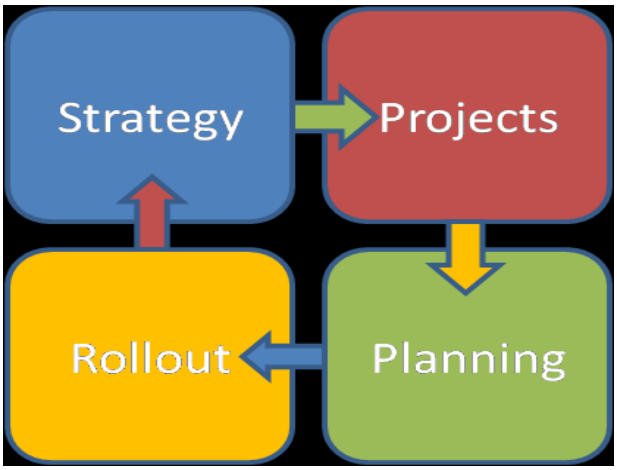
Central University of Technology, Free State

Faculty of Management Sciences

Learning Guide 2016 First Semester



Subject:

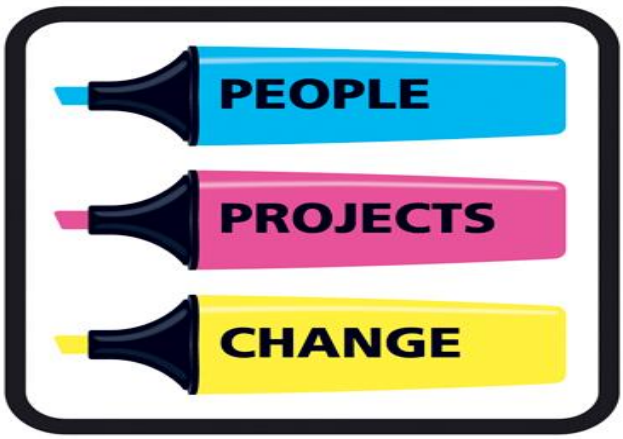
Operational Research IV

Subject Code:

ONV41AB

Programme:

B-Tech: Project Management



Programme Code:

BEBBTPJ

NQF level:

7

Credits:

14

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TABLE OF CONTENTS

NB: The material in this study guide is largely based on: Barry, R.; Stair, R.M.; and Hanna, E.M.; *Quantitative Analysis for Management*; 12th Edition ISBN 9780137129904 Prentice Hall.

COURSE DETAILS

Course Name	**Operational Research IV**
Course Code	ONV41AB
NQF Level	7
Programme	B.Tech Project Management
Credits	14
Notional Hours	140 Hours
Contact Hours	2.00 Hours per week
CLASS ATTENDANCE IS COMPULSORY	

LEARNING ASSUMED TO BE IN PLACE

A. A formal qualification at NQF level 6 or RPL
B. Computer literacy – ability to:
    1. Use Microsoft Word and Excel
    2. Search for information on the internet
C. Basic numeric literacy skills in:
    1. Statistics; and
    2. Mathematics

LEARNING OUTCOMES FOR THE COURSE

After completing this course learners will be able to:

- Explain the basic concepts underlying Quantitative Analysis
- Contribute effectively in a Quantitative Analysis exercise within a business context
- Support the implementation of a Quantitative Analysis exercise
- Be able to make a judgement call as to whether a Quantitative analyst could be of use in a particular business problem

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BRIEF DESCRIPTION OF CONTENT

People have been using mathematical tools to help solve problems for thousands of years. However, the formal study and application of quantitative techniques for practical decision making is largely a product of the 20th century. The techniques we will study in this course have been applied successfully to an increasingly wide variety of complex problems in business, government, healthcare, education, and many other areas. Many such successful uses are discussed throughout this course.

It is not enough, though, just to know the mathematics of how a particular quantitative technique works. You must also be familiar with the limitations, assumptions, and specific applicability of the technique. The successful use of quantitative techniques usually results in a solution that is timely, accurate, flexible, economical, reliable and easy to understand and use.

