PROPOSED MASTER OF SCIENCE IN TELECOMMUNICATION ENGINEERING (MSc. TE) DEGREE PROGRAMME

DAY/ EVENING PROGRAMME

Proposed Starting Date: August 2011

March 2011
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1. INTRODUCTION:

Having been in existence for over 10 years, the Masters Programme in Electrical Engineering has graduated no more than 100 students. On other hand during this period a lot has changed with in all the sub professions of the electrical engineering profession. Many which were originally small sub professions are currently independent with clear career prospects. It is clear in Uganda today that there are two distinct sub professions within electrical engineering – Electrical Power Systems engineering and Electronics & Telecommunications engineering. Consequently, the original electrical engineering graduate programme has been restructured in line with this new structure of the profession here in Uganda and in the world over; but also in consideration of today’s best practice in other Universities.

This document describes the regulation and structure of the curriculum for Master of Science in Telecommunication Engineering studies in the Electrical and Computer Engineering department at Makerere University.

2. PROGRAMMES DETAILS

2.1. Justification:

It has been found necessary to discard the current MSc and MEng programmes in Electrical Engineering owing mainly to the lack of focus in the programme that is required to meet the needs of industry. The programme was too broad with haphazard courses that did not encourage mastering of a specific discipline. The consequence was that there was very little interest in the programme even from among former undergraduate students of the electrical Engineering department.

Moreover, there have been many students who started on the programme and failed to graduate possibly because they never had the ambition to undertake a masters programme. To cater for such students, it has been proposed that a generic Post Graduate Diploma in Electrical Engineering be developed with two areas of concentration that would lead directly into the second year of the proposed master’s programmes.

As such the former MSc and MEng Degrees in Electrical Engineering will be dropped and replaced with the following programmes:

- Telecommunications Engineering (MSc TE)
- Power Systems Engineering (MSc PSE)
- Post Graduate Diploma in Electrical Engineering (PGD EE)

Owing to a common background, the two master’s programmes as well the PGD will share some courses that have been deemed necessary for all students. As such, the course design and distribution has been done with consideration of this fact as demonstrated in the course matrix in Annex III.

2.2. Time Commitment

It is expected that the students to be admitted in the programme will be practicing professionals who desire to develop their careers while maintaining their current jobs. To cater for this flexibility, Course will be delivered in both full semester lectures and modular intensive seminars as may be found appropriate at the time.

2.3. Research Focus

To make learning more research oriented in the curriculum, it is necessary to deliver every course with a strong research bias by putting emphasis on students spending more time researching (including reporting/presenting their work/results) rather than keeping in class.
This is to enable students to learn how to conduct research as well as to learn the various research methodologies.

Consequently, most of the courses will be taught with a strong bias in research as seen in the curriculum. The output from the research will be considered as research lab papers and will constitute end of semester course work assessment.

2.4. Target Group

The programs is targeted to graduates from Physics, Electrical and Electronics Engineering, Telecommunication Engineering, and Computer Engineering, who want to gain graduate knowledge on Electronics, Computer Engineering, Power and Energy and Telecommunication Systems.

2.5. Admission Requirements

To qualify for admission, a candidate must fulfill the general Makerere University entry requirements for a masters degree, and in addition the candidate must fulfill one of the requirements below:

A) Be a holder of a first class or upper second bachelors degree in Physics, Electrical Engineering, Electronics Engineering, Telecommunication Engineering, Computer Engineering, or a closely related field from Makerere University or another recognized University.

OR

B) Be a holder of a lower second bachelors degree in Physics, Electrical Engineering, Electronics Engineering, Telecommunication Engineering, Computer Engineering, or a closely related field from Makerere University or another recognized University and must have 2 year of working experience in Telecommunication or a related filed.

OR

C) Be a holder of a pass bachelors degree in Electrical Engineering, Electronics Engineering, Telecommunication Engineering, Computer Engineering from Makerere University or another recognized University; must have 2 year of working experience in Telecommunication or a related filed and has demonstrated academic maturity by successfully accomplishing the Postgraduate Diploma in Electrical Engineering with a first or upper second class.

2.6. Nature of the Programme

This is a day/evening programme that is completely privately sponsored. Students on the programme can follow one of two study options or plans.

2.6.1. MSc PLAN A

Students on plan A are required to take at least 30 credits of course work and two semesters of fulltime research leading to a dissertation. To qualify for this option, a student shall have completed all their course work and have a research proposal latest by the fourth week of the second semester.

To qualify for graduation, students on Plan A must

i) Complete the required course work in the programme

ii) Undertake at least two (2) seminars during the second year of study where one presents critical outcomes of his/her research
iii) Submit at the end of their research, a published conference paper with proof of publication or a paper of publishable quality as may be approved by the department
iv) Defend their thesis to a Research & Graduate Studies committee constituted by the department
v) Submit the defended dissertation

2.6.2. MSc PLAN B

Students on plan B are required to take 45 credits of course work and one semester of fulltime project work leading to a project report. To qualify for the Plan B MSc, a student shall have completed all their coursework and also have a project proposal by the second week of the third semester.

To qualify for graduation, students on Plan B must
i) Complete the required course work in the programme
ii) Submit at the end of their project work, a conference paper of publishable quality as may be approved by the department
iii) Present their project work and outputs to a projects defense committee constituted by the department
iv) Submit a project report

2.7. Duration

The duration for the M.Sc TE degree programme shall be at least four (4) semesters of fulltime study or the equivalent amount of study time on a part-time basis.

2.8. Tuition Fees

The tuition fees per semester for the programme(s) shall be as shown below:

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Ugandans (or East African residents)</th>
<th>Foreigners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Semester Fees (Shs)</td>
<td>Annual Fees (Shs)</td>
</tr>
<tr>
<td>Full Time</td>
<td>2,850,000</td>
<td>5,700,000</td>
</tr>
</tbody>
</table>
3. Regulations

3.1. Course Assessments

a) Each Course will be assessed on the basis of 100 total marks with proportions as follows:
   o Course Work - 40; and
   o Examination - 60.

b) A minimum of two Course Assignments/Tests shall be required per Course.

c) Course work shall consist of tests, group assignments, presentations and the evaluation of individual research projects.

3.2. Grading of Courses

a) Each Course will be graded out of a maximum of 100 marks and assigned an appropriate letter grade and a grade point as follows:

<table>
<thead>
<tr>
<th>Marks</th>
<th>Letter Grade</th>
<th>Grade Point</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-100</td>
<td>A+</td>
<td>5.0</td>
<td>Exceptional</td>
</tr>
<tr>
<td>80-89</td>
<td>A</td>
<td>5.0</td>
<td>Excellent</td>
</tr>
<tr>
<td>75-79</td>
<td>B+</td>
<td>4.5</td>
<td>Very good</td>
</tr>
<tr>
<td>70-74</td>
<td>B</td>
<td>4.0</td>
<td>Good</td>
</tr>
<tr>
<td>65-69</td>
<td>C+</td>
<td>3.5</td>
<td>Fairly good</td>
</tr>
<tr>
<td>60-64</td>
<td>C</td>
<td>3.0</td>
<td>Pass</td>
</tr>
<tr>
<td>55-59</td>
<td>D+</td>
<td>2.5</td>
<td>Marginal Fail</td>
</tr>
<tr>
<td>50-54</td>
<td>D</td>
<td>2.0</td>
<td>Clear Fail</td>
</tr>
<tr>
<td>45-49</td>
<td>E+</td>
<td>1.5</td>
<td>Bad Fail</td>
</tr>
<tr>
<td>40-44</td>
<td>E-</td>
<td>1.0</td>
<td>Qualified Fail</td>
</tr>
<tr>
<td>0-39</td>
<td>F</td>
<td>0.0</td>
<td>Qualified Fail</td>
</tr>
</tbody>
</table>

b) The following additional letters will be used, where appropriate:
   o W - Withdraw from Course;
   o I - Incomplete;
   o AU - Audited Course Only;
   o P - Pass;
   o F - Failure.

3.3. Minimum Pass Mark

A minimum pass grade for each course shall be 3.0 grade points.

