UNIVERSITY OF MINES AND TECHNOLOGY
[UMaT]
TARKWA, GHANA

UMaT

GUIDELINES FOR POSTGRADUATE STUDIES

2016/17

UNIVERSITY OF MINES AND TECHNOLOGY (UMaT), TARKWA

SCHOOL OF POSTGRADUATE STUDIES

GENERAL REGULATIONS FOR POSTGRADUATE PROGRAMMES
2016/2017 ACADEMIC YEAR

INTRODUCTION

This brochure is specially prepared to afford those who are interested in pursuing postgraduate studies at this University the opportunity of having a firsthand knowledge of programmes available and the regulations thereof.

ENQUIRIES

All enquiries and/or applications for admission, etc, must be addressed to:

The Secretary
School of Postgraduate Studies
University of Mines and Technology
Post Office Box 237
Tarkwa, Western Region
Ghana.
Telephone: +233 (0) 3123 20935 or (0) 3123 20324/20280 Ext. 228
Facsimile: +233 (0) 3123 20306
Email: SPS@umat.edu.gh

BOARD OF SCHOOL OF POSTGRADUATE STUDIES

Dean, School of Postgraduate Studies	- Chairman
Vice Dean	- Member
A representative from Faculty of Mineral Resources Technology Board not below the rank of senior lecturer	- Member
A representative from Faculty of Engineering Board not below the rank of senior lecturer	-Member
HODs of the students concerned	- Member
Faculty Officer of the School not below the rank of Assistant Registrar	- Secretary

FUNCTIONS OF BOARD OF POSTGRADUATE STUDIES

i. To give approval of candidatures, supervisors, coursework, theses topics, titles and synopses for higher qualifications based upon the recommendations from the Departmental and Faculty Boards.

ii. To recommend the appointment of Internal and External Examiners in respect of written papers, dissertations or thesis to the Academic Board based upon recommendations from the Departmental and Faculty Boards.

iii. To keep records of all Postgraduate students.

iv. To give provisional approval to postgraduate examination results upon recommendations from the Departmental and Faculty Boards.

v. To liaise with the Deans on postgraduate matters in their various Faculties.

vi. To establish, through the Dean of International Programme, and maintain links with Postgraduate Schools in other universities or institutions and promote exchanges of postgraduate students and staff engaged in postgraduate work between this University and other institutions.

PROGRAMMES & GUIDELINES

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1 INTRODUCTION

The University of Mines and Technology (UMaT) started in 1952 as the Tarkwa Technical Institute. In 1961, it was reorganised to become the Tarkwa School of Mines to train the required manpower for the mining and allied industries in Ghana. In 1976, the School was affiliated to the Kwame Nkrumah University of Science and Technology (KNUST) as a faculty of that University. It became the Western University College of KNUST in 2001. UMaT was established in November 2004 by an Act of Parliament (Act 677).

1.1 VISION STATEMENT

The vision of the University is to become a Centre of Excellence in Ghana and Africa for producing world-class professionals in the fields of mining, technology and related disciplines.

1.2 MISSION STATEMENT

The mission is to provide higher education in mining, technology and related disciplines, to promote knowledge through effective teaching and learning; to promote knowledge through active research and dissemination of information and to offer professional services through extension activities to the mining and allied industries.

1.3 CORE VALUES

Knowledge, Truth and Excellence

2 PROGRAMMES

2.1 DEGREES AND DIPLOMAS

All postgraduate programmes of study in the University may require coursework together with research work, leading to the award of the following:

- Postgraduate Diploma (PgD)
- Master of Science (MSc)
- Master of Philosophy (MPhil)
- Doctor of Philosophy (PhD)

Postgraduate Diploma programmes are offered by some Departments.

3 GENERAL REGULATIONS

3.1 APPLICATIONS AND PROCEDURE FOR ADMISSION

Applications for admission shall be made on a prescribed form obtainable on-line at www.umat.edu.gh, to which the completed form shall be returned not later than the 28th February preceding the academic year in which a candidate wishes to start the programme or any other approved deadline.

All candidates applying for admission to research programmes shall be required to submit (in about 700 and 2,000 words for MPhil and PhD respectively) an outline of proposed research.

Applications shall then be considered, in the first instance, by the appropriate Departmental Board. The Departmental Board shall satisfy itself of the suitability or otherwise of the candidate and the availability of resources for the successful completion of the candidate's work. Where an interview or a qualifying examination is required for determining the suitability or otherwise of an applicant, the Departmental Board shall decide the form of interview or qualifying examination and appoint a panel from its members to administer the interview or examination. The School of Postgraduate Studies shall be represented at such interview or examination.

The Head of Department shall submit to the School of Postgraduate Studies for its approval, a list of candidates recommended for admission together with:

(a) The pertinent extracts from the minutes of the Departmental Board meeting
(b) Statement on the nature of the programme
(c) Dissertation/thesis topic(s) and an outline of the proposed research (where applicable)
(d) Name(s) of proposed Internal Supervisor(s).

3.2 DESCRIPTION OF POSTGRADUATE STUDIES

Postgraduate studies shall be categorised under two main headings: namely, full-time and part-time.

A full-time study shall be completed within a maximum duration of twenty-four months from the date of registration for a master's programme and thirty-six months for a doctorate programme. A full time student is one who is fully engaged in a programme of study and research throughout the entire duration of his/her programme.

A part-time study shall be completed within a maximum duration of thirty-six months from the date of registration for a master's programme and forty-eight months for a doctorate programme.

These maximum durations may be extended by the Board, on the recommendation of the Supervisor through the Departmental and Faculty Boards, by periods not more than six months to a maximum of one year.

3.3 REGISTRATION

(a) Students admitted to the Postgraduate programmes of this University shall register at their respective Departments and at the School of Postgraduate Studies at the beginning of each semester by filling in the appropriate forms prescribed for that purpose. The student shall plan his/her courses in consultation with his/her Supervisor.

(b) Full time students will be required to register a minimum of three (3) modules per semester.

(c) Students should register modules they intend to participate in by the third week of every semester.

(d) To be of good standing a part-time student must do, at least, three modules per annum.

(e) A student who is unable to register within the formal registration period on grounds of ill-health, shall on provision of a Medical Report issued or endorsed by the University Medical Officer, be allowed to register within ten days from the day of the closure of formal registration.

(f) In the event of the inability of such a student to register within the ten days stipulated in paragraph (e) above, he/she will be allowed a deferment for a semester. In a situation where the first semester courses are prerequisite for the second semester

courses, the deferment shall be for the whole academic year (i.e. two semesters).

(g) There shall be no registration by proxy.

(h) In circumstances of force majeure the case shall be referred to the Vice Chancellor.

3.4 ACADEMIC CALENDAR

The semester periods shall be:

First Semester	June to November
Second Semester	December to May

4 REGULATIONS FOR HIGHER DEGREES

4.1 AIMS AND OBJECTIVES

(a) To train high level manpower and improve students' academic competence.

(b) To solve national/international problems with greater emphasis on solving national problems.

(c) To contribute to knowledge.

4.2 ADMINISTRATION OF POSTGRADUATE PROGRAMMES

Postgraduate programmes are administered by a network of persons, panels and committees/boards at various levels.

(a) The following structure outlines the Boards responsible for the administration of Postgraduate Studies at UMaT:

i. Departmental Board.
ii. Faculty Board.
iii. Board of Postgraduate Studies (hereinafter referred to as the Board).
iv. Academic Board.

(b) The composition and duties of the various Boards are as follows:

(i) **Departmental Board Composition**

The composition is as specified in the Statutes.

Duties

- Admission of suitable candidates into Postgraduate programmes in the Department.
- Dealing with matters relating to admission, registration of students, extension of studies, nomination of Supervisors and examinations.

- Nomination of panel of Examiners (Internal and External).
- Final assessment of students for graduation.
- Review of Postgraduate academic curriculum of the Department within approved regulations.

(ii) **Faculty Board Composition**

The composition is as specified in the Statutes.

Duties

- To consider Faculty Postgraduate matters and make recommendations to the Board
- To deal with matters initiated by it or referred to it by the Board or the Departmental Board
- To recommend to the Academic Board, through the Board, Internal and External Examiners for appointment
- To advise on regulations and syllabuses dealing with courses of study for Postgraduate degrees and other awards of the Faculty.
- To make recommendations to the Academic Board, through the Board, for the award of Postgraduate degrees (other than honorary degrees), diplomas, certificates, University fellowships, studentships, scholarships and prizes within the Faculty.

(iii) **Board of Postgraduate Studies**

The composition and duties are as specified in the Statutes.

(iv) **Academic Board**

The composition and duties are as specified in the Statutes.

4.3 PhD PROGRAMMES

The degree of Doctor of Philosophy (PhD) is awarded upon completion of an approved programme of study in which a candidate has made an original and significant contribution to knowledge.

4.3.1 Entry Requirements

(a) A candidate shall hold a Master's degree or its equivalent from a recognised institution and shall submit evidence of adequate training and ability to undertake the proposed programme.

(b) A candidate who does not hold a Master's degree shall first register for MPhil degree. If

he/she proves himself/herself to be academically capable by the end of the first year of the programme, he/she may be permitted by the Board of Postgraduate Studies on the recommendation of the Department to register for the PhD degree. This registration shall be deemed retrospective from the date of the original registration of the Master's degree.

(c) A candidate who does not satisfy the requirements stated (a) and (b) above but is otherwise adjudged suitable may be admitted. For the purpose of assessing his suitability, such a candidate may be interviewed on the recommendation of the Department concerned.

(d) All foreign applicants must have proficiency in English language.

(e) Admission Letters issued to foreign applicants shall be valid for two years.

4.3.2 Duration of Programme

Subsequent to registration, the candidate shall pursue a full-time programme of study and research for at least two academic years, except that:

(a) A candidate fully engaged in advanced study and research for his/her degree, who before registration, was engaged in research to the satisfaction of the Department concerned, may be exempted from not more than one academic year.

(b) In special circumstances, the Department may recommend, that a candidate be allowed to spend not more than one academic year of his/her programme in advanced study and research at another institution, provided that this work can be supervised in a manner satisfactory to the Department and the Board.

(c) A member of the full-time academic staff of the University may be accepted as a part-time candidate. Where the Board is satisfied that a Senior Member has been engaged in research **evidenced by publication(s)**, he/she may submit a thesis on the research at any time without previous registration.

(d) In special circumstances, the Board on the recommendation of the Departmental and Faculty Boards concerned may accept as a part-time candidate a person who is not a member of the full-time staff of the University but is engaged in an occupation which, in its opinion, affords the candidate the opportunity to pursue his/her programme. In such a case the Board, on the recommendation of the Departmental and Faculty Boards, shall prescribe a minimum period for his/her programme, which in its opinion, having regard to the time he/she is able to devote to the programme

prescribed by the appropriate Department, is equivalent to two academic years of full-time study.

(e) A full-time candidate shall complete his/her programme not later than thirty-six months from the date of registration. A part-time candidate shall complete his/her programme not later than forty-eight months from the date of registration. These maximum times may be extended by the Board, on the recommendation of the Supervisor through the Departmental and Faculty Boards, by periods of not more than six months, to a maximum of forty-eight months for full-time students and sixty-months for part-time students.

(f) Under no circumstances should a full-time PhD programme extend beyond four years

(g) Under no circumstances should a part-time PhD programme extend beyond five years.

4.3.3 Course Work

(a) Course work may be required at the PhD level. A PhD student is required to make a minimum of 36 credits (30 credits for Thesis and six credits for two Seminars). Where a candidate is required to take courses, the credits earned shall be added. Research methods (credit 0) shall be compulsory for all students at the PhD level.

(b) All examination results for the course work shall be considered by the Departmental and Faculty Boards, which in turn, shall make their recommendations to the Board not later than three months after the examination.

(c) The Dean of Postgraduate Studies shall call a meeting of the Board, at least once a semester, for the exclusive purpose of approving examination results, subject to the approval of the Academic Board.

(d) Any postgraduate course recommended by the supervisor taken from either within or without the candidate's Department shall count and be included in his/her transcript.

4.3.4 Thesis

The thesis shall comply with the following conditions:

(a) The greater portion of the work submitted must have been done subsequent to the registration of the student as a candidate for the degree.

(b) The thesis shall be written in English.

(c) The thesis shall consist of the candidate's own account of his/her research, and be certified. It may describe work done in conjunction with the candidate's Supervisor, provided the

candidate states clearly his/her share in the investigation, and that the Supervisor certifies this statement. Under no circumstances shall a paper written or published in the joint names of two or more persons be accepted as a thesis. Work done conjointly with persons other than the candidate's Supervisor shall be accepted as a thesis in special cases only. In such cases the approval of the Departmental, Faculty and Postgraduate Boards shall be given.

(d) Where a thesis is submitted without previous registration by a full-time academic staff of the University, the Head of Department in consultation with the Deans of the Faculty and the School of Postgraduate Studies, shall appoint a three-member Committee to certify the thesis prior to oral examination.

(e) A candidate shall not be permitted to submit a thesis which has been submitted elsewhere. Nonetheless, a candidate shall not be precluded, at the discretion of his/her Supervisor, from incorporating work which he/she has already submitted for a degree in this University or elsewhere, provided that he/she indicates in his/her thesis any work which has been so incorporated.