Quantitative analysis is a scientific approach to managerial decision making. Emotions and guesswork are not part of the quantitative analysis approach. The approach starts with data. Like raw material for a factory, these data are manipulated or processed into information that is meaningful to people making decisions**.** This processing and manipulation of raw data into meaningful information is at the heart of quantitative analysis. Computers have been instrumental in the increasing use of quantitative analysis.

We are also going to consider and study statistics with particular reference to Evidence-based Practice and Evaluation.

The course has a theoretical and practical component. Both components must be satisfactorily completed in order to complete and receive accreditation for the course.

CRITICAL OUTCOMES

After completing this course learners will be able to**:**

- Have a basic understanding of quantitative and qualitative analysis techniques, many of which are used in many business activities
- Make a critical evaluation of what quantitative techniques could be used in the business and when to call in a specialist and how the business could benefit from a quantitative analysis application
- Explain the basic concepts underlying Quantitative Analysis
- Contribute effectively in a Quantitative Analysis exercise within a business context
- Support the implementation of a Quantitative Analysis exercise
- Be able to make a judgement call as to whether a Quantitative analyst could be of use in a particular business problem.
- Develop collaborative skills through class and group assignments
- Demonstrate understanding of concepts through in-class presentations, assignments, texts, and examinations.

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LECTURES

Lectures will not refer exclusively to the textbook material. Rather, they may cover similar concepts and approaches to quantitative analysis using examples from the broader Operational Research literature. **It is assumed that students have read the assigned readings before class therefore learners should always come to class prepared.** Some examination questions will be drawn from the textbooks that will not be discussed at lectures.

In order to attain success in the subject, the learner's own contribution is of vital importance. It is important that s/he realizes that it is their responsibility to prepare for classes and to initiate class discussions.

Success is only possible if learners approach their studies with commitment and diligence and should they not understand any part of the work, they should not be afraid to ask the facilitator for help. Learners should always bring the prescribed textbook and learning guide and workbook to class.

It is important learners attend lectures at all times. It is during this time that:

- The facilitator will highlight the key aspects of the work
- Learner can ask relevant questions regarding the work.
- Learner can gain practical knowledge through the hands-on experience of the facilitator.

It is the responsibility of the learner to obtain relevant information from fellow learners about the work that was done in class should the learner fail to attend class.

The learner is requested to be punctual to class. Cell phones must be switched off at all times.

If any learner has particular issues regarding the lecturer or lectures, s/he should please discuss them with the lecturer in question first before bringing them to the Programme Head.

The student can leave a message with the departmental secretary, if the facilitator cannot be reached immediately. Visits/telephone calls to the private home of the facilitator will NOT be tolerated. Consulting hours will be announced in class.

The facilitator will not repeat lectures during consultation hours or lend notes or transparencies/slides to learners.

ASSESSMENT CRITERIA

Students display knowledge and understanding of basic quantitative and qualitative analysis techniques and demonstrate the capability to effectively contribute in a quantitative analysis exercise in a business context.

ASSESSMENT METHODS

Assessment will be conducted according to any assessment method as approved by the department and the obtained marks may form part of the final mark. Assessment results will be made up of tests, assignments and practical. Evaluation criteria for assignments will be given to the learner in class

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The learner is required to study all the work as set out in the learning guide as well as additional material.

i. Tests

Preliminary test dates and venues have been stated in the learning guide, but they are subject to change. Please pay attention in class to all the information that will be provided with regard to changes.

Should the learner miss a test it is his/her responsibility to inform the facilitator and bring a valid reason in writing within one week of writing the test.

The learner should ensure that the facilitator receives the valid reason on time. The facilitator will then advise the learner on what course of action to take.

No excuse will be accepted for a class evaluation that was missed due to poor class attendance unless the learner can present a valid written reason within one week.

ii. Assignments

Assignments must be submitted on time, on the due date, at the arranged venue, unless the facilitator makes other arrangements.

The facilitator accepts no responsibility for lost assignments. The learner must always keep a copy of every assignment that is submitted.

iii. Class activities and homework

Class activities will be done during class times and the facilitator may take in the activity or part of the activity at the end of the session, for marking.

Homework will be given to students and the facilitator may take in the homework at the beginning of the class session.