3.4. Calculation of Cumulative Grade Point Average (CGPA)

The CGPA shall be calculated as follows:

\[
CGPA = \frac{\sum_{i=1}^{n} (GP_i \times CU_i)}{\sum_{i=1}^{n} CU_i}
\]

where \( GP_i \) is the Grade Point score of a particular course \( i \);
\( CU_i \) is the number of Credit Units of course \( i \);
and \( n \) is the number of courses so far done.
3.5. **Progression**

Progression through the programme shall be assessed in three ways:

3.5.1. **Normal Progress**

This occurs when a student passes each course taken with a minimum Grade Point of 3.0.

3.5.2. **Probationary**

This is a warning stage and occurs if either the cumulative grade point average (CGPA) is less than 3.0 and/or the student has failed a core course. Probation is waved when these conditions cease to hold.

3.5.3. **Discontinuation**

When a student accumulates three consecutive probations based on the CGPA or the same core course(s), he/she shall be discontinued.

3.5.4. **Re-taking a Course**

A Student may re-take any course when it is offered again in order to pass if the student had failed the course. A Student may take a substitute elective, where the Student does not wish to re-take a failed elective.

3.6. **Weighting System**

The weighting unit is the Credit Unit (CU), which is 15 contact hours per semester. A contact hour is equal to

i. one lecture hour,
ii. two practical hours or
iii. four research hours

3.7. **Masters Dissertation**

Students are required to demonstrate their ability to independently formulate a detailed dissertation proposal, as well as develop and demonstrate their dissertation thoroughly.

a) A candidate shall be allowed to formally start on the dissertation after the second semester.

b) A candidate shall submit a dissertation proposal to the School of Engineering Research Graduate Studies Committee during the second semester of the first academic year.

c) The candidate shall execute the dissertation during second year (the third and fourth semesters).

d) The candidate shall submit the dissertation by the end of the fourth semester.

3.7.1. **Passing of a Dissertation**

To pass the Dissertation, the candidate shall satisfy the Internal Examiner, External Examiner, and Viva Voce Committee independently.

3.7.2. **Revised Dissertation**

A candidate, who fails to satisfy the examiners, shall re-submit a Revised Dissertation in accordance with the standing University guidelines for the dissertation examinations.

3.8. **Master's Project**

Students are required to demonstrate their ability to independently formulate a detailed Project Proposal, as well as develop and demonstrate their Project thoroughly.

a) A candidate shall be allowed to formally start on the Project after the second semester.

b) A candidate shall submit a Project Proposal to the School of Engineering Research Graduate Studies Committee during the third semester.
c) The candidate shall execute the Project during the second semester of second year (the fourth semester).
d) The candidate shall submit the Project Report by the end of the fourth semester.

3.8.1. Passing of a Project
To pass the Project, the candidate shall satisfy the examiners in a written report and viva voce independently.

3.8.2. Revised Project Report
A candidate, who fails to satisfy the examiners, shall re-submit a Revised Project Report in accordance with the standing University guidelines for the project examinations.

3.9. Minimum Graduation Load
To qualify for the award of the degree of Master of Science in Telecommunication Engineering (Plan A), a candidate is required to obtain a minimum of 30 credit units for courses passed including all the compulsory courses; undertake 2 research seminars of 2 credit units each and successfully pass the Master's Dissertation (of 10 credit units) within a period stipulated by the School of Graduate Studies, usually not exceeding five (5) years from the date of registration.

To qualify for the award of the degree of Master of Science in Telecommunication Engineering (Plan B), a candidate is required to obtain a minimum of 45 credit units for courses passed including all the compulsory courses; undertake 1 research seminar of 2 credit units and successfully pass the Master's Project (of 5 credit units) within a period stipulated by the School of Graduate Studies, usually not exceeding five (5) years from the date of registration.
4. PROGRAM STRUCTURE

4.1. Course distribution

YEAR I SEMESTER I 4 compulsory courses and at least 1 of 3 Electives - 15 credits
YEAR I SEMESTER II 1 compulsory course and 4 of 7 Electives - 15 credits
YEAR II SEMESTER I Research (for Plan A) or 3 compulsory courses and 2 of 5 Electives (for Plan B) - 15 credits
YEAR II SEMESTER II Research and Thesis (for Plan A) or Project and report (for Plan B) - 15 credits

4.2. MSc TE Plan A Course Layout

Table 2: Course Layout for Plan A MSc Telecommunication Engineering

<table>
<thead>
<tr>
<th>YEAR I</th>
<th>SEMESTER I – 15 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td><strong>Compulsory</strong></td>
<td></td>
</tr>
<tr>
<td>RET 7105</td>
<td>Statistics and Research Methods</td>
</tr>
<tr>
<td>MEC 7101</td>
<td>Principles of Management</td>
</tr>
<tr>
<td>MTE 7101</td>
<td>Digital Communications</td>
</tr>
<tr>
<td>MTE 7102</td>
<td>Computer &amp; Communications Networks</td>
</tr>
<tr>
<td>MTE 7103</td>
<td>Digital Signal Processing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR I</th>
<th>SEMESTER II – 15 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td><strong>Compulsory</strong></td>
<td></td>
</tr>
<tr>
<td>EMT 7201</td>
<td>Advanced Engineering Mathematics</td>
</tr>
<tr>
<td>MTE 7201</td>
<td>Wireless and Mobile Communications</td>
</tr>
<tr>
<td>MTE 7202</td>
<td>Satellite &amp; Microwave (RF) Communications</td>
</tr>
<tr>
<td>MTE 7203</td>
<td>Radar System Engineering &amp; Design</td>
</tr>
<tr>
<td>MTE 7204</td>
<td>Optical Communications</td>
</tr>
<tr>
<td>MTE 7205</td>
<td>Telecom Mgt, and Policy</td>
</tr>
<tr>
<td>MEC 7201</td>
<td>Engineering Project Management</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electives (Choose any two)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTE 7203</td>
</tr>
<tr>
<td>MTE 7204</td>
</tr>
<tr>
<td>MTE 7205</td>
</tr>
<tr>
<td>MEC 7201</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR II</th>
<th>SEMESTER I - 30 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td><strong>Compulsory</strong></td>
<td></td>
</tr>
<tr>
<td>MTE 8100</td>
<td>Telecommunications Research</td>
</tr>
<tr>
<td>MTE 8101</td>
<td>Telecommunications Research seminar</td>
</tr>
<tr>
<td>MTE 8201</td>
<td>Telecommunications Research seminar</td>
</tr>
</tbody>
</table>

4.3. MSc TE Plan B Course Layout

Table 2: Course Layout for Plan B MSc Telecommunication Engineering

<table>
<thead>
<tr>
<th>YEAR I</th>
<th>SEMESTER I – 15 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td><strong>Compulsory</strong></td>
<td></td>
</tr>
<tr>
<td>RET 7105</td>
<td>Statistics and Research Methods</td>
</tr>
<tr>
<td>MEC 7101</td>
<td>Principles of Management</td>
</tr>
<tr>
<td>MTE 7101</td>
<td>Digital Communications</td>
</tr>
<tr>
<td>MTE 7102</td>
<td>Computer &amp; Communications Networks</td>
</tr>
<tr>
<td>MTE 7103</td>
<td>Digital Signal Processing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR II</th>
<th>SEMESTER II – 15 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td><strong>Compulsory</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Table 5: Graduation Requirements

<table>
<thead>
<tr>
<th>Semester / Term</th>
<th>MSc Plan A (44 Cr)</th>
<th>MSc Plan B (52 Cr)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1 Semester 1</strong></td>
<td>A total of at least 30 credits (including 15 Credits of compulsory courses)</td>
<td></td>
</tr>
<tr>
<td><strong>Year 1 Semester 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Year 2 Semester 1</strong></td>
<td>Research &amp; Thesis (10 Cr) Research Seminar (4 cr)</td>
<td>15 course Cr (including 9 compulsory courses)</td>
</tr>
<tr>
<td><strong>Year 2 Semester 2</strong></td>
<td></td>
<td>MSc Project (5 Cr) Research Seminar (2 cr)</td>
</tr>
</tbody>
</table>