(f) Not later than six months before the date when he/she proposes to enter for the examination a candidate shall submit the title of his/her thesis to the appropriate Departmental and Faculty Boards for approval and submission to the Board. After the final title of the thesis has been approved it may not be changed except with the express permission of the Board on the recommendation of the Departmental and Faculty Boards.

(g) The thesis shall be submitted, accompanied by the prescribed form (obtainable from the School of Postgraduate Studies), not later than thirty-six months after the beginning of the programme. In the case of part-time students, this period shall be forty-eight months.

(h) At least FIVE typed or printed comb-bound copies of the thesis shall be submitted to the Board through the Head of Department. The paper size shall be A4 except for drawings and maps, on which no restriction shall be placed. Only one side of the paper shall be used with a margin of 3.05 cm on the left-hand side of the page. Top/Bottom/Right margins shall be 2.54 cm. The thesis shall be typed in either one and half or double line spacing with a maximum of 200 pages excluding appendices.

After the thesis has been approved it must be bound in a standard form as follows:

art vellum or cloth; overcast; edges uncut; lettered boldly up spine in gold (0.625 cm - 1.255 cm) degree, date, name. Black cover.

(i) One copy each of the thesis that has been accepted for the award of a PhD degree shall be deposited at the University Library, the Department and the School of Postgraduate Studies.

4.3.5 Seminar

All PhD candidates are required to present at least two seminars having direct relationship to their thesis. The two seminars must be done before submission of the thesis. A candidate who fails to present a registered seminar on an agreed date without permission shall pay a penalty of 20% of the seminar module fee before he/she shall be allowed to present at the next scheduled date.

4.3.6 Publications

All PhD candidates are encouraged to publish at least a technical paper arising out of their work before graduation.

4.3.7 Progress Report

(a) Candidates' progress on thesis should be monitored through the use of progress report forms every year (see Appendix 1). The forms shall be completed by each student and Supervisor, and each Supervisor shall submit a copy to the Dean of Postgraduate Studies through the Head of Department and the Dean of his/her Faculty.

(b) A candidate who fails to make progress for one year will be put on probation.

(c) A candidate who fails to make progress on his/her programme for two academic years will be withdrawn from the programme.

(d) On the basis of work done in the course of the year, the Departmental and Faculty Boards may recommend for approval by the Board that a candidate continues or terminates his/her studies.

4.3.8 Supervision Committee

(a) For the supervision of a PhD thesis, a team of a minimum of two (2) and a maximum of three (3) Supervisors is recommended to serve as Supervision Committee. The principal Supervisor should be a Senior Lecturer (with a PhD) or above. A Lecturer with a PhD may serve on the committee. The Supervision Committee shall include the Internal Supervisor (s).

(b) Supervisors shall submit reports on the work of each student at the end of each year on

prescribed forms to the Deans of the Faculty and Postgraduate Studies through the Head of the Department.

4.3.9 Assessment

The examination for the award of a PhD degree shall comprise:

- Written examination (where appropriate) and Seminars.
- Assessment of thesis, and
- Oral examination.
- The Pass marks for coursework and thesis are as shown in Table 4.1.

Table 4.1: UMaT Grading Scale for PhD Programmes

Module	Raw Score (%)	Interpretation
Coursework	≥50	Pass
	< 50	Fail (F)
	I or I*	Incomplete
Thesis	≥55	Pass
	< 55	Fail (F)
	I or I*	Incomplete

(a) Two External Examiners and at least three Internal Examiners shall be appointed to examine the thesis. A panel of not less than five Examiners including the two External Examiners shall conduct the oral examination. Only Senior Lecturers (with PhD) and above may be appointed as Internal Examiners except where a Lecturer with PhD is a member of the Supervision Committee. The oral examination shall be public but only the Examiners shall examine the candidate.

(b) The panel for the oral examination shall be made up of the following:

Dean of Postgraduate Studies or a representative - Chairman

The Head of Department or a representative - Member

Two External Examiners and at least three Internal Examiners - Members

(c) In recommending the appointment of an External Examiner for the purpose stated above, the Head of Department, in consultation with the Dean of the Faculty, shall submit to the Board an outline curriculum vitae of the proposed examiner based on a format obtainable

from the School of Postgraduate Studies. The External Examiner should show significant contribution in the area concerned.

(d) (i) The Examiners may recommend to the School of Postgraduate Studies that the candidate whose thesis is not up to the required standard be permitted to re-submit his/her thesis in a revised form within a specified period up to a maximum of twelve (12) months for oral examination;

(ii) Subject to the provisions of Clause d (i), if a candidate's thesis is still not up to the required standard, the Examiners may advise that the candidate re-submits his/her thesis in a revised form within a specified period up to a maximum of 90 days for an oral examination towards the award of either a MPhil degree or Postgraduate Diploma if the candidate so wishes.

(iii) Where a candidate fails to pass the oral examination for the first time, the Examiners may advise that the candidate re-submits his/her thesis in a revised form within a specified period up to a maximum of 90 days for an oral examination towards the award of a PhD degree.

(iv) Where a candidate fails to pass the oral examination for the second time, the Examiners may advise that the candidate re-submits his/her thesis in a revised form within a specified period up to a maximum of 90 days for the award of either a MPhil degree or Postgraduate Diploma if the candidate so wishes.

(e) The panel shall submit its recommendations to the Dean of Postgraduate Studies in the form of a joint report signed by both Internal and External Examiners with respect to the oral examination, and separate reports with regard to the thesis on the basis of prescribed criteria. The appropriate copies of the approved thesis (with the necessary corrections) shall be submitted to the School of Postgraduate Studies through the Head of Department.

(f) A maximum period of 90 days shall be allowed for final corrections to the thesis.

(g) A full fee shall be paid for any oral examination.

4.3.10 Procedure for Award of a Degree

(a) After an oral examination, extracts from the Examiners' report shall be submitted to the Department concerned to enable the student make the necessary corrections in the thesis.

(b) The results of the course work and oral examinations shall be submitted to the Board

through the Departmental and Faculty Boards.

(c) The recommendations of the Board shall be submitted to the Academic Board for approval.

(d) Each successful candidate shall thereafter be awarded a certificate under the seal of the University at a congregation of the University for that purpose.

4.4 MASTER'S PROGRAMMES

There are two levels of Master's programmes in the University: MSc and MPhil.

4.4.1 Designation

(a) Master of Philosophy (MPhil) based on research with limited taught courses.

(b) Master of Science (MSc) based on a combination of taught courses and research.

4.4.2 Entry Requirements

(a) A candidate shall hold a First Class or Second Class (Upper Division) honours degree, or its equivalent, in an appropriate field of study, from a recognised University.

(b) A candidate who does not satisfy the requirement stated in (a) but is otherwise adjudged suitable by the Departmental Board, may, where practicable, be interviewed as determined by the Departmental Board concerned.

(c) A candidate who has satisfactorily completed a Postgraduate Diploma programme may be considered for admission on the recommendation of the Departmental Board concerned.

(d) All foreign applicants must have:

i. Proficiency in English language.

ii. BSc First Class or Second Class (Upper Division) in an appropriate field of study, from a recognised University.

iii. A candidate who satisfies the requirement in (i) and not (ii) but is otherwise adjudged suitable by the Departmental Board, may, where practicable, be interviewed as determined by the Departmental Board concerned.

iv. A candidate who has satisfactorily completed a Postgraduate Diploma course may be considered for admission on the recommendation of the Departmental Board

concerned.

v. Admission Letters issued to foreign applicants shall be valid for two years.

4.4.3 Duration of Programme

A full-time programme leading to a Master's degree shall be not less than one academic year except that:

(a) In special circumstances, the Department may recommend that a candidate be allowed to spend not more than six months of his programme in advanced study and research at another institution provided that his work can be supervised in a manner satisfactory to the Departmental, Faculty and Postgraduate Boards.

(b) In special circumstances, the Board, on the recommendation of the Departmental and Faculty Boards concerned, may accept as a part-time candidate for the degree, any person who is engaged in an occupation, which in their opinion, affords the candidate the opportunity to pursue his/her programme. In such a case the Board on the recommendation of the Departmental and Faculty Boards shall prescribe a minimum period for the duration of his/her programme which in their opinion, having regard to the proportion of his/her time which he/she is able to devote to the programme prescribed by the appropriate Department, is equivalent to twelve months full-time study.

(c) A full time candidate shall complete his/her programme not later than twenty-four months from the date of registration. A part-time candidate shall complete his/her programme not later than thirty-six months from the date of his/her registration.

(d) These maximum times may be extended by the Board, on recommendation of the Supervisor through the Departmental and Faculty Boards, by periods of not more than six months to a maximum of twelve months.

(e) Under no circumstances should a full-time MPhil/MSc programme extend beyond three years.

(f) Under no circumstances should a part-time MPhil/MSc programme extend beyond four years.

4.4.4 Course Work

(a) Course work is required of all Postgraduate programmes at the Master's level. A Master's student is required to make a minimum of 42 credits. Research Methods

(credit 0) shall be compulsory for all **registered** students at the Master's level.

(b) The minimum credits shall comprise: Thesis (15 credits), Seminar (3 credits), Field Trip and Report (3 credits) and minimum of four core courses (12 credits) and three optional courses (9 credits) for MSc students; and Thesis (24 credits), Seminar (3 credits), Field Trip and Report (3 credits) and minimum of four core courses (12 credits) for MPhil students.

(c) A candidate registered for the MPhil degree shall be required to pass all Faculty core courses and may be required to take appropriate courses on the recommendation of the Supervisor and the Departmental Board concerned.

(d) Each module shall run for a maximum of two weeks (10 working days) duration; examination in any module shall be taken immediately after the completion of the module but not later than a week from the completion of the module.

(e) There shall be a minimum of forty (40) contact hours in each module.

(f) A prospective applicant may participate in a module(s) within two (2) years prior to applying for a Postgraduate programme. The results of such a module(s) shall, upon request by the applicant, be credited to him/her upon admission.

(g) Any graduate course taken from either within or without the candidate's Department on the recommendation of the Supervisor shall count and be included in his/her transcript.

(h) All examination results for the coursework shall be considered by the Departmental and Faculty Boards, which in turn, shall make recommendations to the Board not later than three months after the examination.

(a) The Dean of Postgraduate Studies shall call a meeting of the Board, at least once a semester, for the exclusive purpose of approving examination results of coursework, subject to the approval of the Academic Board.

4.4.5 Thesis

The thesis shall comply with the following conditions:

(a) The thesis shall be written in English.

(b) The thesis shall consist of the candidate's own account of his/her research and be so certified. It may describe work done in conjunction with the candidate's Supervisor, provided the candidate states clearly his/her share in the investigation, and that his/her statement is certified by the Supervisor. Under no circumstances shall a paper written or published in the joint names of

two or more persons be accepted as a thesis. Work done conjointly with persons other than the candidate's Supervisor may be accepted as a thesis provided his/her contribution is at least 60%. In such cases the approval of the Departmental, Faculty and Postgraduate Boards shall be given.

(c) A candidate shall not be permitted to submit a thesis, which has been submitted elsewhere, but a candidate shall not be precluded, at the discretion of his Supervisor, from incorporating work, which he/she has already submitted for a degree in this university or elsewhere, provided that he/she indicates in his/her thesis any work which has been so incorporated.

(d) The candidate may submit subsidiary matter in support of his/her candidature any printed contributions to the advancement of his/her subject which he/she may have published independently or conjointly or any other supporting material. In the event of a candidate submitting subsidiary matter of a conjoint nature, he/she shall be required to state fully his/her share of such conjoint work.

(e) A provisional thesis topic shall be submitted through the Departmental and Faculty Boards within the first six months and the final topic before the last six months of the course. Within the last six months of the course any significant change in the thesis topic shall be submitted to the Board for approval.

(f) The thesis shall be submitted, accompanied by the prescribed form obtainable from the School of Postgraduate Studies, not later than the maximum duration for the programme.

(g) At least three typed or printed comb-bound copies of the thesis shall be submitted through the Head of Department to the Board. The paper size shall be A4 except for drawings and maps on which no restrictions are placed. Only one side of the paper shall be used with a margin of 3.05 cm on the left-hand side of the page. Top/Bottom and Right margins shall be 2.54 cm. The thesis shall be typed in either double or one and half line spacing and a maximum of 100 pages excluding appendices.

A thesis, which consists of a collection of excerpts or pamphlets, shall be bound in a similar cover. After the thesis has been approved, it must be bound in a standard form as follows:

- art vellum or cloth; overcast; edges uncut;
- lettered boldly up spine in gold (0.625 cm - 1.255 cm)
- degree, date, name. Dark blue cover.

(h) One copy each of the thesis that has been accepted for the award of a Master's degree shall be deposited at the University Library, the Department and the School of Postgraduate Studies.

4.4.6 Seminar

Every MSc/MPhil student is required to present at least one seminar having direct relationship to his/her thesis. This must be done before submission of the thesis. A candidate who fails to present a registered seminar on an agreed date without permission shall pay a penalty of 20% of the seminar module fee before he/she shall be allowed to present at the next scheduled date.

4.4.7 Publications

All MSc/MPhil students are encouraged to publish at least one paper having relationship to their theses.