The above is done to monitor the learner's progress.

iv. Assessment Guidelines

Evaluation tests and assignments will be set on a regular basis. Most assignments are done in **Group Context**: it is vital that you also focus on the assignments. Past experience has shown that well functioning groups achieve all round success, as they encourage and support the individual.

v. Assessment Terminology

Assessment will take two forms (a) Formative and (b) Summative.

Formative assessment

Formative assessment will be achieved as follows:

- Regular graded group assignments
- Class discussion and feedback on particular relevant topics
- Case studies

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Summative assessment

- Quarterly tests, covering the work done to date – see the work schedule for test dates and requirements
- Semester evaluation covering all the work for the semester.

A diagram of how to calculate your mark is as follows**:**

Semester 1			
Tests	**Group Assignments**	**Practical/Individual Assignments**	**Examinations**
Approx 50%	**Approx 20%**	**Approx 30%**	
40%			**60%**

Note 1: The percentage division between Tests and Assignments and Practical, may differ somewhat from the above, taking into cognisance some input/feedback from the learners, and interaction with the facilitator. A course of this nature should also be dynamic in its outcomes, presentation and business relevance

Note 2: A learner must achieve a minimum of 50% in order to successfully complete the course.

IMPORTANT NOTICE

As the B.Tech Project Management programme is a fourth year university level course students will be expected to produce work that reflects academic maturity. Therefore the following should be noted well:

1. Language usage, logic, academic maturity of arguments, insight, and technical outlay of work all count towards the mark you get.

2. It is a student's responsibility to make assignments, tests and examinations scripts readable. Hand written assignments/projects will not be accepted.

3. Assignments not complying with criteria on assignment layouts will be penalized up to 10 marks. (The criteria will be given to the learner during the course of the year).

4. Forged assignments will receive will receive zero mark. In the same vein plagiarized work will be penalized.

5. Faxed assignments will not be accepted.

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6. **Group work means just that.** For that reason **a minimum of five and a maximum of seven** makes a group. No deviations will be accepted.
7. Distance, work commitment or any other reason is unacceptable.
8. There is a clear institutional regulation regarding absence from class, examinations, and tests. No deviations from the established regulations will be granted.
9. Absence from class or test due to work commitment is undertaken at your own peril and no arrangements will be entertained because of it.
10. Application for extension must be done in writing before the assignments due date.
11. The application must be accompanied by documentation of illness or other exceptional circumstances.
12. Granted extensions are only valid once the facilitator confirms it and the learner has received notification thereof.
13. Make sure you acquaint yourself with the necessary University regulations to avoid inconveniencing yourself.
14. The B.Tech. Project Management programme at the CUT is a part-time contact programme and not distance learning programme (or correspondence course). **Attendance therefore is compulsory.**
15. It is your responsibility to ensure that your employer is aware of your schedules.
16. **Late submission means no submission**. You will be provided with assignment and test schedules. You must make your employers adhere to this and not the University adhering to your work schedule!
17. Due to the large class size, tests and assignments (both individual and group) may be entirely multiple-choice.

STATEMENT ON ACADEMIC INTEGRITY

Academic dishonesty is a serious offence and any violation will not be tolerated in this course. The following examples are not exhaustive but describe CUT's policies for what constitutes academic dishonesty and penalties thereof. It is your responsibility to know what constitutes a violation of academic integrity. Academic dishonesty as far as CUT is concerned includes, but is not limited to: signing an attendance sheet using somebody else's name, allowing somebody to sign an attendance sheet in your name, cheating in examinations, plagiarizing, handing in papers that were downloaded from the internet, fabricating information or citations, facilitating acts of academic dishonesty by others, etc. The usual punishment for academic dishonesty ranges from deduction of marks to total expulsion from CUT.