### 4.4. Graduation Requirements

Table 5: Graduation Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EMT 7201</strong></td>
<td>Advanced Engineering Mathematics</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 7201</strong></td>
<td>Wireless and Mobile Communications</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 7202</strong></td>
<td>Satellite &amp; Microwave (RF) Communications</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 7203</strong></td>
<td>Radar System Engineering &amp; Design</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 7204</strong></td>
<td>Optical Communications</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 7205</strong></td>
<td>Telecommunication Mgt, and Policy</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td><strong>MEC 7201</strong></td>
<td>Engineering Project Management</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td><strong>YEAR II</strong></td>
<td><strong>SEMESTER I - 15 credits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Compulsory</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MPS 8101</strong></td>
<td>Finance in Engineering</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 8101</strong></td>
<td>Marketing Management</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 8103</strong></td>
<td>Microprocessor based Systems</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td><strong>Electives: (Choose any two)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MTE 8104</strong></td>
<td>Operations Research</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 8105</strong></td>
<td>Radar Signal Detection &amp; Data Processing</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td><strong>MTE 8106</strong></td>
<td>Advanced Topics in Communications</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td><strong>YEAR II</strong></td>
<td><strong>SEMESTER II - 15 credits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Compulsory</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MTE 8200</strong></td>
<td>Telecommunications Project</td>
<td>0</td>
<td>75</td>
</tr>
<tr>
<td><strong>MTE 8201</strong></td>
<td>Telecommunications Research seminar</td>
<td>0</td>
<td>30</td>
</tr>
</tbody>
</table>

4.4. Graduation Requirements

Table 5: Graduation Requirements
5. COURSE SYLLABI

5.1. RET 7105 Statistics and Research Methods

Course Description:
This course presents the fundamentals, concepts and methods used in the analysis of data. It covers definitions, methods of computation of the various measures of data summarization. It also introduces stochastic analysis of events and the test used to assess whether a given set of data fits into some general pattern. The course will also cover advanced engineering research skills, focusing on research design, design of data collection instruments, implementation of data collection plans, and principles of research report writing and dissemination.

AIM:
The aims of this course are to:

- Provide students with a strong knowledge base for mathematical analysis.
- Equip students with background and fundamental knowledge behind the techniques for analyzing a vast amount of data for different scenarios with ease
- Equip students with the skills to use the tools for handling large amounts of data
- Explain to students the role of research in knowledge creation
- Instruct students on how research is conducted practically and in academic circles

Detailed Course Content:

1. Research Methods (25 Hours)

Introduction: Definition of Research, Role of Research in the Engineering Profession, Types of Research (Basic Vs Applied; Primary Vs Secondary; Exploratory Vs Constructive Vs Empirical), Research Processes (The Scientific Vs Historical Research Process), Information Literacy Strategies, Research Fund, Research and Publishing

1.2 Elements of General Academic Writing: The Writing Process (Invention, Composition and Revision), Research Concept Note (Synopsis), Proposal, Thesis Report, Papers, Abstracts, Formatting Style (MLA Vs APA)

1.3 Identifying and Formulating a Research Problem: Definition of Research Problem, Identify a Research Problem (Sources of Research Problems), Testing the Feasibility of the Research Problem, Formulating a Research Problem, Statement of the Problem, Components of a Problem Statement

1.4 Developing Other Proposal Components: Formulating a Research Title, Formulating and Stating the Research Objectives, Stating the Research Justification, Literature Review, The Research Methodology, The Research Resources Plan (Work plan, and Budget), References and Bibliography, Appendices, Pagination of Research Proposal

1.5 Research Ethics: Intellectual Property Rights (Makerere IPM Policy and other International IPM Policies), Research Ownership and Mandate of Researcher, Research and Citations (Notation and Standards), Plagiarism (Definition, manifestation, and consequences), Authenticity of Facts and Opinions (Proper Research Language and avoiding weasel word and fallacies), Rights of Human and Animal Survey Respondents

1.6 Data Collections and Analysis: Designing and Executing a Survey, Sources of Data, Sample and Populations, Sampling Methods, Quantitative and Qualitative Approaches, Data Collections Instruments and Methods, their Context and Limitations (Questionnaires Vs Interview Vs Check Lists), Questionnaire Design: Types of Questions, Response Rate and Sample Size, Coding Data: Missing Values, Open Ended Questions

1.7 Research Designing: Choosing an Operational Definition, Experimental and Non-Experimental Designs, Internal and External Validity and Associated Threats, Groups Vs Repeated Measure Design

1.8 Presentation of Research: Oral Presentation (Proposal and Viva Voce), Use of Presentation Aides, Use of Graphics and Animations in Presenting Research, Presentation Language
2. **Statistics and Data Analysis** (20 Hours)

2.1 **Introduction**: Definition of Statistics, Role of Statistics in Engineering Research, Misuse and Abuse of Statistics, Data Measurement


2.3 **Inferential Statistics**: Introduction, Null and alternative hypotheses, Hypothesis testing, Type I and Type II Errors, Analysis of Variance (ANOVA), Inferential Statistics using Data Analysis Software

2.4 **Probability**: probability basics, probability distributions and expectations (2 hrs). Cases of probability distribution curves: poisson and binomial distributions, normal (Gaussian), exponential, gamma, beta and other distributions

**Learning Outcomes**

At the end of this course, a student should be able to:

- Explain the mathematical concepts of data occurrence and analysis
- Apply the different methods of displaying and reporting data
- Compute the various quantities used to summarize data
- Distinguish among the different scenarios of occurrence of events
- To test different data sets to find which models best describe them
- Explain the various terminology used in research methods
- Describe the various research designs applied in research
- Develop a research proposal including identification of a research problem, formulation of research objectives, description of the methodology and the data analysis techniques
- Identify shortcoming in research proposals, designs and reports

**Teaching and Learning Pattern**

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

**Assessment method**

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

**References**:

4. Handbook of Mathematics for Engineers and Scientists Andrei Polyanin, Alexander Manzhirov
5.2. MEC7105: Principles of Management

Course Description:
This course will enable students to develop short and long-range plans to effectively accomplish organizational goals. Through the use of terminology, exercises and case studies, students will be able to give a critical appraisal of real life situations involving organizing, staffing and motivating others. The student will also learn tools to aid in problem solving, valuing diversity and coping with change. The principles learned in this course will allow the student to effectively work with and through others in an organization. The principles are relevant to any type of organization or group, empowering the student to lead others, negotiate, embrace change and better understand the role of business in society. Both principles and practices of management as an academic discipline as well as a profession are surveyed, examined, and reviewed. Students will acquire knowledge through the textbook, and the assigned reading material as well as the material accessible through the web and apply them to specific real world management phenomenon. The course focuses on the fundamentals of the practice of management, including administrative, organizational and behavioral theories. It explores the functions of management and the aspects of the organizational environment.

AIM:

- to understand the roles and functions of managers at various (entry, middle and the top) levels
- to explain the relationships between organizational mission, goals, and objectives
- to comprehend the significance and necessity of managing stakeholders
- to conceptualize how internal and external environment shape organizations and their responses
- to demonstrate empirical understanding of various organizational processes and behaviours and the theories associated with them
- to demonstrate critical thinking skills in identifying ethical, global, and diversity issues in planning, organizing, controlling and leading functions of management
- to understand organizational design and structural issues

Detailed Course Content:

1. Historical Perspectives of Management: The behavioral approach to management, The management science approach, The contingency approach, The system approach
2. Principles of Planning: Defining planning, Purposes of planning, Advantages and potential disadvantages of planning, Management by objectives, Planning tools, Strategic planning, Forecasting and budgeting
3. The Management Task: The Role of management, Defining management, The management process, management functions, Management goal attainment, Management and organizational resources
5. Leadership and Effective Communication: Defining leadership; leader vs. manager, Leadership behaviors, Transformational Leadership, Coaching, Entrepreneurial leadership
6. Controlling for Productivity: Defining production and productivity, Quality and productivity, Operations management, Operations control, Using control tools to control organizations
7. Managerial Ethics and Social Responsibility: Fundamentals of social responsibility, Areas of corporate social responsibility, Social responsiveness and decision making, Influencing individuals performing social responsibility activities, A definition of ethics, Creating an ethical workplace
8. Making Good Business Decisions: Types of decisions, Elements of the decision situation, The decision making process, Decision making conditions, Decision making tools,
Processes for making group decisions

Learning Outcomes
On completion of this course the students should be able to:
- Describe the functions of management.
- Outline the historical theories relating to modern management.
- Explain the role of management within a business setting.
- Outline managerial decision making.
- Identify the steps of problem solving and decision making in organizations.
- Apply knowledge of managerial practices to case studies.
- Recognize challenges in the achievement of good managerial performance.
- Describe human resource planning and staffing processes needed to achieve optimal performance.
- Prepare a business forecast and budget.
- Illustrate how business ethics and social responsibility apply to organizations.
- Define change and stress in organizations and prepare a plan to implement changes using case studies.
- Describe formal and informal organizational communication processes and how to influence employees.