4.4.8 Progress Report

(a) Students' progress on thesis should be monitored through the use of progress report forms every year (see Appendix 1). The forms shall be completed by each student and Supervisor, and each Supervisor shall submit a copy to the Dean of Postgraduate Studies through the Head of Department and the Dean of his/her Faculty.

(b) A MPhil/MSc student who fails to make progress in his/her thesis or fails to achieve a CWA of at least 55% after one year will be put on probation.

(c) A student who fails to make progress on his/her programme for two academic years will be withdrawn from the programme.

(d) On the basis of work done in the course of the year, the Departmental and Faculty Boards may recommend for approval by the Board that a candidate continues or terminates his/her studies.

4.4.9 Supervision

(a) A Senior Member of the rank of **Senior Lecturer and above** is eligible to supervise an MSc/MPhil candidate, though more than one person is preferred. A Lecturer may serve as a co-supervisor.

(b) Supervisors shall submit reports on the work of each student at the end of each year on prescribed forms to the Dean of Postgraduate Studies through the Head of the Department concerned.

4.4.10 Assessment

The examination for the award of MSc and MPhil shall include:

- Written examination (where appropriate)
- Assessment of thesis
- Oral examination
- The Pass marks for course work are as shown in Table 4.2.

Table 4.2: UMaT Grading Scale for Master's Programmes

Module	Raw Score (%)	Interpretation
MPhil/MSc Course Work and MScThesis	≥50	Pass
	< 50	Fail (F)
	I or I*	Incomplete
MPhil Thesis	≥55	Pass
	< 55	Fail (F)
	I or I*	Incomplete

(a) Not less than three Examiners, of whom at least, one shall be an External Examiner appointed by the Board, on the recommendation of the Departmental Board, shall examine the thesis. A panel of not less than three Examiners, including at least one External Examiner, shall conduct the oral examination.

(b) The panel for the oral examination shall be made up of the following:

- Dean of Postgraduate Studies or a representative - Chairman
- The Head of Department or a representative - Member
- One External Examiner and at least two Internal Examiners - Members

(c) When recommending the appointment of an External Examiner, the Departmental Board shall submit outline curriculum vitae of the proposed examiner based on a format obtainable from the Board.

(d) The panel shall submit its recommendations to the Departmental Board in the form of a joint report signed by both Internal and External Examiners with respect to the oral examination and separate reports with respect to the thesis, on the basis of prescribed criteria approved by the Board. These reports together with appropriate copies of approved thesis with the necessary corrections shall be submitted to the School of Postgraduate Studies through the Departmental Board.

(e) In the case of the MSc degree, the components of the examination shall be coursework, thesis and oral examination. Candidates shall be required to pass in each component and the candidate's performance shall determine his/her success or failure. Fifty percent shall be pass for all courses, with fifty-five percent being the CWA for success or failure. A candidate who does not satisfy the Examiners at the oral examination shall not be recommended for the award of a degree, the standard of the thesis notwithstanding.

(f) For both MPhil/MSc degrees a candidate who does not pass the oral examination shall not be recommended for the award of a degree irrespective of the standard of his/her thesis. In such a situation, the candidate will have only one opportunity to re-submit himself for oral examination within a period of six (6) months. The candidate shall pass the Departmental core courses.

(h) (i) The Examiners may recommend to the School of Postgraduate Studies that the candidate whose thesis is not up to the required standard be permitted to re-submit his/her thesis in a revised form within a specified period up to a maximum of six (6) months for oral examination;

(ii) Subject to the provisions of Clause h(i), if a candidate's thesis is still not up to the required standard, the Examiners may advise that the candidate re-submits his/her thesis in a revised form within a specified period up to a maximum of 90 days for the award of Postgraduate Diploma if the candidate so wishes.

iii) Where a candidate fails to pass the oral examination for the first time, the Examiners may advise that the candidate re-submits his/her thesis in a revised form within a specified period up to six (6) months for oral examination.

iv) Where a candidate fails to pass the oral examination for the second time, the Examiners may advise that the candidate re-submits his/her thesis in a revised form within a specified period up to a maximum of 90 days for the award of a Postgraduate Diploma if the candidate so wishes.

4.4.11 Procedure for the Award of a Degree

(a) After an oral examination, extracts from the Examiners' report shall be submitted to the Department concerned to enable the student make the necessary corrections in the thesis.

(b) The results of the course work and oral examinations shall be submitted to the Board through the Departmental and Faculty Boards.

(c) The recommendations of the Board shall be submitted to the Academic Board for approval.

(d) Each successful candidate shall thereafter be awarded a certificate under the seal of the University at a congregation of the University for that purpose.

4.5 POSTGRADUATE DIPLOMA PROGRAMMES

A Postgraduate Diploma is awarded on the basis of a programme of taught courses and a project work.

4.5.1 Entry Requirements

The entry requirement shall be a Bachelor's degree or its recognised equivalent. In addition, candidates must satisfy the appropriate Departmental requirements.

4.5.2 Duration of Programme

A programme leading to a Postgraduate Diploma shall be for a period of one academic year.

4.5.3 Examinations

There shall be written and oral examinations. Practical examinations may also be given where appropriate.

4.5.4 Registration

Candidates shall register in their Department and at the School of Postgraduate Studies at the beginning of each semester for courses in which they are to be examined.

4.5.5 Examiners

(a) A panel comprising not less than three examiners, of whom at least one shall be an External Examiner, shall be appointed by the Board of Postgraduate Studies on the recommendation of the Departmental Board to assess the project work. When recommending the appointment of an External Examiner, the Departmental Board shall submit outline curriculum vitae of the proposed examiner based on a format obtainable from the School of Postgraduate Studies.

(b) A panel comprising not less than three members of whom at least one shall be an External

Examiner shall be appointed by the Board on the recommendation of the Departmental Board to conduct the oral examination.

4.5.6 Assessment

Candidates shall be assessed in accordance with current university regulations. Results of the examinations shall be submitted by the Departmental Board to the School of Postgraduate Studies through the Faculty Board for approval, in the first instance, before being forwarded to the Academic Board for final approval.

4.5.7 Procedure for the Award of a Postgraduate Diploma

Each successful candidate shall be awarded the appropriate Postgraduate Diploma of the University, at a congregation of the University assembled for that purpose.

5 GENERAL INFORMATION

5.1 SOCIAL AND SPORTING FACILITIES

The following facilities exist for the convenience of students:

- Community Service (Halls of Residence)
- Sports and Recreation
- Chaplaincy
- Health and Counseling Services
- Students' Union

5.2 THE ASSOCIATION OF GRADUATE STUDENTS (GRASAG)

(a) The Association, which embraces all Postgraduate students of the University, provides both social and academic facilities for its members. Membership is open to Postgraduate students pursuing approved courses of study and registered with the School of Postgraduate Studies.

(b) Further enquiries should be addressed to:

The President, GRASAG,
c/o School of Postgraduate Studies,
University of Mines and Technology (UMaT),

Tarkwa, Ghana.

5.3 COST/FEES

(a) Academic Facility User Fee as determined by Government.

(b) Module Fees shall be determined from time to time.

(c) Internet Connectivity Fee shall be charged per student per year. This fee is subject to change without notice.

(d) The examination fees shall be as determined from time to time by the University. Fees shall not be refunded, but in the case of justifiable unforeseen circumstances acceptable to the Board, fees may be transferred from one examination to the next.

(e) All fees must be paid into any of the following Account:

i) Account Name – Ecobank UMaT, SPS E-Collect Account

Account Number – 0193 0244 0251 0005

Bank - Ecobank

Branch – Tarkwa

ii) Account Name - University of Mines and Technology Foreign Account

Account Number – 0192 0844 0251 0004

Bank - Ecobank Ghana Limited

Swift Code - ECOCGHAC

Payment of fees by cash is not acceptable by the University.

All information pertaining to fees and other expenses may be obtained from:

The SPS Officer

University of Mines and Technology

P. O. Box 237

Tarkwa, Ghana

Further information on all the above must be addressed to the Registrar.

DEPARTMENT OF GEOMATIC ENGINEERING

6 MASTER'S (MODULAR) PROGRAMME IN GEOMATIC ENGINEERING

6.1 TITLE OF PROGRAMME

The title of the programme is MSc/MPhil Programme (Modular) in Geomatic Engineering.

6.2 PROGRAMME OBJECTIVES

The main objectives of the programme are:

- To provide an avenue for practising Surveyors/Geomatic Engineers in the mining and other establishments to continue their education.
- To turn out competent postgraduates to meet the current demands of the Surveying/Geomatics industry.
- To produce competent postgraduates capable of pursuing careers in the minerals and allied industries, universities and research institutions.

6.3 ENTRY REQUIREMENTS

(a) The entry requirements for the Master's degree in Geomatic Engineering are:

i. Applicants must have BSc First Class or Second Class (Upper Division) in Geomatic or Geodetic Engineering or its equivalent in Earth Sciences and related Engineering programmes from a recognised university.

ii. Holders of UMaT Diploma in the Earth Sciences who hold senior positions in a relevant industry and have at least 5 years professional experience and proven ability in his/her discipline are eligible for admission.

iii. Foreign applicants with proficiency in English language who satisfy the requirements of (i) or (ii) above are eligible for admission after careful consideration of relevant documents.

iv. Applicants who have satisfactorily completed a Postgraduate Diploma programme may be considered for admission on the recommendation of the Departmental Board concerned.

6.4 PROGRAMME REQUIREMENTS

The Department offers two Master's Degree Programmes. These are:

i. MSc Geomatic Engineering Degree Programme

ii. MPhil Geomatic Engineering Degree Programme

a) Graduation Requirements

i. MSc Geomatic Engineering Degree

- A minimum of 48 credit hours is required for the award of MSc degree. This is made up of a minimum of nine (9) modules (at least 27 credit hours). A Graduate Seminar (3 credit hours) and Field trip & Report (3 credit hours) and a Thesis (15 credit hours)

ii. MPhil Geomatic Engineering Degree

- A student is required to do six (6) core modules outlined in Section 6.5a. In addition, he/she may audit modules recommended by the Supervisor to facilitate the student's research work. The candidate is also required to present at least one seminar.
- The successful defense of a thesis is required for the award of the award of the MPhil Degree in Geomatic Engineering. The thesis should be an embodiment of independent research conducted by a student under the guidance of a Supervisor on a significant problem in a chosen area of Geomatic Engineering.

b) Programme Duration

- Full Time: A maximum of 4 semesters for course work and Thesis work.
- Part Time: A maximum of 6 semesters.

6.5 PROGRAMME STRUCTURE

a) Core and Compulsory Modules

The MSc coursework comprises 6 core modules namely:

i. Geodesy (GM 504)

ii. Remote Sensing (GM 511)

iii. Digital Photogrammetry (GM 502)

iv. Geographic Information Systems (GM 507)

v. Global Navigation Satellite Systems (GM 510)

vi. Statistical Models (GM 509)

Research Methods (GM 521) is compulsory but does not earn any credit.

- In addition, a minimum of three (3) other modules must be selected by the candidate in consultation with his/her Supervisor. Introduction to Computer Applications is compulsory but a candidate may apply for exemption.
- Applicants without adequate Geomatics background will be required to register for the module in "Introduction to Geomatic Engineering". Field trips will be organised and all students will be required to participate in at least one of them. An essential requirement of the modules is that students devote the afternoons to tutorials, practicals or field trips.

b) Content of Modules

The module to be run, credit hours and module numbers are as follows:

Module No.	Course Number	Name of Course	Credit Hours
-	GM 261	Introduction to Geomatic Engineering**	0
-	GM 521	Research Methods*	0
-	GM 351	Introduction to Computer Applications*	0
1	GM 500	Thesis	15
2	GM 501	Shoreline Modelling and Prediction	3
3	GM 502	Digital Photogrammetry	3
4	GM 503	Operations Research	3
5	GM 504	Geodesy	3
6	GM 505	Spatial Data Modelling for 3D GIS	3
7	GM 506	Mine Economic and Financial Evaluation	3
8	GM 507	Geographic Information System (GIS)	3
9	GM 508	Principles of Mine Planning and Design	3
10	GM 509	Statistical Models	3
11	GM 510	Global Navigation Satellite Systems	3
12	GM 511	Remote Sensing	3
13	GM 512	Geographic Information Management	3
14	GM 513	Environmental Management	3
15	GM 514	Cartography	3

16	GM 515	Postgraduate Seminar	3
17	GM 516	Engineering Surveying	3
18	GM 517	Geographic Data for Resource Management	3
19	GM 518	Field Trip & Report	3
20	GM 519	Land Administration and Information Systems	3
21	GM 520	Mine and Sub-Surface Surveying	3
22	GM 522	Application of GIS & Remote Sensing	3
23	GM 523	Fleet Management	3
24	GM 524	Environmental and Spatial Statistics	3
25	GM 525	Geo-information for Disaster Risk Management	3
26	GM 526	Sustainability and Corporate Social Responsibility	3

*Preparatory Module **Pre-requisite Module for non-Geomatic Engineers

GM 261 Introduction to Geomatic Engineering

Credits: 0

Digital levels. Digital theodolite. Modern surveying techniques: Classical positioning systems, Triangulation, and Trilateration. Engineering surveying. Modern positioning system: GPS, IPS and DPS.