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PRESCRIBED TEXTBOOK

1. *Quantitative Analysis for Management*; 11th Edition: Render, B; Stair, M.R.; Hanna, M.E. - ISBN 9780137129904 Prentice Hall

Additional Textbook: Theory

Quantitative Methods for Business; 12th Edition: Anderson DR, Sweeney DJ, Williams TA, Camm JD & Martin K – ISBN 9781133584469, South-Western Cengage Learning

WHILE THE UTMOST CARE WAS TAKEN WHILE PLANNING AND COMPILING THIS LEARNING GUIDE, IT REMAINS SUBJECT TO CHANGE

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IMPORTANT DATES AND ACTIVITIES

Due dates	Assessment Type	Form of Assessment	Mark Allocation	
01/03	Test 1	Class Test	50% of course mark	20% of final mark
12/04	Test 2	Class Test	50% of course mark	20% of final mark
23/05 – 04/06	1st Semester Exam	A formal 3-hour examination	100% of exam mark	60% of final mark
06/06 – 17/06	Sickness, Special and Supplementary Exams	A formal 3-hour examination	100% of exam mark	60% of final mark
27/03/2016	First quarter test marks entered into ITS system by faculties			
11/05/2016	Second quarter test marks entered into ITS system by faculties			
PLEASE REFER TO TIME TABLE FOR LECTURE VENUES, TIMES, AND DAYS!!				

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SYLLABUS

TOPIC	EXPECTED OUTCOMES	HOW DO YOU KNOW IF YOU HAVE ACHIEVED THE EXPECTED OUTCOME?	Practical Application
Learning Unit 1 **Introduction to Quantitative Analysis**	**To understand:** 1. The quantitative analysis approach and its application in a real situation 2. The use of modelling in quantitative analysis 3. The use of computers and spreadsheet models to perform quantitative analysis 4. Problems associated with quantitative analysis 5. Break-even analysis	**The ability to:** 1. Discuss the quantitative analysis approach and its application in a real situation 2. Describe the use of modelling in quantitative analysis. 3. Use computers and spreadsheet models to perform basic quantitative analysis 4. Identify problems associated with quantitative analysis 5. Conduct break-even analysis	Individual Practice Page 37: No's 1-23 Individual Assessment None Group Assignment: Case study: To be confirmed in class

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Additional Notes Learning Unit 1

Importance of Qualitative Factors.

Section 1.2 gives students an overview of quantitative analysis. In this section, a number of qualitative factors, including federal legislation and new technology, are discussed. Students can be asked to discuss other qualitative factors that could have an impact on quantitative analysis. Waiting lines and project planning can be

used as examples.

Discussing Other Quantitative Analysis Problems.

Section 1.2 covers an application of the quantitative analysis approach. Students can be asked to describe other problems or areas that could benefit from quantitative analysis.

Discussing Conflicting Viewpoints*.*

Possible problems in the QA approach are presented in this chapter. A discussion of conflicting viewpoints within the organization can help students understand this problem. For example, how many people should staff a registration desk at a university? Students will want more staff to reduce waiting time, while university administrators will want less staff to save money. A discussion of these types of conflicting viewpoints will help students understand some of the problems of using quantitative analysis.

Difficulty of Getting Input Data.

A major problem in quantitative analysis is getting proper input data. Students can be asked to explain how they would get the information they need to determine inventory ordering or carrying costs. Role-playing with students assuming the parts of the analyst who needs inventory costs and the instructor playing the part of a veteran inventory manager can be fun and interesting. Students quickly learn that getting good data can be the most difficult part of using quantitative analysis.

Dealing with Resistance to Change*.*

Resistance to change is discussed in this chapter. Students can be asked to explain how they would introduce a new system or change within the organization. People resisting new approaches can be a major stumbling block to the successful implementation of quantitative analysis. Students can be asked why some people may be afraid of a new inventory control or forecasting system.

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TOPIC	EXPECTED OUT-COMES	HOW DO YOU KNOW IF YOU HAVE ACHIEVED THE EXPECTED OUTCOME?	Practical Application
Learning Unit 2 **Probability Concepts and Applications**	1 Understand the fundamental probability concepts and their place in inferential statistics.	1 Be able to describe: 1.1 Mutually Exclusive and Collectively Exhaustive Events 1.2 Statistically Independent Events 1.3 Statistically Dependent Events 2 Be able to apply the following to practical applications; 2.1 Random variables 2.2 Probability distribution 2.3 The normal distribution	Individual Practice P80 No's 1 -22 No's 37 -39 Individual Assessment None Group Assignment: No's 37 and 41

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Additional Notes Learning Unit 3

Concept of Probabilities Ranging From 0 to 1.