Recommended and Reference Books

5.3. MTE 7101 Digital Communications

Course objective:
In the last few decades, digital communication has drastically improved our quality of life. Amenities such as fax machines, pagers, cell phones, and internet, are now considered indispensable. None of them are possible without digital communication. This course explores elements of the theory and practice of digital communications. The course will
- Model and study the effects of channel impairments such as noise and distortion, on the performance of communication systems;
- Introduce signal processing, modulation, and coding techniques that are used in digital communication systems.

AIM:
- To thoroughly cover digital communications theory including information theory, source and channel coding, modulation and multiple access principles and techniques as well as the recent advances in Digital communications, including MIMO and OFDM.
- To study pulse modulation and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To learn baseband pulse transmission, which deals with the transmission of pulse-amplitude, modulated signals in their baseband form.
To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.

Detailed Course Content:

Introduction:
- **Review of Probability Theory**: Probability space, random variables, density functions, independence; Expectation, conditional expectation, Baye’s rule; Stochastic processes, autocorrelation function, stationarity, spectral density
- **Analog-to-digital conversion**: Sampling (ideal, natural, sample-and-hold); Quantization, PCM;

Communication System:
- **Source coding** (data compression): Measuring information, entropy, the source coding theorem; Huffman coding, Run-length coding, Lempel-Ziv;
- **Communication channels**: Band limited channels, The AWGN channel, fading channels
- **Receiver design**: General binary and M-ary signaling; Maximum-likelihood receivers; Performance in an AWGN channel; The Chernoff and union/Chebyshev bounds; Simulation techniques; Signal spaces
- **Modulation**: PAM, QAM, PSK, DSK, coherent FSK, incoherent FSK
- **Channel coding**: Block codes, hard and soft-decision decoding, performance; Convolutional codes, the Viterbi algorithm, performance bounds; Trellis-coded modulation (TCM)

Digital Signaling:
- **Signaling through band limited channels**: ISI, Nyquist pulses, sequence estimation, partial response signaling; Equalization
- **Signaling through fading channels**: Rayleigh fading, optimum receiver, performance; Interleaving
- **Synchronization**: Symbol synchronization; Frame synchronization; Carrier synchronization

Multicarrier & Multi user communications:
- Medium Access Schemes -TDMA, FDMA, CDMA technique;
- MIMO, OFDM and others

Teaching and Learning Pattern

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:
2. BP Lathi, “Modern Digital and Analog Communication Systems”
3. L. W. Couch, “Digital and Analog Communication”
4. Simon Haykins, "Communication Systems”
5. Popoulis, "Probability, Random Variable and Stochastic Processes”
5.4. **MTE 7102 Computer Communications Networks**

**Course objective:**
The course studies the basic concepts of communication networks, protocols and their performance as well as the design constraints of developing and deploying these networks.

**AIM:**
To understand communication architectures, focusing on the TCP/IP model but in relation to the OSI model, describing the principles and protocols that apply at each layer. Assignments may include programming exercises for implementation of the protocols and algorithms studied. As a result of successfully completing this course, students will:

1. Become familiar with layered communication architectures (OSI and TCP/IP).
2. Understand the client/server model and key application layer protocols.
3. Learn sockets programming and how to implement client/server programs.
4. Understand the concepts of reliable data transfer and how TCP implements these concepts.
5. Know the principles of congestion control and trade-offs in fairness and efficiency.
6. Learn the principles of routing and the semantics and syntax of IP.
7. Understand the basics of error detection including parity, checksums, and CRC.
8. Know the key protocols for multimedia networking including IntServ and DiffServ for IP.
9. Familiarize the student with current topics such as security, network management, sensor networks, and/or other topics.

**Detailed Course Content:**

**Review**
- **Review of Telecommunication networks:** Hardware & software, reference models (Protocol Starks): OSI Vs TCP/IP, transmission (TX) media, the telephone system and the new telecommunication systems.
- **Physical Layer:** Basics of EM wave Transmission: Modulation, Digitization, Synchronization, Physical Layer Standards: RS-232, CCITT X.21;

**Computer Networks:**
- **Link Layer:** Data transfer between neighboring network elements including encoding, framing, error correction, access control for shared links (MAC protocols) examples to include Ethernet, fast ethernet, satellite etc
- **Network Layer:** host-to-host connectivity, detailed study of generic routing & addressing - also for today's internet
- **Transport Layer:** host-to-host data transport. Detailed study of reliable data transport, congestion control, flow control with examples of TCP and UDP
- **TCP/IP Application layer:** Detailed study of the Network Applications including HTTP, FTP, electronic mail protocols (SMTP, POP3, IMAP), DNS and distributed file sharing.

**Advanced Concepts:**
- **Advanced topics in computer networks:** Multimedia networking (quality of service), computer security, wireless networks, overlay networks.
- **Case studies of new/emerging network systems /technologies:** HTTP load balancing, Network caching, Content distribution (Akamai), Peer-to-peer systems (Gnutella/BitTorrent).

**Teaching and Learning Pattern**
The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real
life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

**Assessment method**

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

**References:**


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5.5. MTE 7103 Digital Signal Processing:

**Course Objective**

This course will examine a number of advanced topics and applications in one-dimensional digital signal processing, with emphasis on optimal signal processing techniques. Topics will include modern spectral estimation, linear prediction, short-time Fourier analysis, adaptive filtering, plus selected topics in array processing and homomorphic signal processing, with applications in speech and music processing.

**Discrete-time signals and systems;** the z-transform. Input-output relationships; discrete-time networks. The discrete-time Fourier transform and sampling; practical sampling issues; signal quantization. The discrete Fourier transform, the fast Fourier transform, and high-speed convolution. Filter design from analog models; impulse-invariant, bilinear, and spectral transformations. FIR filter design, windowing, and frequency-sampling methods. Equiripple filter design. Coefficient quantization. Examples of DSP applications and implementations.


**Teaching and Learning Pattern**

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

**Assessment method**

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will
carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:

5.6. EMT7201 Advanced Engineering Mathematics

Course objectives
The course gives the background for simple analytical derivation and numerical calculations for stochastic processes in discrete and continuous time as well as the application of Finite Element Methods to the solution of partial Differential Equations arising from Structural Engineering, Heat Conductions, Geomatic Engineering and Electrical Transmission Lines and using appropriate software tools e.g. MATLAB. Topics include Finite Element Discretization and the Direct Stiffness Method, Mathematical Formulation of Finite Elements, Computer Implementation of Finite Elements, Stochastic (Random) Processes and Estimation Theory.

AIM:
The objectives are to develop a fundamental understanding of state-of-the-art finite element formulations and procedures, to develop an appreciation for the strengths and limitations of modern finite element methods and related software, to reinforce knowledge in solid mechanics with particular emphasis on nonlinear and dynamic problems, and to learn to utilize finite element methods as a research tool. Topics include finite element fundamentals and Weighted residual and finite element methods for the solution of hyperbolic, parabolic and elliptical partial differential equations, with application to problems in science and engineering. Error estimates. Standard and discontinuous Galerkin methods

The course gives the background for simple analytical derivation and numerical calculations for stochastic processes in discrete and continuous time as well as Estimation Theory.