GM 521 Research Methods

Credits: 0

Definition of research. Objectives of research. Motivation in research. Characteristics of research. Types of research. Problems in starting research. Definition of ethics and professionalism. How ethics and values intersect with professionalism. Ethical theory and applications: Branches of ethics, Classification of ethical theories, Standards of ethical conduct in science, Common ethical principles in science, Code of ethics for engineers. Fraud in Science. Choosing a research topic. Identification and sources of problem. Formulating hypothesis. Functions of literature review. References and Bibliography. Research designs and approaches. Principles of experimental designs. Sampling basics. Characteristics of a good sample design. Methods of data collection. Validity and Reliability of Data. Processing, anaysis and interpretation of data. Report writing: Significance of report writing. Papers and reports: Management reports, Proposals, Journal papers, Conference papers, Thesis. Format for

presentation of thesis at UMaT: Structure and form of a thesis, Headings and numbering, Style and punctuation, Extra-linguistic material, Production of the thesis, Editing and revising, Assessment (Seminars, Thesis)

GM 351 Introduction to Computer Applications

Credits: 0

Introduction to PC. Basic hardware components of the PC. Operating systems software DOS. Operating systems hardware (Dosshell, Windows, File Managers and Utilities). Word processing. Data processing. Database. Graphics. Software installation and interfacing. Summary.

GM 500 Thesis

Credits: 15/24

An independent research work under the guidance of Supervisor(s) on a topic in the student's area of specialisation. A thesis embodying the results of the research will be presented to the Department after an oral defense. A panel will assess thesis.

GM 501 Shoreline Modelling and Prediction

Credits: 3

The coastal environment. Oceanographic and geomorphologic factors influencing the coast: currents, waves, tides, sea-level rise due to climate change and anthropogenic intervention in coastal processes. Shoreline modelling techniques: the Erosion based approach and the recession based methods, Erosion based volumetric methods, application and limitation, Recession based methods (Bruun's rule; modified Bruun's rule; Beach slope, sea-level rise rate shoreline excursion method). The SCAPE model for shoreline modelling and prediction, (merits and limitations). Modelling shoreline and prediction using Multi variates regression analysis (Specification of variables; generation of the regression model, beta values determination and testing of model).

GM 502 Digital Photogrammetry

Credits: 3

Fundamentals of digital image acquisition: sampling, quantization, resampling and error sources.

Charge-Coupled Device (CCD) architecture, operation and error sources. Automated interior, relative and absolute orientation. Image matching techniques: signal-based, feature-based and relational, with emphasis on cross-correlation and least squares matching. Use of epipolar constraints in image matching. Multi-resolution analysis and image pyramids. Digital image rectification. Feature extraction.

GM 503 Operations Research

Credits: 3

Nature of Operations research in mining, Linear, the simplex algorithm for integer & Goal programming, transportation and assignment problems, decision analyses, markov analysis, simulation, queuing models, inventory control models, production scheduling methods-CPM, dynamic programming.

GM 504 Geodesy

Credits: 3

Physical geodesy: potential theory, earth, reference and anomalous gravity field, measurement of gravity. Figure of the earth. boundary value problems. Geometrical and gravimetric geoid determination. Dynamic satellite geodesy. Satellite alimetry. Fundamentals of coordinates reference systems. Quality measures and integrity. Satellite Based Augmentation Systems (SBAS) and Ground Based Augmentation Systems (GBAS). Reference frames and coordinate transformations. Height systems. Earth rotation. Solid earth tides. Geodynamics: geodetic and geophysical setting, terrestrial reference frames.

GM 505 Spatial Data Modelling for 3D GIS

Credits: 3

An overview of 3D GIS development. 2D and 3D spatial data representations. The fundamentals of geo-spatial modelling. The conceptual design. The logical design. Object-orientation of tins spatial data. The supporting algorithms. Applications of the model. The web and 3D GIS.

GM 506 Mine Economic and Financial Evaluation

Credits: 3

Nature of and requirements for mining projects, course objectives and expected outcomes. Time

value of money and economic equivalence, estimation of revenue and coststt. Investment allowance, Mine Taxation and royalties. Financial alternatives. Cash flow models and analysis, investment decision methods and criteria, sensitivity and risk analysis, mine feasibility study. Case studies.

GM 507 Geographic Information Systems (GIS)

Credits: 3

Introduction to GIS: Purpose of GIS, Representation of real world. Geographic information and spatial data types. Data processing systems. Determining and mapping position: Data quality, Spatial referencing, Measures of location, Error on maps, Satellite based position. Data entry and preparation. Spatial data analysis. Data visualisation: GIS and maps, The visualisation process, The cartographic toolbox, Map cosmetics and dissemination.

GM 508 Principles of Mine Planning and Design

Credits: 3

General mine planning and design principles. Surface mine planning and design. Underground mine planning and design. Siting of facilities. Risk analysis in Mine planning. Environmental control measure in mine planning. Sustainable use of mined land and closure planning.

GM 509 Statistical Models

Credits: 3

Basic Statistical Procedures, Regression and Linear Models, Application of Multiple Regression, Statistical Inference and Modeling, Use of Transformation, Correlation and its Relationship with Regression

GM 510 Global Navigation Satellite Systems

Credits: 3

Principles and theory of satellite positioning. Space-base positioning systems (such as GPS and GLONASS). An overview of the theory and applications of satellite surveying: Artificial satellites, Satellite orbital motion, Kepler element. GNSS concepts and characteristics. GNSS measurement: Pseudoranging, Carrier phase measurement, GNSS time, Error sources and measurement accuracy, Mission planning. Position determination techniques: Single point and

differential positioning, Static and kinematic, Post mission and real time processing. DGPS concepts. Using GPS for height determination. Reference datum and datum transformation. Integrating satellite data into local co-ordinate systems. Satellite orbits and GPS observables, Physical influence of GPS Survey, Ambiguity Resolution Techniques, GPS Positionng modes, GPS observation equations and Equivalence Properties, GPS application.

GM 511 Remote Sensing

Credits: 3

Concepts of digital remote sensing and energy interaction. Remote Sensing Platforms. Image statistics, display, preprocessing. Rectification of digital imagery. Digital image processing: Image processing, Image enhancement, and classification. Spectral and Spatial filtering. Thematic information extraction, change detection and accuracy assessment. Special sensors: Thermal, Hyperspectral and Microwave.

GM 512 Geographic Information Management

Credits: 3

Concept of geo-information technology and management. Motivation for acquiring basic knowledge in technology. Presentation of basic terminology in management. Discussion of the challenges for land administration and national surveys in a changing technological and institutional environment. Presentation of examples of innovative approaches to Geospatial data infrastructures. Emerging concepts in linking objectives of Geo-spatial data policy, land policy and policy instruments (World Bank, UN and FAO policies). Data sources, acquisition, conversion and processing. Data models, process models and databases (central/local). Electronic exchange and distribution of geo-information. Quality parameters and review procedures.

GM 513 Environmental Management

Credits: 3

Environmental impacts of mining. Air quality/pollution. Air quality modeling: Water quality/ pollution, water quality modeling. Noise. Environmental aspects of ground vibrations and air blasts. Environmental impact assessment methodologies and practices. Ghana's Environmental

Policy.

GM 514 Cartography

Credits: 3

GIS and cartographic visualisation. Data sources. Development and management of a cartographic database. Cartographic modeling and data analysis: Spatial, Temporal and Thematic comparisons. Terrain visualisation. Scientific Visualisation. The use of colour in non-temporal animations. Dynamic variables. Visualisation in GIS. Hypermaps. Rendering systems for interactive scientific visualisation. Definitions of terrestrial coordinate systems and reference frames. Coordinate transformations between geodetic datum: Molodensky, Bursa-Wolf. Map projection theory-conformity, differential geometry. Map projection types: Conical, Cylindrical, Azimuthal. Choosing optimal projections. Case studies of projections used in Ghana and overseas.

GM 515 Postgraduate Seminar

Credits: 3

Students will be required to make a minimum of one presentation on the progress and research underway in their areas of specialisation. The seminar will be assessed by a Departmental Panel. Postgraduate students are required to attend.

GM 516 Engineering Surveying

Credits: 3

Control networks for engineering projects: Methods used in determining horizontal control, Traversing, Triangulation, Trilateration, Intersection, Intersection, Resection and Satellite Position Fixing. Vertical controls-levelling Datum and principle of levelling. Inverted staffs. Trigonometric levelling methods. Deformation monitoring: Causes, Types and Importance and Analysis of deformation measurements. Underground surveys. Transfer of controls underground: Weisbach triangle method, Weiss quadrilateral method, gyro-theodolite method. Transfer of height underground: Digital Terrain Modelling- DTM generation, DTM representation as grid or TIN visualisation. Highway functional classification; Highway location survey. Geomatic design of highways: Cross-sectional elements, Factors affecting design, Horizontal alignment design

and Vertical alignment design. Computer application in geometric design. Intersection design and control: Basic principles of grade-separated intersections. Pavement design: Pavement types and structure. Stresses and strain in pavement maintenance and management: Problem of highway maintenance, Defects in pavements and their causes, Road maintenance activities, Methods for measuring road condition and Pavement management systems.

GM 517 Geographic Data for Resource Management

Credits: 3

Geographic data to information for resource management (extract and integrate spatial and non-spatial data from various sources and formats). Explore, analyze and interpret information contained in geographical data. Data obtained through sampling, statistic and cartographic visualization, descriptive and inferential statistics. Multi-Criteria Decision Analysis. Validity and reliability of results.

GM 518 Field Trip & Report

Credits: 3

Field trip will be organized and students are required to participate in, at least, one of them. They are required to submit a written report and make oral presentation on it/them.

GM 519 Land Administration and Information Systems

Credits: 3

Concepts of land policy and land management and administration, process design. Simulation and management of workflows. Land dispute and adjudication. Cadastral and social tenure mapping. Value assessment and land use classification. Business administration. Planning and control. Financial management. Modelling of data, processes, stakeholder analysis, community participation, information system design, development, (re-)engineering, information management (legal aspects, authentication, pricing, costing), SDI concept and application (authentic registers).

GM 520 Mine and Sub-Surface Surveying

Credits: 3

Mine surveying (Surface and Underground). Correlation of surface and underground surveys.

Underground surveying methods. Underground traversing. Stope surveying (Cavity monitoring systems). Directional control for drives, raises and inclines. Survey of diamond drill bore holes.

GM 522 Application of Geographic Information System (GIS) and Remote Sensing (RS)

Credits: 3

Image enhancement and visualization. Image classification and Interpretation. Spatial data visualization. RS data interpretation for land resource inventory. RS and GIS for land resource change analysis. GIS tools for landscape analysis, GIS and RS for E.I.A.

GM 523 Fleet Management

Credits: 3

General management principles and skills. Fleet and transport management. Definitions of fleet management. Objectives and costs of fleet management. Definition of customer service in a fleet environment. Vehicle management. Vehicle selection criteria. Own or contract analysis. Optimizing costs. Managing vehicle replacement. Vehicle specifications and inventory system. Preventive and corrective Maintenance. Workshop management. Manpower efficiency. Loss control/safety Management. Safety hazards in fleet and workshop Operations. Planning for and controlling safety. Transportation and distribution management. Tracking and monitoring vehicles. Selection of the best mode of transport. Structuring distribution routes. Managing the fleet organization. leading. Training and motivating the team. Budgeting and cost control. Key performance indicators. The balanced scorecard of fleet and transport. Performance evaluation and improvement. Action planning.

GM 524 Environmental and Spatial Statistics

Credits: 3

Geostatistical interpolation methods: Semi variogram, Kriging (spatial prediction), Estimation problems. Spatial point processes: Simulation, Spatial sampling strategies. Processes in space and time. Statistical models and methods for spatially varying phenomena. Homogeneous/non homogeneous processes. Applications to ozone, climate data etc. Spatial models for grid data and inference. Extreme value methods: Crossing limits for air pollution, Changes in climate extremes, Time series with long range dependency.

GM 525 Geo-information for Disaster Risk Management

Introduction to Disaster Risk Management, Spatial Data for Risk Management, Spatial Multi-Criteria Evaluation, Risk Assessment, Hazard Assessment, Elements at Risk, Vulnerability Analysis, Risk Analysis, Risk Management.

GM 526 Sustainability and Corporate Social Responsibility

i) The concept of sustainable development

The Brundtland report, three pillars of sustainable development, Resource curse,

ii) Corporate Social Responsibility (CSR)

Theories of CSR behaviour and disclosure, fairness, equality and corporate social responsibility, the Equator Principle, the business and environmental case for CSR

iii) Developing a corporation's place in the community

The socio-economic context and roles of corporations, companies and host communities, negotiation, communities and sustainable development, relocation, compensation, alternative livelihood issues

iv) Case studies from mining communities

Three (3) case studies on host community-company agitations/success stories and the learning points (The lecturer may invite people from the community relations outfit of nearby mines to share experiences).

7 DOCTOR OF PHILOSOPHY PROGRAMME IN GEOMATIC ENGINEERING

7.1 ENTRY REQUIREMENTS

- A candidate shall hold a Master's degree or its equivalent in earth science and related disciplines from a recognised institution and shall submit evidence of adequate training

and ability to undertake the proposed programme.

