			instantiation, Access stored elements, boxing
			• **HashMap**
			Declaration, instantiation, Access stored elements, boxing
			LinkedList
			• **Queue**
			Definition, FIFO principle, Add(), peek() and poll() methods
			• **Stack**
			  o Definition(Vector), LIFO principle.
			  o Push(), peek() and pop() method
			• **Tree**
			  o Definition
			  o Advantages of a tree(Order of items in a tree)
			  o Node in a Tree
			  o Storing elements in a tree
				them through iteration.
				
				• Students arrange items using a paper in form of Tree
				
				• Students write a program instantiate Tree, store elements in a Tree and access them in iteration.

Links to other subjects: *Mathematics (Arithmetic)*

Assessment criteria : *students can store multiple objects in collections in Java*

Materials: computers , projector, NETBEANS/HTML Editor , internet connection , digital material

TOPIC AREA: PROGRAMMING			SUB-TOPIC AREA: WEB PROGRAMMING	
Senior 6 : Computer Science		**Unit-44:** Java Enterprise web applications		**No. of Periods: 18**
Key Unit Competency: To be able to design and run a Java enterprise web application				

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Describe the stages of the software development process (i.e., problem definition, analysis, design, implementation, testing, maintenance).
 	
• Identify the use of features namely Scriplet, Expression, Directive, Declaration and Comments in JSP
	• Configure and manipulate tomcat web server.
	
	• Create a dynamic web application using JSP-SERVLET
	
	• Organize J2EE content in their appropriate folders.
	
	• Create JSP pages using features namely Scriplet , Expression, Directive, Declaration and Comments in JSP
		• Appreciate the use of controller to link user's views and the database.
		
		• Enjoy interaction with database through dynamic web application
			• **Tomcat**
			  o Definition
			  o Components of tomcat
			  o (Coyote, Catalina, jasper)
			
			• **HTTP Request**
			
			• **HTTP Response**
			
			• **Web application**
			  o Servlet objects(Definition, Role of servlet, servlet container)
			  o Java Servlet pages (JSP files),
			  o Resources (images, CSS, JS etc)
				• Students access tomcat administration page through port 8080, explore built-in webapps, stop and start tomcat, locate the configuration folder and manage tomcat-user.xml file
				
				• Students use NetBeans IDE to create Dynamic J2EE Application containing packages for classes and servlet, images and css folders and locate views inside WEB-INF and access them using a controller/servlet.

	• Use collections to set servlet attributes and display them in JSP content using Java Standard Tag Library and Expression Language
	
	• Design a form in JSP pages and access values in servlet using request methods like getParameter.
	
	• Name appropriately the URL to be displayed to the user in deployment descriptor(web.xml)
	
	• Establish a JDBC connection to MYSQL database
	
	• Create a J2EE application which interact with the database
	
	• Interrogate the database using SQL
			o Configuration files (namely web.xml, deployment descriptor))
			
			• **Installation and configuration of tomcat Configuration directory**
			  o Server.xml
			  o Tomcat-user.xml[add user]
			  o Web.xml
			  o Contex.xml
			• **Manage web applications**(start, stop, deploy and undeploy)
			
			• Use help **http://localhost:8080/docs/**
			• URL(**Uniform Resource Locator**)
			• **Components of URL**
			o Protocol
			o Port
			o Resource
			o Server
			o Path
			o Optional Query String
			
			• **Static and dynamic web**
				• Students create a collections of objects(String, integer) and access, set attributes names and access and iterate them to JSP files using EL and JSTL
				
				• Students use JSP features namely Scriplet , Expression, Directive, Declaration and Comments in JSP
				
				• Students design a HTML form in JSP pages and access values in servlet using request methods like getParameter.
				
				• Students give meaningful names to servlets in deployment descriptor
				
				• Students set connection to the database using MYSQL-JDBC connection, insert data into database, edit these data, delete , interrogate the database

| | | | | pages | using SQL queries and display the result into JSP using EL and JSTL |
| | queries in a J2EE application | | | o Definition and difference
o Project creation
o Packages, servlet, JSP, deployment descriptor
o HTTP session(.getAttribute, .setAttribute)
Java Servlet pages

o Definition, role,
o Scriplet in a JSP,
o Expression in JSP
o Directive in JSP
o Declaration
o Comments in JSP
o Attributes in a JSP
o Request scope (page, session, servlet)

• **Expression language in JSP**
• **Java Standard Tag Library**
o **Core , c** [out, if, choose, forEach]
o XML , x
o l18N , fmt[formatDate]
o Database , sql
o Functions , fn | • Students discuss on steps involved in software designing.

• Students create a J2EE Web application project following basic steps of software design principle before generating codes.