Detailed Course Content:

1. Finite Element Methods (30 Hours)
1.1 Finite Element Discretization and the Direct Stiffness Method: The Direct Stiffness, Finite Element Modeling: Mesh, Loads, BCs, Multifreedom Constraints, Superelements and Global-Local Analysis
2. **Stochastic (Random) Processes** *(09 Hours)*

Definition; Characterization: Probabilistic Description, Expected Values and Autocovariance Functions
Classification: Stationary, Wide-Sense Stationary, Ergodic, Markov, Normal and Poisson Processes
Analysis and Processing of Stochastic Processes: Spectral Density, and Response of Linear Systems to Random Input,

3. **Estimation Theory** *(06 Hours)*

- Definitions: Estimators, Point and Interval Estimators
- Properties of Point Estimators
- Types of Estimation: Estimation of a Distribution's Unknown Parameter; Estimating the value of an inaccessible variable in terms of an accessible variable
- Estimators: Maximum Likelihood Estimator, Bayesian Estimator, Mean Square Linear Estimator: Univariate Linear Regression; Orthogonality; Basic extension to Multivariate Linear Regression

**Learning Outcomes**

Students should be proficient in basics of Finite Elements Methods, Properties and Classification of Stochastic Processes, associated mathematically rigorous proofs, and some programming language.

The Students should be able to articulate the Properties of classical Stochastic Processes and how these are applied in the classification of the same.

**Teaching and Learning Pattern**

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques.

**Assessment method**

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

**References:**


5.7. MTE 7201 Wireless & Mobile Communications

AIMS:
- To discuss the evolution of mobile systems, the convergence of mobile telecommunications and the internet, and the challenges for future mobile systems
- To study the foundations of mobile and wireless communications systems including the physical layer issues underpinning such systems e.g. pathloss, multipath and inter symbol interference, multiple access techniques and their capacities, diversity, equalization and other techniques aimed at improving mobile communication systems.
- To evaluate today's cutting edge research problems in wireless and mobile communications.

Detailed Course Content:
- Large scale radio propagation effects: path loss and shadowing
- Small scale radio propagation effect: multipath fading
- Narrowband fading (Rayleigh fading, Ricean fading, Nakagami fading) and Wideband fading (channel scattering function, channel coherence bandwidth, power delay profile, channel coherence time, Doppler power spectrum)
- Capacity of wireless channels: AWGN channels; LTI channels (SISO, SIMO, MISO, frequency selective channels) and flat fading channels (slow and fast fading, with or without CSI at tx)
- Overview of Analog & digital modulation and detection - Signal Spaces, Basis Functions
- Performance of digital modulation over wireless channels
- Techniques to improve performance of wireless systems: Diversity, Adaptive modulation, Multiple antennas and space-time coding, Equalization, Multi-carrier modulation (OFDM), Spread spectrum (Direct sequence SS and frequency hopping SS), RAKE receivers

Teaching and Learning Pattern
The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques.

Assessment method
Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:

5.8. MTE 7202 Satellite & Microwave Communications

Course Description:
This course will cover the most relevant aspects of satellite & microwave communications, with emphasis on the most recent applications and developments.

AIMS:
- To understand Radio communication in general and also the special aspects that relate to microwave and satellite communications.
- To give a thorough understanding of satellite systems including topics of orbits and constellations, satellite space segment, and propagation and satellite links; baseband communications techniques for satellites including modulation, coding, multiple access and on-board processing as well as the applications of various satellite communications systems and with emphasis on recent development in LEO satellite systems for personal communications.
- To discuss the use of microwave radio systems in communications highlighting the design, deployment and operational challenges of microwave radio communications.

Detailed Course Content:

Radio Communications Principles
- Review of wireless Communication principles
- The design of a digital radio link: link budgets, modulation, error control coding, baseband signaling theory, and multiple access methods.
- Broadcast radio Systems: AM, FM broadcast

Satellite Communications:
- A review on the background and basic concepts of satellite communications.
- Satellite orbital aspects with emphasis on the geostationary orbit
- Satellite subsystems, launching methods, and on-board processing.
- Frequency assignments and propagation aspects that affect the satellite.
- Antennas and earth station technology including the design of very small aperture terminals (VSATs).
- Non-geosynchronous orbits and their applications.
- Specific applications of satellites including the global positioning system (GPS), satellites for mobile communication, and satellites for internet.

Microwave Communications:
- Physics of microwave components
- Microwave systems design, link budgets and link designs
- Interconnection of microwave links to make networks.
• Telecommunication transport systems (PDH, SDH, Ethernet on Microwave, Copper, & Fiber) and how microwaves fit into this part of the system.

Teaching and Learning Pattern
The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method
Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:
6. Ferdo Ivanek (Editor): ‘Terrestrial Digital Microwave Communications’, Artech House

5.9. MTE 7203 Radar System Engineering & Design

Course Description:
This course discusses the fundamental principles behing the design and operation of Radar systems for different applications. It is intended to make the student understand the principles of Radar and its use in military and civilian environment and give them them familiarity with navigational aids available for navigation of aircrafts and ships.

AIMS:
1. To derive and discuss the Range equation and the nature of detection.
2. To apply doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars
3. To refresh principles of antennas and propagation as related to radars, also study of transmitters and receivers.

Detailed Course Content:
1. THE NATURE OF RADAR: Introduction; The Radar Equation; Radar Block Diagram and Operation; Radar Frequencies; History of Radar Development; Applications of Radar

2. THE RADAR EQUATION: Prediction of Range Performance; Minimum Detectable Signal; Receiver Noise; Probability-density Functions; Signal-to-noise Ratio; Integration of Radar Pulses; Radar Cross Section of Targets; Cross-section Fluctuations; Transmitter Power; Pulse Repetition Frequency and Range Ambiguities; Antenna Parameters; System Losses; Propagation Effects

3. CW AND FREQUENCY-MODULATED RADAR: The Doppler Effect; CW Radar; Frequency-modulated CW Radar; Airborne Doppler Navigation; Multiple-frequency CW Radar

4. MTI AND PULSE-DOPPLER RADAR: Moving-target-indication (MTI) Radar; Delay Lines and Cancelers; Subclutter Visibility; MTI Using Range Gates and Filters; Pulse-doppler Radar; Noncoherent MTI; MTI from a Moving Platform—AMTI; Fluctuations Caused by Platform Motion; Effect of Sidelobes on Pulse-doppler AMTI Radar

5. TRACKING RADAR: Tracking with Radar; Sequential Lobing; Conical Scan; Simultaneous Lobing or Monopulse; Target-reflection Characteristics and Angular Accuracy; Tracking in Range; Tracking in Doppler; Acquisition; Examples of Tracking Radars; Comparison of Trackers

6. RADAR TRANSMITTERS: Magnetron Oscillator; Klystron Amplifier; Traveling-wave-tube Amplifier; Amplitron and Stabilitron; Grid-controlled Tubes; Comparison of Tubes; Modulators

7. ANTENNAS: Antenna Parameters; Antenna Radiation Pattern and Aperture Distribution; Parabolic-reflector Antennas; Scanning-feed Reflector Antennas; Cassegrain Antenna; Lens Antennas; Array Antennas; Pattern Synthesis; Cosecant-squared Antenna Pattern; Effect of Broadband Signals on Antenna Patterns; Effect of Errors on Radiation Patterns; Radomes; Focused Antennas

8. RECEIVERS: The Radar Receiver; Superheterodyne Receiver; Receiver Noise; Noise Figure; Effective Noise Temperature; Environmental Noise; RF Amplifiers; Crystal Mixers; IF Amplifiers; Displays; Duplexers

9. PROPAGATION OF RADAR WAVES: Propagation over a Plane Earth; The Round Earth; Refraction; Anomalous Propagation; Low-altitude Coverage; Radar Diffraction Screen; Attenuation by Atmospheric Gases; Microwave-radiation Hazards

10. SYSTEMS ENGINEERING AND DESIGN: Systems Engineering; Radar Parameter Selection; Example—Aircraft-surveillance Radar ASDE; Airborne Weather-avoidance Radar; Bistatic Radar; Radar Beacons

Teaching and Learning Pattern

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:


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5.10. MTE 7204 Optical Communications

Course Description:
This course covers the basic material of fiber optic components, systems, and networks. It starts with the basic physics behind optical components, continuing with a discussion of optical components and their interconnection to make networks, and leading at the end to a discussion of large-scale all-optical networks that represent the future of Networking.