People often misuse probabilities by such statements as, "I'm 110% sure we're going to win the big game." The two basic rules of probability should be stressed.

Where Do Probabilities Come From?

Students need to understand where probabilities come from. Sometimes they are subjective and based on personal experiences. Other times they are objectively based on logical observations such as the roll of a die. Often, probabilities are derived from historical data—*if* we can assume the future will be about the same as the past.

Confusion Over Mutually Exclusive and Collectively Exhaustive Events.

This concept is often foggy to even the best of students—even if they just completed a course in statistics. Use practical examples and drills to force the point home. The table at the end of Example 3 is especially useful.

Addition of Events That Are Not Mutually Exclusive.

The formula for adding events that are not mutually exclusive is $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$. Students must understand why we subtract $P(A \text{ and } B)$. Explain that the intersection has been counted twice.

Statistical Dependence with Visual Examples.

Figure 2.3 indicates that an urn contains 10 balls. This example works well to explain conditional probability of dependent events. An even better idea is to bring 10 golf balls to class. Six should be white and 4 orange (yellow). Mark a big letter or number on each to correspond to Figure 2.3 and draw the balls from a clear bowl to make the point. You can also use the props to stress how random sampling expects previous draws to be replaced.

Concept of Random Variables.

Students often have problems understanding the concept of random variables. Instructors need to take this abstract idea and provide several examples to drive home the point. Table 2.2 has some useful examples of both discrete and continuous random variables.

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Bell-Shaped Curve.

Stress how important the normal distribution is to a large number of processes in our lives (for example, filling boxes of cereal with 32 ounces of cornflakes). Each normal distribution depends on the mean and standard deviation. Discuss Figures 2.8 and 2.9 to show how these relate to the shape and position of a normal distribution.

Three Symmetrical Areas Under the Normal Curve.

Figure 2.10 is very important, and students should be encouraged to truly comprehend the meanings of _1, 2, and 3 standard deviation symmetrical areas. They should especially know that managers often speak of 95% and 99% confidence intervals, which roughly refer to _2 and 3 standard deviation graphs. Clarify that 95% confidence is actually _1.96 standard deviations, while _3 standard deviations is actually a 99.7% spread.

Expected Value of a Probability Distribution.

A probability distribution is often described by its mean and variance. These important terms should be discussed with such practical examples as heights or weights of students. But students need to be reminded that even if most of the men in class (or the United States) have heights between 5 feet 6 inches and 6 feet 2 inches, there is still some small probability of outliers.

Using the Normal Table to Answer Probability Questions*.*

The IQ example in Figure 2.11 is a particularly good way to treat the subject since everyone can relate to it. Students are typically curious about the chances of reaching certain scores. Go through a*t least* a half-dozen examples until it's clear that everyone can use the table. Students get especially confused answering questions such as *P*(*X* _ 85) since the standard normal table shows only right-hand-side *Z* values. The symmetry requires special care.

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Learning Unit 3 **Transportation and Assignment Models**	1. To have an understanding of the steps involved in using assignment and transportation models to solve Linear Programming (LP) problems.	2. Structure special LP problems using the transportation and assignment models 3. Use the northwest corner, VAM, MODI, and stepping-stone methods 4. Solve facility location and other application problems with transportation models	<u>Individual Practice</u> P474 No' 11 -14 <u>Individual Assessment</u> None <u>Group Assignment</u>: To be decided

Additional Notes Learning Unit 4

Transportation Models in the Chapter.

This is a long chapter, in part, because of the four transportation algorithms that are discussed. If time is an issue in your course, select one of the two initial solution methods and one of the two final solution methods to cover in class. The easiest, but *not* most efficient, are the northwest corner and stepping-stone rules.

Using the Northwest Corner Rule.

This approach is easily understood by students and is appealing to teach for that very reason. Make sure the students understand the weakness of the algorithm (that is, it ignores costs totally). Ask them to come up with their own approaches that could improve on this. Invariably, a good student will present an approach that comes very close to VAM. Name the student's approach after him (or her) and tell him he could have been famous if he had devised it 50 years earlier.