- A candidate who does not hold a Master's degree shall first register for MPhil degree. If he proves himself/herself to be academically capable by the end of the first year of the programme, he/she may be permitted by the Board of Postgraduate Studies on the recommendation of the Department to register for the PhD degree. This registration shall be deemed retrospective from the date of the original registration of the Master's degree.
- A candidate who does not satisfy the requirements stated above but is otherwise adjudged suitable may be admitted. For the purpose of assessing his suitability, such a candidate may be interviewed on the recommendation of the Department concerned.

7.2 PROGRAMME DURATION

A candidate shall pursue full-time programme of study and research for at least two years, except that:

- A candidate fully engaged in advance study and research for his/her degree, who, before registration, was engaged in research to the satisfaction of the Department concerned, may be exempted for not more than one academic year.
- In special circumstances, the Department may recommend that a candidate be allowed to spend not more than one academic year of his/her programme in advanced study research at another institution, provided that his/her work can be supervised in a manner satisfactory to the Department and the School of Postgraduate Studies.
- A full-time candidate who is engaged in research for the degree shall present himself/herself for examination not later than three years from the date of his/her registration.
- A part-time candidate shall present himself/herself for examination not later than four years from the date of registration.
- In special cases, an extension of these time limits may be granted on the recommendation of the Department.

7.3 AREAS OF RESEARCH

A candidate may be required to audit appropriate courses/modules and also submit a thesis under the supervision of an academic staff in any of the following areas of research:

a. GIS and Remote Sensing Applications

b. Fleet Management
c. Mine Planning and Design
d. Mine and Sub-Surface Surveying
e. Global Navigation Satellite System
f. Digital Photogrammetry
g. Engineering Surveys
h. Digital Image Processing

7.4 EMPLOYMENT OPPORTUNITIES

Students may make a career in the following Institutions:

a. Survey and Mapping Division
b. Ghana Highway Authority
c. Large and Small Scale Mining & Allied Companies
d. Construction and Irrigation Companies
e. Environmental Protection Agency
f. Cocoa Research Institute
g. The Navy
h. Forestry Commission
i. The University and other Tertiary And Research Institutions
j. Other Governmental and Non-Governmental Agencies
k. Water Resources Institutes

Table 7.1 List of Academic Staff and Areas of Specialisation

NAME	Academic/Professional Qualification	Designation	Areas of Specialisation
Prof D. Mireku-Gyimah	DSc (KNUST), PhD, DIC (London), MSc (Mos Min Inst), CEng, MIMM, MSME, MNYAS, FGIG, FGA	Professor	Mine Design and Planning, Operation Research, Mine Economic and Financial Evaluation, Mineral Resource Estimation, Mine Feasibility Study and Environmental Impact Assessment, Social Corporate Responsibility.
Prof N. A. Amegbey	Dr Ing (TUBerlin),	Professor	Environmental and Safety

	MSc (Pet Min Inst), FMVS, MGDMB, MSME		Engineering/Human Factor, Mining Regulations, Mine Environment, , Mine Ventilation Environmental Impact Assessment, Safety in Mines, Mining Regulations, Mine machinery.
Assoc Prof S. Al-Hassan	PhD (Wales), BSc,PgD (KNUST), MIMM	Assoc Professor	Mine Planning & Design, Surface & Underground mining Technology, Geostatistics, and Mineral Economics. Small Scale Mining.
Assoc Prof V. A. Temeng	PhD (Michigan), MSc (Zambia), BSc, PgD (KNUST),MGhIE	Assoc Professor	Materials Handling, Operation Research, Modelling and Simulation of Mine Production and Equipment Systems
Dr B. Kumi-Boateng	PhD (UMaT), MSc (KNUST), MSc (ITC); BSc (KNUST), Cert in Remote Sensing (UT), MASPRS	Senior Lecturer	Land and Compensation Surveys; Geo-information Science for Environmental Systems Analysis & Management; Spatial Statistics; Carbon Mapping
Mr P. E. Baffoe	MSc (Moscow) AGIS, MFIG	Senior Lecturer	Digital Photogrammetry: Mine Surveys: Monitoring and Modeling of Noise Levels
Mrs Cynthia Boye	PM (Netherlands), BSc (KNUST), MGhIS, MGhIE	Senior Lecturer	GIS and Applications; Shoreline Change Detection, Monitoring and Predictions; Feature Change Analysis; Cadastral and Engineering Surveys
Dr E. E. Duncan	PhD(Malaysia), MSc (Glasgow), BSc (KNUST), GhIS, MFIG	Senior Lecturer	GIS (2D & 3D), GPS, Remote Sensing and Geodesy
Mr E. A. A. Kwesi	MPhil (KNUST), BSc, (KNUST)	Lecturer	GIS and Digital Cartography
Mr S. Mantey	MPhil (Cambridge), BSc, (KNUST), Member, IEEE GRSS; Member, AARSE	Lecturer	Remote Sensing and GIS in Environmental Systems Analysis, GPS Surveys
Mr M. S. Aduah*	MSc (Enschede), MSc	Lecturer	Geo-information Science for

	(Lund), BSc (KNUST), Cert (Enschede)		Environmental modeling & Management
Dr Issaka Yakubu	PhD (UMaT), MPhil (UMaT), BSc (KNUST), Certificate (UT)	Lecturer	GIS and Applications, Global Navigation Satellite Systems (GPS, GLONASS) and Applications, Engineering and Cadastral Surveying; Multi-Criteria Spatial Analysis; Disaster Risk Management and Environmental Assessment for Spatial Planning.
Ms N. D.Tagoe	MSc (Germany), BSc (KNUST)	Lecturer	Digital Photogrammetry, Desktop and Web GIS, Remote Sensing
Mr Y. Y. Ziggah	MEng(China), BSc (KNUST)	Assistant Lecturer	Physical Geodesy, Satellite Geodesy

**On study leave*

DEPARTMENT OF GEOLOGICAL ENGINEERING

8 MASTER'S (MODULAR) PROGRAMME IN GEOLOGICAL ENGINEERING

8.1 TITLE OF PROGRAMME

The title of the programme is MSc/MPhil Programme (Modular) in Geological Engineering.

8.2 PROGRAMME OBJECTIVES

Geologists today are looking for new and innovative ways of finding new ore deposits to meet the growing demands of society. Mineral exploitation is associated with environmental problems, and this poses a great challenge to the geologist who must find remedies to avoid ecological disaster as the industry expands.

The Geological Engineering programme recognises these facts and strives to develop new approaches within the framework of a sound quality education.

The Modular Master's Programme aims at producing motivated and highly qualified geologists/geological engineers who can be relied upon to identify and solve the numerous problems confronting the mineral and construction industries in Ghana and the West African sub-region. The programme also aims at providing a firm grounding in basic and advanced concepts and modern methods of mineral exploration, geotechnical engineering and hydrogeology.

It is structured to offer the possibility of continuing education thereby making it possible for practicing earth scientists and/or engineers in the industry to update and upgrade their knowledge and skills in the various areas of specialisation while still on the job.

The main objectives of the programme are:

- To provide an avenue for practicing earth scientists in the mining and related industries to develop and update their knowledge and skills in mineral exploitation, geological engineering and hydrogeology.

- To turn out competent postgraduates with creative thinking and innovation by challenging them to identify and solve problems independently and/or collectively through research.
- To produce competent postgraduate students capable of advanced careers in the minerals and allied industries, universities and research institutions.

8.3 ENTRY REQUIREMENTS

a) The entry requirements for the Master's Degree in Geological Engineering are:

(i) Applicants must have BSc First Class or Second Class (Upper Division) or its equivalent in Earth Sciences and related Engineering programmes from a recognised university.

(ii) All other applicants who do not satisfy (i) above but have degrees in Engineering & Science may be eligible only after passing an interview.

(iii) Holders of the UMaT Diploma in the Earth Sciences who hold senior positions in a relevant industry and have at least 5 years professional experience with proven ability in their discipline are eligible for admission.

(iv) Foreign applicants with proficiency in English language who satisfy the requirements of (i) or (ii) above are eligible for admission after careful consideration of their relevant documents.

(v) Applicants who have satisfactorily completed a Postgraduate Diploma programme may be considered for admission on the recommendation of the Departmental Board concerned.

8.4 PROGRAMME REQUIREMENTS

The Department offers two Master's Degree Programmes. These are:

(i) MSc Geological Engineering Degree Programme

(ii) MPhil Geological Engineering Degree Programme

a) Graduation Requirements

i. MSc Geological Engineering Degree

- A minimum of 48 credit hours is required for the award of MSc Degree. This is made up of a minimum of nine (9) modules (at least 27 credit hours), Graduate Seminar (3 credit

hours), Field trip and Report (3 credit hours) and Thesis (15 credit hours).

ii. MPhil Geological Engineering Degree

- A student is required to do six (6) core modules outlined in Section 8.5a. In addition, he/she may audit modules recommended by the Supervisor to facilitate the student's research work. The candidate is also required to present at least one seminar.
- The successful defence of a thesis is required for the award of the MPhil Degree in Geological Engineering. The thesis should be an embodiment of independent research conducted by a student under the guidance of a Supervisor on a significant problem in a chosen area of Geological Engineering.

b) Programme Duration

- Full-time: A maximum of four (4) semesters for coursework and thesis
- Part-time: A maximum of six (6) semesters.

8.5 PROGRAMME STRUCTURE

a) Core and Compulsory Modules

The MSc course work comprises 5 core modules namely:

- Operations Research (GL 503)
- Statistical Models (GL 509)
- Financial & Economic Evaluation (GL 506)
- Environmental Management (GL 513)
- GIS & Remote Sensing (GL 552)

In addition, a minimum of 4 other modules must be selected by the candidate in consultation with his/her Supervisor(s). Research Methods (GL 521) is compulsory but does not earn credit.

- Computer Applications is compulsory but a candidate may apply for exemption. Applicants without adequate background in geology will be required to register for the module in "Introductory Geology".
- Field trips will be organised and all students will be required to participate in at least one of them. An essential requirement of the modules is that students devote the afternoons to tutorials, practicals or field trips.

b) Content of Modules

The modules to be run, credit hours and module numbers are as follows:

Module No.	Course No.	Name of Course	Credit Hour
-	**GL** 261	Introductory Geology**	0
-	**GL** 351	Introduction to Computer Applications*	0
-	**GL** 521	Research Methods*	0
-	**GL** 503	Operations Research	0
1	**GL** 500	Thesis	15
2	**GL** 502	Mineral Resource Evaluation	3
3	**GL** 505	Applied Rock Mechanics	3
4	**GL** 506	Economic & Financial Evaluation	3
5	**GL** 509	Statistical Models	3
6	**GL** 513	Environmental Management	3
7	**GL** 515	Postgraduate Seminar	3
8	**GL** 518	Field Trip & Report	3
9	**GL** 551	Ore Deposit Geology	3
10	**GL** 552	GIS and Remote Sensing	3
11	**GL** 553	Mineral Exploration Geochemistry	3
12	**GL** 554	Industrial Minerals	3
13	**GL** 556	Advanced Ore Microscopy	3
14	**GL** 557	Applied Hydrogeology	3
15	**GL** 558	Exploration Drilling and Sampling	3
16	**GL** 559	Water Resources Management	3
17	**GL** 560	Advanced Ore Microscopy	3
18	**GL** 562	**GL 562** Mine Water Hydrology	3
19	**GL** 572	Groundwater Engineering	3

* Preparatory Module, ** Pre-requisite Module for non-Geological Engineers

GL 261 Introductory Geology

Credits: 0

Basic Geological Concepts, Principles & Theories, Origin and Composition of the Earth, Geologic Time Scale, Formation & Properties of the various Rock Types I,Formation & Properties of the various Rock Types II, Plate Tectonics and Associated Features, Surficial Processes (Elements of Weathering, Geomorphology, etc.),Study of Geological Structures, Geologic Structures & their Effect on Rock/Soil Strength Parameters, Basic Concepts in Economic Geology & Mineral Exploration, Geologic Hazards and the Environment.

GL 351 Introduction to Computer Applications

Credits: 0

Introduction to PC, Basic Hardware Components of the PC, Operating Systems Software DOS, Operating Systems Hardware (DOSshell, Windows, File Managers and Utilities), Word Processing, Data Processing, Database, Graphics. Software Installation and Interfacing, Summary.

GL 551 Ore Deposit Geology

Credits: 3

Orthomagmatic Deposits, Disseminated & Stockwork Cu, Mo, W, & Sn Deposits, Stratified and Stratabound Deposits, Hydrothermal and Vein Deposits (Felsic Associates), Sedimentary Ore Deposits (Fe & Mn), Mineralisation in Space & Time, Tectonic Settings as Controls of Mineralisation, Geochemistry in Mineral Exploration, Isotopic Geology, Fluid Inclusion Studies.

GL 553 Mineral Exploration Geochemistry

Credits: 3

An overview of Geochemical Methods in Mineral Exploration, Sample Preparation & Geochemical Analysis, Drainage Sediment Geochemistry, Heavy Minerals in Exploration, Soil Geochemistry, Rock Geochemical Surveys, Biogeochemistry, Hydro- & Gas-Geochemistry, Analytical Chemistry, Geochemistry of Gold & Data Interpretation I & II.