AIMS:
The most important outputs of the course should include understanding of:
- The physical principles of optical fibers, components, devices and networks how the components work together to create useful fiber optic networks
- How fiber optic networks are used to create large-scale communications networks and the basic economics of fiber-based networks
- How to buy optical communications services and what they cost
- How all-optical networks will function, and their advantages and problems

Detailed Course Content:
- **Optical Fibre**: The Nature of Light, Transmitting Light on a Fibre, Light Propagation in Multimode and Single-Mode fibres, Plastic Optical Fibre (POF), Hard Polymer (plastic) Clad (silica) Fibre (HPCF)
- **Optical Sources**: Light Emitting Diodes (LEDs), Lasers.
- **Optical Detectors**: Photoconductors; Photodiodes including Schottky-Barrier and Avalanche Photodiodes (APDs); Hetero-Interface Photo detectors, Travelling-Wave, Resonant-Cavity, Phototransistors.
- **Optical Devices**: Optical Component Technologies, Optical Amplifiers, Second Harmonic Generation (SHG), Splitters and, Polarization Control, Lenses and Diffraction, Filters, Modulators and Switches, Repeaters
- **Fibre Manufacture, Cables & Connectors**: The Technology of Fiber, Fibre Cables, splicing.
- **Point-to-Point Transmission Systems**: Modulation, System Engineering, & Control of Dispersion
- **Optical Link Connections in Electronic Networks**: Fibre Distributed Data Interface (FDDI), Ethernet (IEEE 802.3), Fibre Channel, Synchronous Optical Network (SONET) and SDH, Asynchronous Transfer Mode (ATM); WDM (Systems, Standards)
- **Optical Network Operations**: connectors and multiplexors; Measuring instruments and techniques: power meter, optical spectrum analyzer, OTDR, BER meter; Link Budget and loses: Measuring optical fiber cable loses; optical network simulation packages (PTDS); safe working practices.

Teaching and Learning Pattern
The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques.
Assessment method

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:

5.11. MTE 7205 Telecomm Regulation, Management and Policy

Course Description

This course provides a panorama review to the telecommunications sector from policy, business and technology perspectives. It explores the driving forces behind the radical change in the telecommunications policy and the significant impact of this regulatory change on business operation. Such key issues as universal service, digital convergence, network interconnection, the WTO, spectrum auction, regulatory environment of mobile multi-media services, VoIP and international settlement will be highlighted explicitly. It will also address the increasing importance of telecommunications in the business innovation, such as value co-creation and reverse economy. At the end of the semester, it will provide a general review of Uganda and East Africa’s telecommunications market benchmarked against the rest of the developing and developed world.

This will study all generic issues about Telecommunication systems, their management and standardization as well as their effects on society. In all study components, discussions will be held on four regions:
- Uganda,
- East Africa,
- Africa and the Developing world,
- The developed world & International

AIMS:

1. To learn the economics, function, organizational structure and procedures involved in the operation and management of the telecommunications industry
2. To develop alertness to the business dynamics in the media industry and understand the implications of media industry news events to media management
3. To develop problem-solving and presentation skills required in media management careers
4. To cultivate leadership and interpersonal communication skills required in media management careers

Detailed Course Content:
Critical components will include:
- Structure of The telecommunications & ICT Industry
- International standardization, Regulation and development.
- Regulation in Uganda and other developing countries and its effects / contribution to development.
- Telecommunications Law and Policy
- Human rights and gender issues for technology,
- Rural telecommunications and universal access.

The outline below may be followed but not necessarily chronologically:
- Telecommunications and Telecommunications Policy: The Introduction
- Basic Principle of Telecommunications
- Digitization and Digital Convergence: Where is the Border between Telecom, Broadcasting and Computing?
- Wireless Communications and Spectrum Regulation: Is 3G License too Expensive?
- Telecommunications Network: What does the Telephone Network Look Like in Africa?
- Next Generation Networks: Portable Internet?
- Business and Socioeconomic Implications of Telecommunications
- Arguments over natural monopoly
- Necessity and Feasibility of Telecommunications Deregulation.
- Organizational Restructuring of Telecommunications: From Monopoly to Competition, and to the Bubble and Its burst
- Regulation over network interconnection
- Case Study: Local Network Competition in East Africa
- Case Exercise: Negotiation over Network Interconnection
- The privatization of telecommunications
- VoIP and International Settlement: Implications for Developing Countries
- Foreign Direct Investment of Telecommunications and WTO's Basic
- Telecommunications Agreement:
- Regulatory Environment of Mobile Multimedia Services: Implications of "Bus Uncle"
- The Support Economy and Telecommunications Transformation: Why Blog is so Popular?
- Uganda’s Telecommunication Market: A Review
- East Africa’s Telecommunications market: A Review

Teaching and Learning Pattern

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

Course text

References:
2. Geroski, Barriers to Entry and Strategic Competition, 1990
5. Fransman, Martin," Telecoms in the Internet Age": from boom to bust to--? Oxford University Press: Oxford, 2002;

5.12. MEC 7201 Engineering Project management

Course Description

An overview of the theory and practice of managing projects in any organization, applying widely used software tools for project management and risk analysis. Emphasis is on leadership in project management: managing projects or tasks in a team environment; building teams; and utilizing communication, organization and conflict management skills. Discussion covers the various phases of a project, including initiating, planning, executing, monitoring and controlling, and closing the project. Topics include analytical approaches and quantitative methods in project management, such as earned value management and techniques for estimating project duration and cost, optimizing allocation of resources, expediting projects and scheduling algorithms. Simulation tools and statistical techniques are used to analyze uncertainty in project selection, budget allocation and time estimation. Project management knowledge areas are examined and linked to industry practices for successful management of projects.

AIMS:

As technological integration and construction complexity increase, so does construction lead times. To stay competitive companies have sought to shorten the construction times of new infrastructure by managing construction development efforts effectively by using different project management tools. In this course, three important aspects of project management are taught:

- the theory, methods and quantitative tools used to effectively plan, organize, and control projects;
- efficient management methods revealed through practice and research;
- Hands-on, practical project management knowledge from on-site situations and field trips.

The aims of this course are to:
- Enable students appreciate the role of projects in any industrial setting.
- Give students and understanding of the conduct of projects in all its various aspects such as project planning and management, tendering and procurement.

Detailed Course Content:

1. Foundations of Project Management (3 Hours)
An overview of the theory and practice of managing projects in any organization. Emphasis is on leadership in project management: managing projects or tasks in a team environment; building teams; and utilizing communication, organization and conflict management skills. Discussion covers the various phases of a project, including initiating, planning, executing, monitoring and controlling, and closing the project. Project management knowledge areas are examined and
linked to industry practices for successful management of projects. The goal is to gain a solid understanding of how to successfully manage each phase of the project life cycle, work within organizational constraints, set goals linked directly to stakeholder needs and utilize proven project management tools to complete projects on time and within budget while meeting specifications. Essential concepts, processes and techniques are applied through management of a team project, which requires regular progress reports and reviews.

2. **Project Risk Management** (6 Hours)
An in-depth analysis of risk management methodologies, from both strategic and tactical perspectives. State-of-the-art tools and techniques for identifying, measuring and monitoring risks in the project management environment are examined. Both qualitative and quantitative risk analyses are conducted, and strategies for proactive risk aversion and reactive risk response are developed. Focus is on how a comprehensive risk management approach can enable a project team to proactively manage issues that adversely impact the successful control and completion of a project.

3. **Project Communications Management** (3 Hours)
An overview of conflict resolution processes and methods and the skills needed to manage the human elements within project management—a task as challenging as managing the technical aspects. Topics include critical communication and conflict resolution issues faced by project workers in today's global corporate environment. Innovative approaches to successfully negotiating and resolving conflicts among team members, colleagues, managers and stakeholders are introduced and practiced. Proven techniques to make conflict a constructive—rather than a destructive—experience are analyzed. Emphasis is on case study analysis, effective communication behaviors, negotiation skills and virtual team processes to successfully lead both domestic and global projects.

4. **Project Quality Management** (9 Hours)
A study of the policy, processes and procedures involved in assuring that projects will satisfy the objectives for which they were undertaken. Emphasis is on quality planning, quality assurance, quality control, and process improvement. Discussion covers all the activities that determine quality objectives, policies, and responsibilities. The importance of customer satisfaction, prevention over inspection, management responsibility and continuous improvement is recognized. Topics include control charts, cause and effect diagrams, Pareto charts, failure mode and effect analysis, design reviews and cost of quality. Course content and approach are compatible with the International Organization for Standardization.