• Students deploy J2EE application to web server. |

			• **JDBC Connection**
			   o Load Driver
			   o Establish Connection
			   o Retrieving Values
			   o Updating Tables
			   o Prepared Statements
			Software design process
			
			Waterfall model	

Links to other subjects:

Assessment criteria : *Students can build dynamic web Application in J2EE using software design principles.*

Materials: *computers, projector, NETBEANS, internet connection , digital material*

TOPIC AREA: COMPUTER GRAPHICS AND MULTIMEDIA	SUB-TOPIC AREA: COMPUTER RAPHICS AND MULTIMEDIA	
Senior 6 : Computer Science	Unit-45:Introduction to Computer Graphics	No of Periods: 20

Key Unit Competency: To be able to describe computer graphics terminology, create, capture graphics images and edit them using software

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Describe parts and functions of a digital camera, Scanner as image capturing tool • Explain computer graphics related terms • Identify places and areas where graphics are mostly used • State different	• Use Digital camera and scanners in everyday life with all functions available • Demonstrate the difference between vector graphics and bitmap graphics • Creating vector graphics and bitmap graphics using basic graphic elements • Manipulate vector graphics by using	• Appreciate the use of camera and scanners as digital image capturing tool • Appreciate the use graphics to improve data presentation • Enjoy the way graphics is used to improve the appearance.	**Digital Camera** Zoom, Resolution in Mega pixel, Shutter, Power on , button, Photo Click button, Battery, tripod, memory card, Flash, menu, configuration, importing pictures in computer using USB cable **Using scanner to capture images, setting resolution**	Teacher helps learners to define computer graphics related items. Learners do photo shoot with a digital camera to be familiar with all operation Learners use scanner to capture some images from papers. Students are given a sample of every type of graphics and they resize them and discuss and compare the different type.

graphics file format. • Know and understand how to use vector basic graphic elements to create the graphic	graphics features • Edit Digital graphic images in various software such as Ms-Paint, Microsoft Office Picture Manger, Adobe Photoshop		**Definitions:** Computer graphics, model, vector graphics, bitmap graphics image,2D, 3D,Vector, Raster, … Pixel, resolution, pixel per inch, color schemes: 8-bit, 16-bit, 32-bit Calculating size of an uncompressed image file Graphic file format JPEG,GIF,PNG, TIFF, **Areas of Graphics use** Advertisement Decoration services Logos Books illustrations Magazines Product Packaging	In small groups, teacher facilitates students to create a vector and bitmap graphic using graphic elements Teacher demonstrate Ms-Paint, Ms-Office Picture manager and Adobe Photoshop to create and edit graphics images and learners do hands-on exercises in these software

			Entertainment	
			Graphics software	
			Ms-Paint	
			Ms-Office Picture Manager	
			Adobe Photoshop	
			Basic Graphic elements	
			Lines, curves, sectors, polygons, circles, ovals, squares, rectangles, brush, spray and fill tools, text writing	
			Graphic features and editing tools	
			Copy and paste, Duplicate, Move and arrange(for align and order), Resize, Flip(reflexion), Skew (Shear, Slant), Rotate, Group, Combine, Cut out, Trim, Weld and Intersect, Red eye removal, Crop an image, magnify an area of picture, Change colour,	

			colour picker, Brightness and contrast, Colours for the outlines and fill of objects, create shading and fill objects with pattern and texture	
			Font as part of the graphic design	
			Reshape Vector Graphics	
			Manipulate nodes and control points	
			Tools in Photoshop	
			Image size, canvas size,, Rectangular selection, Free-form selection, Magic wand, Color picker, Eraser, paint bucket, Gradient, Brush, smudge, sharpen, clone stamp, Shape, Line, Rectangle, Feather, Inverse, Polygon Lasso, Magnetic Lasso, Transform, Scale, Rotate/Flip/Distort, Color	

			Adjustment, Filter, Lens Flare, Lightening, Blur, Layers, Ordering of layers, saving Photoshop images in other formats	

Link to other subjects: Fine art and Craft(Drawing, painting and coloring)

Assessment criteria: Students are able to effectively create, capture and edit graphic images using software.

Materials: Computers, Projector, Digital Camera, Scanner, Image Editing Software such as Ms-Paint, Ms-Office Picture Manager, Adobe Photoshop, digital material