GL 557 Applied Hydrogeology

Credits: 3

Evaporation, Precipitation, Runoff & Stream flow, Properties of Aquifers, Theory of Groundwater Flow, Applications of Groundwater Flow, Regional Groundwater Flow, Groundwater Geology, Water Chemistry, Exploration for Groundwater, Groundwater Modelling. Case Studies.

GL 513 Environmental Management

Credit.: 3

Environmental Impact of Mining (an Overview), Air Quality/Pollution, Air Quality Modeling, Water Quality/ Pollution, Water Quality Modeling, Noise, Environmental Aspects of Ground Vibrations and Air Blasts, Environmental Impact Assessment Methodologies, Environmental Impact Assessment Practices, Ghana's Environmental Policy

GL 503 Operations Research

Credit.: 0

Nature of Operations Research in Mining, Linear, the Simplex Algorithm for Integer & Goal Programming, Transportation and Assignment Problems, Decision Analysis, Markov Analysis, Simulation, Queuing Models, Inventory Control Models, Production Scheduling Methods – CPM, Dynamic Programming

GL 509 Statistical Models

Credits: 3

Basic Statistical Procedures I, Basic Statistical Procedures II, Regression and Linear Models I, Regression and Linear Models II, Application to Multiple Regression I, Application to Multiple Regression II, Application to Multiple Regression III, Statistical Inference & Statistical Modelling I, Statistical Inference & Statistical Modelling II, Use of Transformation, Correlation & its Relationship with Regression

GL 559 Water Resources Management

Credits: 3

Water Resources Management, Groundwater Development, Sustainability & Water Budgets,

Impacts of Groundwater Development on Basin Hydrogeology, Water Quantity and Water Hazard Issues, Mass Transport and Mass Transfer Processes in Groundwater, Water Quality, Water Contamination and Pollution, Attenuation of Contamination and Groundwater Remediation , Water Law, Meeting the Challenges of Water Sustainability

GL 552 GIS and Remote Sensing

Credits: 3

Photogrammetry & Introduction to Remote Sensing, GIS in Mineral Exploration, Spatial Data Models, Geological Applications of GIS, Data Base Management I, Data Base Management II, Spatial Interpolation I, Spatial Interpolation II, Image Processing I, Image Processing II

GL 558 Exploration Drilling and Sampling

Credits: 3

Introduction to Exploration Drilling, Diamond Drilling; Equipment and Techniques, Innovations in Diamond Drilling, Deflection & Orientation of Drill holes, Ore Sampling, Solution of Structural Problems in Drilling with Stereonet I, Solution of Structural Problems II, Solution of Structural Problems III, Sampling: Techniques, Sampling: Calculations/Projections.

GL 560 Advanced Ore Microscopy

Credits: 3

Introduction; the Ore Microscope, Physical Properties of Ore Minerals, Optical Properties of Ore Minerals, Applications of the Ore Microscope, Ore Textures, Textures of Ore & Gangue Minerals I, Textures of Ore & Gangue Minerals II, Textures of Ore & Gangue Minerals III, Ionic Sizes, Isomorphism, Polymorphism & Solid Solutions, Case Studies.

GL 556 Mineral Exploration Geophysics

Credits: 3

Geophysics in Mineral Exploration, Regional Gravity and Aeromagnetic Surveys, Gamma Ray Spectrometry, Principles of EM Prospecting Methods, Airborne EM Methods I: “Input”, Airborne EM methods II. “Helicopter EM”, Ground-Based EM I: Frequency Domain, Ground-Based EM I: Time Domain, VLF EM, Induced Polarisation (IP) Method.

GL 554 Industrial Minerals

Credits: 3

Introduction, Concepts, Geological Overview, Mining, Processing, Transportation, Marketing of IM's, Igneous Materials I, Igneous Materials II, Igneous Materials III, Presentation of Review Papers, Sedimentary Materials I, Sedimentary Materials II, Sedimentary Materials III/Metamorphic Materials I, Metamorphic Materials II, IM's of Ghana; Trends, Changes & the Future of IM's.

GL 562 Mine Water Hydrology

Credits: 3

Mining and the Water Environment, Mine Water Chemistry. Hydrology and Mining, Physical Impacts of Mineral Extraction on Hydrological Systems, Hydrological Issues in Dewatering, Waste Rock Piles & Tailings Dams, Hydrology of Abandoned Mines & Rebound Processes, Hydrological Intervention in Mine Water Remediation, Treatment of Polluted Mine Waters, Case Studies I, Case Studies II.

GL 505 Applied Rock Mechanics

Credits: 3

Basic Concepts in Rock and Soil Mechanics, Rock and Soil Tests for Design Analysis (in-situ and Laboratory Testing of Rocks and Soils, Geotechnical Mapping and Rock Mass Classification, Stereograhic Projection Methods in Rock Mechanics, Groundwater, Seepage and De-watering Analysis, Stability of Soil and Rock Slopes, Design of Underground Excavations and Pillars, Foundations Design, Dam Foundations and Leach Pads, Site Investigation.

GL 572 Groundwater Engineering

Credits: 3

Groundwater Structure Systems,Impacts of Groundwater on Basin Hydrology, Groundwater Modeling & Assessment I, Groundwater Modeling & Assessment II, Groundwater in Engineering Construction, Groundwater Instrumentation, Groundwater Monitoring Control and Cost, Groundwater Seepage and Mitigation, Groundwater in Site Investigation, Design of Groundwater Drainage Systems.

GL 502 Mineral Resource Evaluation

Credits: 3

Introduction to Ore Resource Evaluation, Theory of Regionalised Variables, Statistical Theory and Applications, Quantifying the Criteria of Estimation, Variography, Practical Production and Modelling of Semi-Variograms, ID Regularisation of Variograms; Extension Variance and Estimation Variance, Practical- Application of Extension Theory to Block Resource Evaluation;Global Resource Estimation and Estimation Variance I, Global Resource Estimation, Optimal Estimation and Kriging II, Volume-Variance and Grade-Tonnage Relationship I,Volume-Variance and Grade-Tonnage Relationship II: Case Studies.

GL 506 Economic & Financial Evaluation

Credits: 3

Nature of and Requirements for Mining Projects, Course Objectives and Expected Outcomes, Time Value of Money and Economic Equivalence, Estimation of Revenue and Costs, Investment Allowances, Mine Taxation and Royalties, Financing Alternatives, Cash Flow Models and Analysis, Investment Decision Methods and Criteria, Sensitivity and Risk Analysis, Mine Feasibility Study, Case Studies.

GL 515 Postgraduate Seminar

Credits: 3

Students will be required to make at least one presentation on the progress and research underway in their areas of specialisation. The seminar will be assessed by a Departmental Panel. All Postgraduate students are required to attend the Seminar(s).

GL 518 Field Trip & Report

Credits: 3

Field trips will be organised and students are required to participate in, at least, one of them. They are required to submit a written report(s) and make oral presentation on it/them

GL 500Thesis

Credits: 15/24

An independent research work under the guidance of (a) Supervisor(s) on a topic in the student's

area of specialisation. A bound thesis embodying the results of the research will be presented to the Department after an oral defense. A panel will assess this.

9 DOCTOR OF PHILOSOPHY PROGRAMME IN GEOLOGICAL ENGINEERING

9.1 ENTRY REQUIREMENTS

- A candidate shall hold a Master's degree or its equivalent in earth sciences and related disciplines from a recognised institution and shall submit evidence of adequate training and ability to undertake the proposed programme.
- A candidate who does not hold a Master's degree shall first register for MPhil degree. If he proves himself/herself to be academically capable by the end of the first year of the programme, he/she may be permitted by the Board of Postgraduate Studies on the recommendation of the Department to register for the PhD degree. This registration shall be deemed retrospective from the date of the original registration of the Master's degree.
- A candidate who does not satisfy the requirements stated above but is otherwise adjudged suitable may be admitted. For the purpose of assessing his suitability, such a candidate may be interviewed on the recommendation of the Department concerned.

9.2 PROGRAMME DURATION

A candidate shall pursue full-time programme of study and research for at least two years, except that:

- A candidate fully engaged in advance study and research for his/her degree, who, before registration, was engaged in research to the satisfaction of the Department concerned, may be exempted for not more than one academic year.
- In special circumstances, the Department may recommend that a candidate be allowed to spend not more than one academic year of his/her programme in advanced study research at another institution, provided that his/her work can be supervised in a manner satisfactory to the Department and the School of Postgraduate Studies.
- A full-time candidate who is engaged in research for the degree shall present

himself/herself for examination not later than three years from the date of his/her registration.

- A part-time candidate shall present himself/herself for examination not later than four years from the date of registration.
- In special cases, an extension of these time limits may be granted on the recommendation of the Department.

9.3 AREAS OF RESEARCH

A candidate may be required to audit appropriate courses/modules and also submit a thesis under the supervision of an academic staff in any of the following areas of research:

- Mineralogy, Petrology and Geochemistry
- Economic Geology
- Water Resources Management
- Mine Water Remediation
- Environmental Geology and Hydrogeology
- Geotechnical Engineering

9.4 EMPLOYMENT OPPORTUNITIES

There are employment opportunities in the following areas:

- Large and Small Scale Mining and Allied Companies
- Financial Institutions
- Construction Companies
- Environmental Protection Agencies
- Mines Department
- Minerals Commission
- The Universities and other Educational and Research Institutions
- Geological Survey Department
- National Energy Board
- Water companies
- Other Governmental and Non-governmental Agencies

Table 8.1 List of Academic Staff and Areas of Specialisation

Name	Designation	Academic /Professional Qualification	Areas of Specialisation
Prof. D. Mireku-Gyimah	Professor	DSc (KNUST), PhD, DIC (London), MSc (Mos Min Inst), CEng, MIMM, MSME, MNYAS, FGhIG, FGA	Mine Design and Planning, Operation Research, Mine Economic and Financial Evaluation, Mineral Resource Estimation, Mine Feasibility Study and Environmental Impact Assessment.
Prof. Dzigbodi-Adjimah	Professor	Dr rer nat (TU Berlin), MSc (Leicester), BSc (Ghana), CEng (London), FGhIG, MIMM	Ore Deposit Geology, Ore Microscopy, Exploration Management.
Prof. Newton Amegbey	Professor	Dr Ing (TUBerlin), MSc (Pet Min Eng Inst), FMVS, MGDMB, MSME	Mine Ventilation, Environmental and Safety Engineering/Human Factors, Mining Regulations, Mine Machinery
Prof. J. S. K. Kuma	Professor	PhD (Newcastle), MSc, PgD (Delft), BSc (Ghana), MIAH, MGhIG	Water Resource Assessment and Management, Mine Water Hydrology, Geophysics
Assoc. Prof. Sulemana Al-Hassan	Associate Professor	PhD (Wales), BSc, PgD (KNUST), MIMM	Mine Planning and Design, Surface and Underground Mining Technology, Geostatistics, Mineral

			Economics
Assoc. Prof Victor A. Temeng	Associate Professor	PhD (Michigan Tech.), MSc (Zambia), BSc, PgD (KNUST)	Operation Research, Materials Handling, Mine Economic Evaluation, Mine Planning
Dr G. M. Tetteh	Lecturer	PhD, MPhil, BSc (Ghana), MGHIG	Structural Geology and Petrology
Dr. Jerome A. Yendaw	Lecturer	PhD (Heriot Watt), BSc (KNUST), Dip (KNUST), MGhIG, MGGS	Foundations Design, Ground Improvement, Environmental Geotechnics, Knowledge based Systems, Ground Engineering
Dr. A. Ewusi	Lecturer	PhD & MSc (Bransdenburg Tech Unv., Germany), BSc (KNUST)	Groundwater Resource Assessment & Management, Groundwater Monitoring, Groundwater Modelling, Geophysics
Dr M. Affam	Senior Lecturer	PhD(UMaT), MSc, BSc (KNUST), MGhIG, MGhIE, MCIM	Rock and Soil Mechanics, Foundation Design and Exploration Techniques
Dr B. Kumi-Boateng	Senior Lecturer	PhD (UMaT), MSc (ITC), MSc, BSc (KNUST)	Research Methods
Assoc Prof P. A. Eshun	Associate Professor	PhD (UMaT), MPhil, PgD, BSc (KNUST), MSME	Computer Application, Operation Research, Mine Economic and Financial Evaluation, Mine Management, Mine Machinery
Dr A. A. Annor	Lecturer	PhD & MSc	Groundwater Resource

		(Bransdenburg Tech Unv., Germany), BSc (KNUST)	Assessment & Management, Groundwater Monitoring, Groundwater Modelling
Dr E. E. Duncan	Senior Lecturer	PhD, MSc (Glasgow), BSc (KNUST)	Geographic Information Systems (GIS), Remote Sensing and Global Positioning Systems (GPS)

DEPARTMENT OF MINING ENGINEERING

10 POSTGRADUATE DIPLOMA PROGRAMME (PgD) IN MINING ENGINEERING

10.1 ENTRY REQUIREMENTS

i) Applicants must have BSc First Class or Second Class in Mining Engineering, relevant Engineering or Earth Sciences from a recognised university.

ii) All other applicants who do not satisfy (i) above but have degrees in Engineering and Science are eligible only after an interview.

iii) Holders of the UMaT Diploma who have at least 3 years professional experience and with proven ability in their respective disciplines are eligible for admission.

iv) Foreign applicants with proficiency in English language who satisfy the requirements of (i) or (ii) above are eligible for admission after careful consideration of relevant documents.

v) Applicants who have satisfactorily completed a Postgraduate Diploma programme may be considered for admission on the recommendation of the Departmental Board concerned.