5. **Project Procurement Management** (6 Hours)
An examination of the tools needed for project procurement management. Focus is on determining what needs to be purchased or acquired and determining when and how to acquire it. Topics include planning the contracting efforts (documenting products and services and identifying potential sellers); requesting sellers’ responses (obtaining information, quotation, bids, offers or proposals); selecting the seller (receiving and reviewing offers, selecting among those potential offers and negotiating a contract); administering contracts (managing the relationship between buyers and sellers, including documentation, corrective actions and contract changes); and closing contracts (completing the contract and settling all open issues).

6. **Financial and Strategic Management of Projects** (9 Hours)
Financial and strategy making in project management. Covers: project cost estimation developed from work breakdown structure; formulating, monitoring and controlling project budgets; impact of project scope and schedule; managing project changes; management reserves to cover risks and contingencies; top-down and bottom-up budgeting; Earned Value Management as a key tool to monitor, evaluate and forecast project costs, schedule, results and performance; deriving project cash flows; investment project evaluation; discounted cash flow, internal rate of return and net present value methodologies; cost of capital; and capital budgeting. Broader issues examined include links between project and corporate financial
performance, business ethics, corporate social responsibility, project and organizational culture issues, communications and information flow, financial risk analysis and project sustainability, for government as well as privately funded projects.

7. Advanced Project Methods (9 Hours)
An overview of advanced methods of managing projects, applying widely used software tools for project management and risk analysis. Topics include analytical approaches and quantitative methods in project management, such as earned value management and techniques for estimating project duration and cost, optimizing allocation of resources, expediting projects and scheduling algorithms. Simulation tools and statistical techniques are used to analyze uncertainty in project selection, budget allocation and time estimation. Discussion covers project portfolio management and how multiple projects and programs fit into strategic direction of an organization. The processes, tools and techniques of project management are applied to a team project with emphasis on quantitative and analytical methods.

Learning Outcomes
At the end of this course, a student should be able to:
• Distinguish between a programme, project and a routine activity
• Demonstrate knowledge and skills of processes, techniques, standards, empirical guidelines, computer software, team building used in project
• Develop project requirements especially human and financial
• Explain the various project monitoring and control techniques

Teaching and Learning Pattern
The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method
Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:
5.13. MPS 8102  Finance in Engineering

AIM:

The course introduces students to the core areas of financial management, providing the platform from which the other technical accountancy areas can be studied in greater detail.

Detailed Course Content:


Receivables Management – Credit management through credit policy variables, marginal analysis, Credit evaluation : Numerical credit scoring and Discriminate analysis. Control of accounts receivables, Factoring.

Inventory Management: Determinations of inventory control levels : ordering, reordering, danger level. EOQ model. Pricing of raw material. Monitoring and control of inventories, ABC Analysis.


Financial Management of sick units: Definition of sickness, causes, symptoms, predictions, revival strategies, institutions for revival of sick units. Economic Value Added (EVA) – concept, components of EVA. Market Value Added (MVA)

Teaching and Learning Pattern

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method
Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:

3. I.M. Pandey – Financial Management (Vikas), 9/e, 2005
5. Ross, Westerfield & Jaffe, Corporate Finance– TMH – 7/e, 2005
7. Vanhorne, Financial Management & Policy, Pearson / PHI

5.14. MTE 8102 Marketing Management

AIM:

This course provides an overview of marketing processes and marketing principles, and provides students with the opportunity to apply the key concepts to practical business situations.

Course Description

Marketing Management is the art and science of choosing target markets and getting, keeping, and growing customers through creating, delivering, and communicating superior customer value. Marketing management seeks to meet organizational objectives by effectively satisfying customers in a dynamic environment.

Detailed Course Content:

Concept of marketing and its role in business and public organisations. Marketing decisions. Need for scientific marketing analysis, Uses and limitations of mathematical models in marketing. Classifications of market structure depending upon the nature of competitive conditions.

Introduction of a new product, Consumer behaviour, Utility measure for product search, Break-even analysis for product evaluation, PERT and CPM in product development. Demand elasticities and elasticity theorem, Factors affecting pricing decision, Pricing methods, Joint optimization of price, quality and promotional effort, Purchasing under fluctuating prices.

Promotional decisions in the presence of competition, Game theory models for promotional effort, Spatial allocation of promotional effort, Media allocation for advertisement, Brand switching analysis.

Channels of distribution, Transportation decision, Locating company's wholesale dealers and warehouses.

Case studies relating to marketing decisions.

Learning Objectives

• To apply marketing theory and concepts to what marketers do in "the real world"
• To use marketing concepts to make business decisions
• To improve familiarity with current challenges and issues in marketing

**Teaching and Learning Pattern**

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

**Assessment method**

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

**References:**


5.15. **MTE 8103 Microprocessor based Systems**

**Course Description:**

The course provides students with an understanding of microprocessor-based systems and their use in instrumentation, control and communication systems.

**AIM:**

On successful completion of this unit, students should be able, at threshold level, to:

• Investigate microprocessor-based systems.
• Produce software for a microprocessor-based system
• Interface microprocessor-based systems

**Detailed Course Content:**

**Introduction and Historical Perspectives**

• Architecture basics, Complex Instruction Set Computers (CISC) and Reduced Instruction Set Computers (RISC) processors, Advantages and Drawbacks of CISC & RISC, Logical Similarity with example of a typical microprocessor,
• Short Chronology of Microprocessor Development with reference to CISC families such as INTEL, AMD and MOTOROLA, RISC families development of POWER PC, Alpha, Sparc

**Microprocessor and Microprocessors:**

• Specifications, 89C51, and variants, Generation of addresses, data and control buses, selection of proper buffers, loading considerations, clock circuits and power on reset design, Technologies and comparison of Intel 8 to 32 bit Microprocessor and Microcontroller, Special features of microcontrollers.
Fundamental Architectures:
- Defining a Computer Architecture e.g. degree of pipelining, basic topology, technology used etc.,
- Von Neumann and Haward Architectures, Single Processor Systems, Parallelism Implementation using pipelines and multiple units, Superpipelining, Superscalar,
- Very Long Instruction Word (VLIW) architectures, Building multithreaded processors,

System Design:
- Minimum system with 89C51 to monitor frequency, voltage, displacement, liquid level, weight, speed, traffic light control system with s/W development for above.
- Isolation Techniques: Various relays, opto-couplers and their specifications, Interfacing of Relays and opto-couplers, isolation methods for heavy and a.c. loads
- Signal Transmission: V to I and I to V Conversion, V to F and F to V Conversion, netic and Electrostatic Shielding and Grounding.

System design for Control Applications:
- Transducers for temperature, pressure and speed and interfacing them to signal conditioners, Instrumentation Amplifiers for thermocouple, bridge and LVDT,
- System design with 89C51 for measurement and control of temperature, pressure, speed using ON/OFF, Proportional and PID modes, stability aspects of the system, s/w development for above.

ARM processor Architecture:
- Introduction to ARM processor and its important features, and Architecture Programming model, Processor Operating State, Memory Formats,
- Instruction, Length, Data Types, Operating Modes, Exceptions and Interrupts Latencies and Reset.

Introduction to AVR, Architecture and Hardware Resources of AVR Microcontrollers.
- Architecture: The Arithmetic Logic Unit, Program and Data Memories, Downloadable Flash Program Memory, SRAM Data Memory, General-Purpose Register File, I/O Register, EEPROM Data Memory, Peripherals, Timer/Counter, Watchdog Timer, Serial Peripheral Interface SPI, Universal Asynchronous Receiver and Transmitter, Analog Comparator, I/O Ports, Reset and Interrupt System, Interrupt Vector Table, Reset Sources, Clock, Handling the Hardware Resources
- Development Tools: ATMEL AVR Assembler and Simulator, ATMEL AVR Studio.

Multiple Processor Systems
- SIMD, MIMD and multi-computer approaches.
- Implementation Considerations: Memory Hierarchy, prefetching techniques, coherent caches, pipelining, ternary logic, packaging considerations, wafer scale integration.

Implementation of Functional Units:
- Memory Management, Arithmetic Logic Unit, Floating Point Unit, Branch Unit, Vector Unit, Load/Store Unit.
- Case Study of INTEL x86 family: Overview and Features in brief.