TOPIC AREA: COMPUTER GRAPHICS AND MULTIMEDIA			SUB-TOPIC AREA: COMPUTER GRAPHICS AND MULTIMEDIA	
Senior 6 : Computer Science		**Unit-46:** Multimedia		**No of Periods: 18**
Key Unit Competency: To be able to explain the different use of multimedia and interactive multimedia applications and to use multimedia software to create video.				
Learning Objectives			**Content**	**Learning Activities**
Knowledge and understanding	**Skills**	**Attitudes and values**		
• Describe the procedure to capture and represent digital sound using discrete levels of amplitude in sound wave • Describe the procedure of movie-making in term of frames, frame rate, flikers • Identify the media	• Explain different multimedia tools and applications • Create an interactive power point presentation • Use software to edit and bind digital images, audio and video data together to form an effective multimedia content	• Appreciate the effectiveness of multimedia tool and applications. • Appreciate the effectiveness of video data in real life as a set of thousands of continuous images and associated sound • Creativity and appreciation of media in the society	**Introduction** Definition, different types of media, media applications, hardware and software requirements, techniques or steps **Interactive multimedia power point presentation** Create hyperlinks to: A location in the current presentation, another presentation, a file, an e-mail	• Teacher helps learners to understand and explain the multimedia tools and applications • In small groups, teacher facilitates students to create hyperlinks • Students in groups use media tools to capture images, video, audio or search images on the internet to create an

tools used to create images, audio and video files appropriately			address. **Create action buttons** Buttons for: play or stop inserted sound/movie during presentation, playing a CD during presentations, adding sound/movie effects to an animation **Digital Audio recording and Editing** Various audio file format: 3gp, mp3, wav. Use of Microphone, Musical instruments to record a sound, edit sound file using various operations such as Fade-In, Fade out, crop, Echo, Increase or decrease volume, reduce noise and humming, remove vocal, Equalizer, Channels, Digital Video Recording and editing Various video file format: 3gp, mp4, mpeg, avi, flv. Recording videos using mobile camera,	interactive media files • Learners create a multi media power point presentation • Learners record audio files using microphone and edit them in audio editing software • Learners record video files using mobile camera, handy camera and edit them in video editing software • Learners create a short animation in flash

			webcam, digital camera or handy cam, importing video in computer using USB cable, IEEE 1394 fire-wire cable, editing video in software by creating clips, deleted unwanted clips, adding background music, captions, sub titles, effects Animation Frames, manipulation of frames on time line , adding effect, loop, adding character, Morphing	

Link to other subjects: *Physics (Acoustic), Electronics, Audio-Video Editing and Film making*

Assessment criteria: *Students are able to correctly create a multimedia audio, video and animation file using multimedia tools.*

Materials: *Computers, Projector, scanner, digital cameras, phone camera, microphone, Handycam, flash media files, headphones, Ms power point, Windows Movie Maker, Adobe Creative suite, Windows Sound Recorder software, Macromedia Flash, digital material*

Topic Area: Programming	Sub-topic Area: Object Oriented Programming	
Senior 6 : Computer Science	Unit-47: File handling in C++	No of Periods: 18

Key Unit Competency : To be able to **o**pen, close, create a data file in C++ and read, write and append data to Files

Learning Objectives			Content	Learning Activities
Knowledge and understanding	**Skills**	**Attitudes and values**		

• Describe concept of File Streams, Input/ Output as stream
 	
• Describe steps and syntax to open, close files, write or read data from files
	• Create Files in C++, open and close files in appropriate mode of read, write, append
	
	• Effectively read data from file and write data on file using C++ code
		Appreciate the concept of file, as C++ using standard input cin and standard output cout also as file stream	**Types of Files:** Plaintext file, binary files
			
			File Streams
			  o Ifstream (to read from), ofstream (to write to), fstream (to read/write/append)
			  o fopen and fclose command
			  o read and write command
			  o Writing data or object to a file
			  o Reading data or object from a file
				• Teacher give an example to learners where a file is opened in write mode, some data received from keyboard is written to it and file is closed.
				• In another example, same file is opened in Read mode; data is accessed and shown on screen.

Link to other subjects:

Assessment criteria: Students are able to correctly create , open, close data files in C++ and read, write or append data to it.

Materials: Computers, projector, internet, c++ compiler, digital material

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7. APPENDICES

SUBJECTS AND WEEKLY TIME ALOCATION FOR A'LEVEL

Subjects in Secondary 4-6		Number of periods per week (1 period = 40 min.)		
Core subjects		**S4**	**S5**	**S6**
1. Mathematics		7	7	7
2. Physics		7	7	7
3. Computer Science		7	7	7
4. Chemistry		7	7	7
5. Biology		7	7	7
6. Geography		7	7	7
7. History		7	7	7
8. Economics		7	7	7
9. Literature in English		7	7	7
10. Kinyarwanda major		7	7	7
11. Kiswahili major		7	7	7
12. French major		7	7	7
13. Religion major		7	7	7
14. Entrepreneurship		6	6	6
15. General Studies and Communication		3	3	3
17. Subsidiary Mathematics		3	3	3
Electives Subjects	18. English minor	4	4	4
	19. French minor	4	4	4
	20. Kinyarwanda minor	4	4	4
	21. Kiswahili minor	4	4	4
Co-curricular Activities	Religious activities	2	2	2
	Sports/ Clubs	2	2	2
	Computer/library	2	2	2