10.2 PROGRAMME REQUIREMENTS

The Department offers a Postgraduate Diploma programme in Mining Engineering.

a) Graduation Requirements

i. Postgraduate Diploma in Mining Engineering Degree

- A minimum of 33 credit hours is required for the award of a Postgraduate Diploma degree. This is made up of a minimum of seven (7) modules (at least 21 credit hours), Postgraduate Seminar (3 credit hours), Field trip & Report (3 credit hours) and Thesis (6 credit hours).

b) Programme Duration

The duration of the programme is one year on full-time basis.

10.3 PROGRAMME STRUCTURE

The PgD programme requires that the candidate works on an identified project topic in any of the following mining disciplines:

- Environmental Engineering in Mining.
- Rock Mechanics.
- Geostatistics.
- Blasting and Fragmentation.
- Mineral Economics.
- Mine Management.
- Mine Design and Planning.
- Mine Mechanisation.
- Mine Economics & Financial Evaluation.
- Materials Handling.
- Each module runs for a maximum of two weeks (10 working days) duration; examinations in any module shall be taken within a week after completion of the module.
- There shall be a minimum of forty (40) contact hours in each module (4 hr/day).
- A prospective applicant may participate in a module(s) within two (2) years prior to applying for a Postgraduate programme. The results of such a module(s) shall, upon request by the applicant, be credited to him/her upon admission.

11 MASTER'S (MODULAR) PROGRAMME IN MINING ENGINEERING

11.1 TITLE OF PROGRAMME

The title of the programme is Master's Programme (Modular) in Mining Engineering.

11.2 PROGRAMME OBJECTIVES

Ghana possesses diverse mineral wealth ranging from major exploited minerals such as gold, diamond, manganese, bauxite, salt, sand and gravel, to less exploited minerals such as iron, limestone, copper, kaolin, oil and bitumen. In recent years, many investors have been attracted to the mineral industry in Ghana following the promulgation of favourable minerals and mining

laws by the government. Several mining companies, both large and small scale, have been set up and a lot more have acquired prospecting licenses in this country.

The viability of this growing industry and the future of Ghana depend largely on the ability of Mining Engineers to:

- Plan, design and evolve satisfactory solutions to the complex issues associated with mining.
- Operate the mines profitably in the face of the ever-changing global economic and social problems.
- Ensure that the mines are operated in an environmentally friendly manner.

The Modular Master's Programme in Mining Engineering is designed to produce highly qualified Mining Engineers capable of meeting the numerous challenges of the growing mineral industry in Ghana and elsewhere.

The programme aims at providing a firm grounding in basic and advanced concepts and modern methods of mining engineering as well as offering a selection of special courses related to developing areas of the subject, particularly those areas of importance to Ghana.
The programme is structured to offer the possibility of continuing education and therefore makes it possible for practicing engineers in the industry to update and upgrade their knowledge and skills in the various areas of specialisation while still on the job.

The main objectives of the programme are:

- To provide an avenue for practicing engineers in the mining and related industries to continue their education.
- To turn out competent postgraduates to meet the current demands of the mineral industry.
- To prepare competent postgraduates for various research institutions.

11.3 ENTRY REQUIREMENTS

a) The entry requirements for the Master's Degree in Mining Engineering are:
   i. Applicants must have BSc First Class or Second Class (Upper Division) in Earth Sciences or Engineering from a recognised University.

ii. All other applicants who do not satisfy (i) above but have degrees in Engineering & Science may be eligible only after passing an interview.

iii. Holders of UMaT Diploma who hold senior positions in a relevant industry and have at least 5 years professional experience with proven ability in their discipline are eligible for admission.

iv. Foreign applicants with proficiency in English language who satisfy the requirements of (i) or (ii) above are eligible for admission after careful consideration of relevant documents.

v. Applicants who have satisfactorily completed a Postgraduate Diploma programme may be considered for admission on the recommendation of the Departmental Board concerned.

11.4 PROGRAMME REQUIREMENTS

The Department offers two Master's Degree Programmes. These are:

i. MSc Mining Engineering Degree Programme; and

ii. MPhil Mining Engineering Degree Programme.

a) Graduation Requirements

i. MSc Mining Engineering Degree

- A minimum of 42 credit hours is required for the award of MSc degree. This is made up of a minimum of seven (7) modules (at least 21 credit hours), Postgraduate Seminar (3 credit hours), Field trip & Report (3 credit hours) and Thesis (15 credit hours).

ii. MPhil Mining Engineering Degree

- A student is required to do four (4) core modules outlined in Section 11.5a. In addition, he/she may audit modules recommended by the Supervisor to facilitate the student's research work. The candidate is also required to present at least one seminar.
- The successful defence of a thesis is required for the award of the MPhil Degree in Mining Engineering. The thesis should be an embodiment of independent research conducted by a student under the guidance of a Supervisor on a significant problem in

a chosen area of Mining Engineering.

b) Programme Duration

- Full-time: A maximum of four (4) semesters for coursework and thesis
- Part-time: A maximum of six (6) semesters for coursework and thesis

11.5 PROGRAMME STRUCTURE

a) Core and Compulsory Modules

The MSc coursework comprises 4 core modules namely:

- Operations Research (MN 503)
- Statistical Models (MN 509)
- Environmental Management (MN 513)
- Mine Economic & Financial Evaluation (MN 506)

Research Methods is compulsory for all postgraduate students but does not earn any credits.

- In addition, a minimum of 3 other modules must be selected by the candidate in consultation with his/her Supervisor(s). Introduction to Computer Applications is compulsory but a candidate may opt for examination without taking the module in which case the fee is 20% of the module fee. Applicants without adequate mining background will be required to register for the module in "Introduction to Mining Engineering".
- Field trips will be organised and all students will be required to participate in at least one of them. An essential requirement of the modules is that students devote the afternoons to tutorials, practicals or field trips.

b) Content of Modules

The modules to be run, module numbers, module names and credit hours are as follows:

Module No.	Module Name	Credits
First Semester		
MN 261	Introduction to Mining Engineering**	0
MN 351	Introduction to Computer Applications *	0
MN 521	Research Methods	0
MN 501	Mine Mechanisation	3
MN 503	Operations Research	3
MN 505	Applied Rock Mechanics	3
MN 509	Statistical Models	3
MN 511	Explosives and Rock Fragmentation	3
MN 513	Environmental Management	3
Second Semester		
MN 500	Thesis	15
MN 502	Mineral Resource Evaluation	3
MN 504	Mineral Economics	3
MN 506	Economics and Financial Evaluation	3
MN 508	Surface Mine Planning & Design	3
MN 510	Materials Handling	3
MN 512	Environmental Engineering in Mining	3

*Preparatory Module ** Pre-requisite Module for non-Mining Engineers

MN 261 Introduction to Mining Engineering

Credits: 0

Basic introduction to underground and surface mining terminologies. Description of various operations in underground and surface mining: drilling, blasting, mucking, supporting, stoping, ventilation, benching, stripping, reclamation, including technology and equipment. Introduction to small scale mining. Impact of mining on the environment.

MN 351 Introduction to Computer Applications

Credits: 0

Introduction to PC. Operating System Software. Word Processing using MS Word. Spreadsheet software using MS Excel. Presentation Software using MS PowerPoint. Database Management System Software using MS Access.

MN 521 Research Methods

Credits: 0

Definition of research. Objectives of research. Motivation in research. Characteristics of research. Types of research. Problems in starting research. Definition of ethics and professionalism. How ethics and values intersect with professionalism. Ethical theory and applications: Branches of ethics, Classification of ethical theories, Standards of ethical conduct in science, Common ethical principles in science, Code of ethics for engineers. Fraud in Science. Choosing a research topic. Identification and sources of problem. Formulating hypothesis. Functions of literature review. References and Bibliography. Research designs and approaches. Principles of experimental designs. Sampling basics. Characteristics of a good sample design. Methods of data collection. Validity and Reliability of Data. Processing, anaysis and interpretation of data. Report writing: Significance of report writing. Papers and reports: Management reports, Proposals, Journal papers, Conference papers, Thesis. Format for presentation of thesis at UMaT: Structure and form of a thesis, Headings and numbering, Style and punctuation, Extra-linguistic material, Production of the thesis, Editing and revising, Assessment (Seminars, Thesis)

MN 501 Mine Mechanisation

Credits: 3

Introduction. Drilling Machines-Percussive Drills and Rotary Drills. Boring Machines, Raise Borers and Tunnel Borers. Boring Machines-Tunnel Borers and Blindhole Borers. Excavators - Front End Loaders (FEL). Load-Haul-Dump Machines. Haulage Trucks. Stationary Mine Machinery Pumps and Compressors. Hoists. Maintenance of Mine Machinery.

MN 503 Operations Research

Credits: 3

Nature of Operations Research in Mining. Linear, the Simplex Algorithm for Integer and Goal Programming. Transportation and Assignment Problems. Decision Analysis. Markov Analysis. Simulation. Queuing Models. Inventory Control Models. Production Scheduling Methods – CPM, PERT. Dynamic Programming.

MN 505 Applied Rock Mechanics

Credits: 3

Basic Concepts in Rock and Soil Mechanics. Rock and Soil Tests for Design Analysis in-situ and Laboratory Testing of Rocks and Soils. Geotechnical Mapping and Rock Mass Classification. Stereograhic Projection Methods in Rock Mechanics. Groundwater, Seepage and De-watering Analysis. Stability of Soil and Rock Slopes. Design of Underground Excavating and Pillars. Foundation Design for Surface Structures. Dam Foundations and Leach Pads. Site Investigation for Surface Structures.

MN 509 Statistical Models

Credits: 3

Basic Statistical Procedures. Regression and the Linear Models. Regression and the Linear Models. Application to Multiple Regression. Statistical Inference and Statistical Modelling. Use of Transformation; Correlation and its Relationship with Regression.

MN 511 Explosives and Rock Fragmentation

Credits: 3

Drilling; Fragmentation Principles and Blasting Theory. Explosives; Criteria for Selecting Explosives. General Consideration of Geology and Rock Properties on Blast Design and Blast Results. Surface Design Bench Blast. Underground Blast Design Tunneling, Stoping, etc. Charge Loading, Blast Initiation and Delay Blasting. Environmental Effects of Blasting. Specialised Blasting Techniques. Blasting Economics and Benefits. Blast Performance Assessment.

MN 513 Environmental Management

Credits: 3

Environmental Impact of Mining (an Overview). Air Quality/Pollution. Air Quality Modeling. Water Quality/ Pollution. Water Quality Modeling. Noise. Environmental Aspects of Ground Vibrations and Airblasts. Environmental Impact Assessment Methodologies. Environmental Impact Assessment Practices. Ghana's Environmental Laws and Regulations.

MN 515 Postgraduate Seminar

Credits: 3

Students will be required to make at least one presentation on the progress and research underway in their areas of specialisation. This will be assessed by a Departmental Panel. Postgraduate students are required to attend the seminar(s).

MN 502 Mineral Resource Evaluation

Credits: 3

Introduction to Ore Resource Evaluation. Theory of Regionalized Variables. Statistical Theory and Applications. Quantifying the Criteria of Estimation. Variography, Practical Production and Modeling of Semi-Variograms. ID Regularization of Variograms. Extension Variance and Estimation Variance. Practical-Application of Extension Theory to Block Resource Evaluation. Global Resource Estimation and Estimation Variance. Optimal Estimation and Kriging. Volume-Variance and Grade-Tonnage Relationship. Case Studies.

MN 504 Mineral Economics

Credits: 3

Introduction to Mineral Economics – Its Nature and Scope. Basic Micro and Macro-economics: Demand and Supply, Elasticity and its Applications, Market Structures, National Income, International Trade. Economics of the Mineral Industry: Mineral Demand, Mineral Supply, Applications to Mineral Market Instability. Pricing and Trading in Minerals: Mineral Prices Determination, Efforts to Stabilize Mineral Prizes, Sources of Pricing Information, Mineral Trade.

MN 506 Mine Economic and Financial Evaluation

Credits: 3

Overview of Mine Economic and Financial Evaluation. Time Value of Money and Economic Equivalence. Estimation of Revenue and Costs. Investment Allowances, Mine Taxation and Royalties. Financing Alternatives. Cash Flow Models and Analysis. Investment Decision Methods and Criteria. Sensitivity and Risk Analyses. Mine Feasibility Study. Case Studies.

MN 508 Surface Mine Planning and Design

Credits: 3

Scope of Surface Mine Planning and Design. Definition of Surface Mine Planning and Design Parameters. Ultimate Pit Definition and Mining Systems. Equipment/Production Scheduling. Opening-up of a Surface Mine. Environmental Requirements of Surface Mining Planning and Design. Aspects of Computing to Mine Planning and Design. Aspects of Ore Reserve Modeling and Simulation of Mineral Extraction Systems. Computer-Aided Design Software Packages for Surface Mining Scheduling and Evaluation.