Teaching and Learning Pattern
The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method
Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:

5.16. MTE 8104 Operations Research

AIM:
This is an introductory course on operations research that will give students the essential tools of operations research to enable them model and make scientifically based decisions in production environments

Course Description:
The course focuses on Modeling in operations research, linear programming (Simplex method, duality, sensitivity analysis), network models (shortest path, PERT/CPM, maximum flow, minimum spanning tree, transportation and assignment), Poisson processes, and queuing models

Detailed Course Content:

- Introduction to operations research, Operations research techniques, simulation models
- Linear programming formulation and graphic solution: Models of mathematical operations research, art of modeling, construction of the LP model, graphical LP solution
- The Simplex method: Standard LP form, basic solution, The Simplex method, the M-method, the two-phase method, degeneracy, alternative optimal solution, unbounded solution, infeasible solution
- Sensitivity analysis and dual problem: Definition of the dual problem, the relationship between the optimal primal and dual solution, economic interpretation of duality, the dual Simplex method, primal-dual computations, sensitivity analysis
- Transportation, assignment, and transshipment models: Definition of the transportation model, determination of a starting solution, the transportation algorithm, definition of the assignment problem, the Hungarian method, the transshipment model
- Network models: Network definition, minimal spanning tree algorithm, shortest route problem, shortest route algorithm, maximal flow model, enumeration of cuts, maximal flow algorithm, CPM, PERT
- Queuing systems: Elements of a queuing model, role of exponential distribution, birth and death models, steady state measures of performance, single server models, multiple-server models, machine servicing model, Pollaczek-Khintchine formula, queuing decision models

Learning Outcomes
• Formulate LP problems and describe the logic underlining the steps in the Simplex method and solve LP problems by Simplex method.
• Formulate the dual problem and describe its economic interpretation and interpret the LP solution.
• Use the Dual Simplex method to find the optimal solution of an LP.
• Use primal-dual computational formulas to find a solution of an LP.
• Conduct sensitivity analysis.
• Formulate and solve the transportation and assignment problems.
• Describe and solve the minimal spanning tree, the shortest path problem and the maximal flow problems.
• Use CPM and PERT to find the critical path and time schedule of a project.
• Describe the elements of a queuing model and the role of the exponential distribution in queuing models.
• Represent a queuing system by a transition-rate diagram.
• Define the steady state measures of performance of a queuing system.
• Establish the transition-rate diagram, the transition probabilities and the measures of performance for selected queuing models.

Teaching and Learning Pattern

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method

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References:

5.17. MTE 8105  Radar Signal Detection and Data Processing

AIM:
This course builds on the first course in Radar to discuss the signal and data processing principles of radar systems. Fundamental radar system concepts will be developed in this four-hour tutorial session. Each topic will be illustrated using a worked example.

Detailed Course Content:
DETECTION OF RADAR SIGNALS IN NOISE: Matched-filter Receiver; Correlation Detection; Detection Criteria; Inverse Probability; Detector Characteristics; Performance of the Radar Operator; Delay-line Integrators; Binary Integration

EXTRACTION OF INFORMATION FROM RADAR SIGNALS: Phase and Amplitude Measurements; Review of Radar Measurements; Statistical Estimation of Parameters—Likelihood Function; Theoretical Accuracy of Range and Doppler-velocity Measurements; Uncertainty Relation; Angular Accuracy; Transmitted Waveform; Pulse Compression;

CLUTTER, WEATHER, AND INTERFERENCE: Ground Clutter; Sea Clutter; Clutter Reduction; Meteorological Echoes; Attenuation by Precipitation; Visibility of Targets in Weather Clutter; Angles; Interference; ECM and ECCM

RADAR DETECTION OF EXTRATERRESTRIAL OBJECTS: Radar Echoes from the Moon and Planets; Radar Detection of the Sun and Meteors; Radar Observation of Auroras and Ionized Media; Tracking of Earth Satellites and Space Vehicles

Teaching and Learning Pattern
The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real-life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students’ understanding of the problem based learning techniques.

Assessment method
Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:
5.18. **MTE 8106 Advanced Topics in Communications Engineering**

**AIM:**
The course is intended to discuss advanced concepts relating to communications systems and networks. It also discusses recent advances in research in communications and signal processing both within and outside Makerere University.

**Detailed Course Content:**
Details of the course including content and delivery systems will be determined during any semester in which the course is offered and by the professor(s) that will be taking the course.
### ANNEX I: PERSONNEL

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Highest Qualification</th>
<th>Position</th>
<th>Availability</th>
<th>Specialization</th>
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<tbody>
<tr>
<td>1</td>
<td>E. Luguijo</td>
<td>PhD</td>
<td>Assoc. Prof.</td>
<td>Full-Time</td>
<td>Electrical Engineering, Engineering Mathematics</td>
</tr>
<tr>
<td>2</td>
<td>M. K Musaazi</td>
<td>PhD</td>
<td>Senior Lecturer</td>
<td>Full-Time</td>
<td>Electrical Engineering, Engineering Mathematics</td>
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<tr>
<td>3</td>
<td>S. Tickodri-Togboa</td>
<td>PhD</td>
<td>Assoc. Prof.</td>
<td>Full-Time</td>
<td>Telecommunications, Engineering, Engineering Mathematics, ICT.</td>
</tr>
<tr>
<td>4</td>
<td>J. Byaruhanga</td>
<td>PhD</td>
<td>Assoc. Prof.</td>
<td>Full-Time</td>
<td>Maintenance Engineering</td>
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<tr>
<td>5</td>
<td>P. Mugisha</td>
<td>MSc</td>
<td>Senior Lecturer</td>
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<tr>
<td>6</td>
<td>Ms. D. Okello</td>
<td>PhD</td>
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<td>Telecommunications, Electronic Engineering</td>
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<td>7</td>
<td>L.L. Kaluuba</td>
<td>PhD</td>
<td>Senior Lecturer</td>
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<td>Telecommunication, Computer Engineering, Engineering</td>
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<tr>
<td>8</td>
<td>Julius Butime</td>
<td>PhD</td>
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<td>9</td>
<td>P. Da Silva</td>
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<td>10</td>
<td>D. Nsubuga Mubiru</td>
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<td>11</td>
<td>A. Sendegeya</td>
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<td>Mr. E. Matumbwe</td>
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<td>15</td>
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7. ANNEX II: PROGRAMME COSTING

PROGRAMME COSTING
A. SUMMARY

EXPECTED INCOME

I Tuition Fees
Total Admission Number 10
Number of semesters 2
Amount Payable per Student per semester 2,850,000/=  
Total Amount per Semester 28,500,000/=  
Total Amount per Year 57,000,000 /=

II DISTRIBUTION
College (61%) 34,770,000/=  
Central Activities (39%) 22,230,000/=  
Total 57,000,000=/=

B DETAILS OF PROGRAMME COSTING

INCOME
College allocation 34,770,000/=  

EXPENDITURE

I Teaching Expenses
Lecture/tutorials/practical hours @50,000 x 510 CH 25,500,000 /=

II Administrative Activities
College Activities (Administration/Cleaning, Furniture, etc.) 3,000,000/=  

III Teaching Materials

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### 8. ANNEX III: PROGRAMME INTERRELATIONSHIP

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<td>RET 7105 Statistics and Research Methods</td>
<td>MEC 7105: Principles of Management</td>
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<td>MTE 7101 Digital Communications</td>
<td>MPS 7101 Power Systems Operation and Management</td>
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<td>MTE 7201 Wireless &amp; Mobile Communications</td>
<td>MPS 7201 Industrial Electronics</td>
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<td>MTE 7202 Satellite &amp; Microwave Communications</td>
<td>MPS 7202 Power System Protection &amp; Relaying</td>
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<td>Electives (Select at least 2)</td>
<td>MTE 7203 Radar System Engineering &amp; Design</td>
<td>MPS 7203 Electrical Machines &amp; Machine design</td>
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<td>MTE 7204 Optical Communications</td>
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<td>MTE 7205 Telecom Mgt, and Policy</td>
<td>MEC 7201 Engineering Project Management</td>
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**PLAN A**

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<th>YEAR</th>
<th>SEM I &amp; II</th>
<th>MTE 8200 / MPS 8200 Research &amp; Thesis</th>
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**PLAN B**

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