Using the Stepping-Stone Method.

Students usually pick up the concept of a closed path and learn to trace the pluses and minuses fairly quickly. But they run into problems when they have to cross over an empty cell. Stress that the cities in the tableau are just in random order, so crossing an unoccupied box is fine. The big test is Table 10.5. Once students comprehend this tracing, they are usually ready to move on. Remind students that there is *only one* closed path that can be traced for each unused cell.

Dummy Rows and Columns.

Another confusing issue to students is whether to add a dummy row (source) or dummy column destination) in a transportation problem. A slow and careful explanation is valuable so that students can reach an intuitive understanding as to the correct choice. Also note that the software adds these dummies automatically.

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Learning Unit 4 **Decision Analysis**	1. Understand the decision-making process in order to improve decision-making under uncertainty.	1. List the steps of the decision-making process. 2. Describe the types of decision-making environments. 3. Make decisions under uncertainty. 4. Use probability values to make decisions under risk 5. Develop accurate and useful decision trees.	Students should practice end-of-chapter exercises on pp. 122-132.
TOPIC	**EXPECTED OUT-COMES**	**HOW DO YOU KNOW IF YOU HAVE ACHIEVED THE EXPECTED OUTCOME?**	**Practical Application**
Learning Unit 5 **Forecasting**	1. Understand how to employ various models and tools to predict the outcomes of decisions.	1. Understand and know when to use various families of forecasting models. 2. Compare moving averages, exponential smoothing, and other time-series models. 3. Seasonally adjust data. 4. Understand Delphi and other qualitative decision-making approaches. 5. Compute a variety of error measures.	Students should practise questions on pp. 204 - 210:

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Learning Unit 6 **Inventory Control Models**	1. Gain an understanding of how to establish the balance between demand and supply of inventory.	1. Understand the importance of inventory control and ABC analysis. 2. Use the economic order quantity (EOQ) to determine how much to order. 3. Compute the re-order point (ROP) in determining when to order more inventory. 4. Handle inventory problems that allow quantity discounts or non-instantaneous receipt. 5. Understand the use of safety stock. 6. Describe the use of material requirements planning in solving dependent-demand inventory problems. 7. Discuss just-in-time inventory concepts to reduce inventory levels and costs. 8. Discuss enterprise resource planning concepts.	Practice questions on pp. 257- 265.
TOPIC	**EXPECTED OUTCOMES**	**HOW DO YOU KNOW IF YOU HAVE ACHIEVED THE EXPECTED OUTCOME?**	**Practical Application**

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Work plan for the semester

SEMESTER 1 – 2016

FACULTY OF MANAGEMENT SCIENCES

PLANNING - 2016

WEEK	MONTH	DATE	DAYS	REMARKS		
1	Feb	01-05	5 days	Introduction/Learning unit 1		
2	Feb	08-12	5 days	Learning unit 1		
3	FEB	15 - 19	5 days	Learning unit 2		
4	FEB	22 - 26	5 days	Learning unit 2		
5	FEB/MAR	29 - 04	5 days	Test 1		
6	MAR	07 - 11	5 days	Learning unit 3		

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7	MARCH	14 - 18	5 days	Learning unit 3		
8	MARCH	22 - 24	3 days	Learning Unit 4		
24 March - 03 April: Holidays						
9	APRIL	04 - 08	5 days	Learning unit 4		
10	APRIL	11 - 15	5 days	Test 2		
11	APRIL	18 - 22	5 days	Learning unit 5		
12	APR	25 - 29	4 days	Learning unit 5		
13	MAY	03 - 06	5 days	Learning unit 6		
14	MAY	09 - 13	5 days	Learning Unit 6		
15	May	16 - 20	5 days	REVISION		
16	MAY	23/05 – 04/06	3 weeks	Main Exam		
17	JUNE	06 -	2	Sick/Special/Supplementary Exam		

		17	weeks			
29 June - 19 July: Holidays						
18	JULY	18 - 22	5 days	Second Semester Begins		