MN 510 Materials Handling

Credits: 3

Introduction to Aspects of Materials Handling in Mines. Materials and their Characteristics. Materials Handling Equipment. Haulage of Bulk Materials. Combined Haulage Systems. Transfer and Loading Stations Hoisting. Hydraulic Transport. Haulage Organisation.

MN 512 Environmental Engineering in Mining

Credits: 3

Airflow through Subsurface Environments. Subsurface Ventilation Network. Subsurface Ventilation Simulation. Subsurface Climate Simulation. Human Thermoregulation Modelling. Thermal Stress Environments. Mine Waste Management. Environmental Management of Tailings. Rehabilitation of Mine Sites. Environmental Issues in Small Scale Mining.

MN 514 Underground Mine Planning and Design

Credits: 3

Scope of Underground Mine Design and Planning. Design Strategies. Long and Short Term Planning. Equipment Selection and Production Scheduling. Surface Facilities and Primary Development Layout. Design Consideration for Naturally Supported Mining Systems. Design Consideration for Artificially Supported Mining Systems. Design Considerations for Caving Mining Systems. Computer-Aided Underground Mine Design and Planning. Case Studies.

MN 516 Mine Management

Credits: 3

Introduction: Some developments in management thought, functions of mine managers. Managerial planning and decision-making. Principles of Orgnanising, Organisational Structure Design and Analysis, Decentralisation and Delegation of Authority. Staffing – How to Select an Employee for the Job, Matching the Job with Employee Education, Training and Development. The Human Factor, Motivation and Leadership. Direct and Indirect Control Techniques, Management by Objectives, Exception and Delegation. Problems and Conflict Management. Case Studies.

MN 518 Field Trip and Report

Credits: 3

Field trips will be organised and students are required to participate in at least one of them. They are required to submit a written report(s) and make an oral presentation on it/them.

MN 500 Thesis

Credits: 15/24

An independent research work under the guidance of a Supervisor(s) on a topic in the student's area of specialisation. A thesis embodying the results of the research will be presented to the Department and defended orally. A panel will assess the thesis.

12 DOCTOR OF PHILOSOPHY PROGRAMME IN MINING ENGINEERING

12.1 ENTRY REQUIREMENTS

- A candidate shall hold a Master's degree or its equivalent earth sciences and related disciplines from a recognised institution and shall submit evidence of adequate training and ability to undertake the proposed programme.
- A candidate who does not hold a Master's degree shall first register for MPhil degree. If he/she proves himself/herself to be academically capable by the end of the first year of the programme, he/she may be recommended to register for the PhD degree; this registration shall be deemed retrospective from the date of the original registration for the Master's degree.
- A candidate, who does not satisfy the requirements stated above but is otherwise adjudged suitable, may be admitted.

12.2 PROGRAMME DURATION

Subsequent to registration, the candidate shall pursue a full-time programme of study and research for at least two years, except that:

- A candidate fully engaged in advanced study and research for his/her degree, who, before registration, was engaged in research to the satisfaction of the Department concerned, may be exempted for not more than one academic year.
- In special circumstances, the Department may recommend that a candidate be allowed to spend not more than one academic year of his/her programme in advanced study research at another institution, provided that his/her work can be supervised in a manner satisfactory to the Department and the School of Postgraduate Studies.
- A Full-Time candidate who is engaged in research for the degree shall present himself/herself for examination not later than three years from the date of his/her registration.
- A Part-Time candidate shall present himself/herself for examination not later than four years from the date of registration.

In special cases, an extension of these time limits may be granted on the recommendation of the

Department.

12.3 AREAS OF RESEARCH

A candidate may be required to audit appropriate courses/modules and also submit a thesis under the supervision of an academic staff in any of the following areas of research:

- Environmental Engineering in Mining
- Rock Mechanics
- Geostatistics
- Blasting and Fragmentation
- Mineral Economics
- Mine Management
- Mine Design and Planning
- Mine Mechanisation
- Mine Economics & Financial Evaluation
- Materials Handling

12.4 EMPLOYMENT OPPORTUNITIES

There are employment opportunities in the following areas:

- Large and Small Scale Mining and Allied Companies
- Financial Institutions
- Construction Companies
- Environmental Protection Agencies
- Minerals Commission
- The Universities and other Educational and Research Institutions
- National Energy Board
- Other Governmental and Non-governmental Agencies

12.5 AVAILABLE RESOURCES

a) Academic Staff

Table 11.1 List of Academic Staff and Areas of Specialisation

Name	Academic/ Professional Qualification	Areas Of Specialisation
Assoc Prof Peter Arroja Eshun	PhD (UMaT), MPhil, PgD, BSc (KNUST)	Economic and Financial Evaluation of Mineral Projects, Corporate Social Responsibility in the Mining Industry, Mine Management, Mine Feasibility Studies, Environmental Impact Assessment
Prof Daniel Mireku-Gyimah	PhD, DIC (London), MSc (Mos. Min. Inst.), CEng, MIMM, MSME, MNYAS, MGhIG	Mine Design & Planning, Operations Research, Mine Economic & Financial Evaluation, Mineral Resource Estimation, Mine Feasibility Study and Environmental Impact Assessment
Prof Newton Amegbey	Dr-Ing (TU Berlin), MSc (Pet. Min. Inst.), FMVS, MGDMG, MSME	Mine Ventilation and Safety Engineering/Human Factors, Mining Regulations, Mine Machinery
Prof Sulemana Al-Hassan	PhD (Cardiff), PgD, BSc (KNUST), MGhIG	Mine Planning & Design, Surface & Underground Mining Technology, Geostatistics, Mineral Economics
Assoc Prof Victor Amoako Temeng	PhD (Michigan Tech.), MSc (Zambia), PgD, BSc (KNUST)	Operations Research, Materials Handling, Mine Economics, Mine Planning
Dr B. Kumi-Boateng	PhD (UMaT), MSc (ITC), MSc, BSc (KNUST)	Research Methods
Mr Emmanuel M. Buaba	MS. (Exeter), PgDip, BSc (KNUST)	Geotechnical Engineering, Mine Ventilation & Safety Engineering, Mine Machinery
Mr. Kenneth Joseph Bansah	MPhil (UMaT), BSc (KNUST)	Environmental Management, Mine Machinery, Alluvial and Ocean Mining, Mining Laws and Regulations and Operations Research in Mining
Mr Bright Oppong Afum	MSc (Aberystwyth), BSc (KNUST)	Explosives & Blasting Technology, Environmental Monitoring & Analysis, Surface & Underground Mining Systems, Underground Mine Planning & Design, Mining Regulations

DEPARTMENT OF MINERALS ENGINEERING

13 MASTER'S (MODULAR) PROGRAMME IN MINERALS ENGINEERING

13.1 TITLE OF PROGRAMME

The title of the programme is Master's Programme (Modular) in Minerals Engineering.

13.2 PROGRAMME OBJECTIVES

Mineral resources contribute significantly to the economy of Ghana; providing employment and foreign exchange among others. This notwithstanding, the mining industry is faced with technical, environmental and social problems. The available ores are low grade and their mineralogical composition very complex, a situation that results in low recovery and generation of large volume of waste material. The latter presents a real environmental challenge, which undermines public trust for the industry. Furthermore, there are other mineral resources that are least exploited like industrial minerals and there is the need to train human resources for the processing of these minerals.

The programme is therefore designed to:

- Train and upgrade the knowledge of Mineral Engineers to cope with the ore complexities and their inherent environmental issues.
- Enhance the diversification and maximization of mineral processing in Ghana and elsewhere.
- Produce competent postgraduates capable of making a career in research and teaching.

13.3 ENTRY REQUIREMENTS

a) The entry requirements for the Master's Degree in Minerals Engineering are:

i. A BSc First Class or Second Class (Upper Division) or its equivalent in Applied Sciences and related engineering programmes.

ii. All other applicants who do not satisfy the requirements of (i) above but have degrees in Engineering & Science may be eligible only after passing an interview.

iii. Holders of UMaT Diploma in the Earth Sciences, who have at least five (5) professional experience with proven ability in their discipline are eligible for admission.

iv. Foreign applicants with proficiency in English language who satisfy the requirements of (i) or (ii) above are eligible for admission after careful consideration of relevant documents.

v. Applicants who have satisfactorily completed a Postgraduate Diploma programme may be considered for admission on the recommendation of the Departmental Board concerned.

13.4 PROGRAMME REQUIREMENTS

The Department offers two Master's Degree Programmes. These are:

i. MSc Minerals Engineering Degree Programme

ii. MPhil Minerals Engineering Degree Programme

a) Graduation Requirements

i) MSc Minerals Engineering Degree

- A minimum of forty-five (45) credit hours is required for the award of the MSc. Degree. This is made up of a minimum of four (4) compulsory and four other modules (at least 24 credits hours), Graduate Seminar (3 credit hours); Field Trip & Report (3 credits) and Thesis (15 credits).

ii) MPhil Minerals Engineering Degree

- A student is required to take four (4) compulsory modules outlined in Section 12.5a. In addition he/she may also take modules recommended by the Supervisor to facilitate his/her research work. The student is required also to present at least one seminar.
- The successful defence of a thesis is required for the award of the MPhil degree in Minerals Engineering. The thesis should be an embodiment of independent research conducted by the student under the guidance of a Supervisor(s) on a significant problem in a chosen area of Minerals Engineering.

b) Programme Duration

- Full-time: A maximum of four (4) semesters for coursework and thesis

- Part-time: A maximum of six (6) semesters.

13.5 PROGRAMME STRUCTURE

a) Core and Compulsory Modules

The MSc/MPhil course work comprises four core modules:

- Operations Research (MR 503)
- Statistical Models (MR 509)
- Economic & Financial Evaluation (MR 506)
- Environmental Management (MR 513)

Research Methods (MR 521) is compulsory but does not earn credit for all postgraduate students

- In addition, each MSc student will select four other modules in consultation with his/her Supervisor(s). Introduction to Computer Applications is compulsory but a candidate may apply for exemption. Applicants without adequate mineral engineering background will be required to register for the module in "Introduction to Minerals Engineering".
- Field trips will be organised and all students will be required to participate in at least one of them. An essential requirement of the modules is that students devote the afternoons to tutorials, practicals or field trips.

b) Course Structure

First Year: First Semester Modules

Course No.	Course Name	Credits
MR 351	Introduction to Computer Applications*	0
MR 261	Introduction to Minerals Engineering**	0
MR 521	Research Methods	0
MR 501	Mineralogy	3
MR 503	Operations Research	3
MR 505	Mineral Particle Systems	3
MR 507	Aqueous Processes in Mineral Engineering	3

MR 509	Statistical Models	3
MR 511	Biotechnology in Mineral Engineering	3
MR 513	Environmental Management	3

* Preparatory Module ** Preparatory Module for non-Mineral Engineers

First Year: Second Semester Modules

Course No.	Course Name	Credits
MR 500	Thesis	15
MR 502	Precious Minerals Beneficiation	3
MR 504	Non-Ferrous Metal Beneficiation	3
MR 506	Economics and Financial Evaluation	3
MR 508	Industrial Minerals Beneficiation	3
MR 510	Mine Waste Management	3
MR 512	Mineral Process Design and Control	3
MR 515	Seminar	3
MR 518	Field Trip and Report	3

c) Contents of Modules

Introduction to Computer Applications (0)

Introduction to PC, Basic hardware components of the PC, Operating systems software DOS, Operating systems hardware (DOSshell, Windows, File Managers and Utilities) Word Processing, Data processing, Database, Graphics, Software installation and interfacing and summary.

Introduction to Mineral Engineering (0)

Comminution & classification, concentration processes, leaching, purification and metal recovery.

MR 521 Research Methods

Credits: 0

Definition of research. Objectives of research. Motivation in research. Characteristics of research. Types of research. Problems in starting research. Definition of ethics and professionalism. How ethics and values intersect with professionalism. Ethical theory and applications: Branches of ethics, Classification of ethical theories, Standards of ethical conduct in science, Common ethical principles in science, Code of ethics for engineers. Fraud in Science. Choosing a research topic. Identification and sources of problem. Formulating hypothesis. Functions of literature review. References and Bibliography. Research designs and approaches. Principles of experimental designs. Sampling basics. Characteristics of a good sample design. Methods of data collection. Validity and Reliability of Data. Processing, anaysis and interpretation of data. Report writing: Significance of report writing. Papers and reports: Management reports, Proposals, Journal papers, Conference papers, Thesis. Format for presentation of thesis at UMaT: Structure and form of a thesis, Headings and numbering, Style and punctuation, Extra-linguistic material, Production of the thesis, Editing and revising, Assessment (Seminars, Thesis)

MR 501 Mineralogy (3)

Introduction to mineralogy of sulphides, oxides, carbonates and chlorides - with special reference to crystal structure. Mineral identification techniques; X-ray diffractometry, X-ray fluorescence, atomic absorption spectrophotometry, ore microscopy, etc. Isomorphism, texture of ores, gangue minerals and grain size defects. Basic laboratory work in ore microscopy. Application of mineralogy to process metallurgy; leaching, roasting, etc.

MN 503 Operations Research (3)

Nature of operational research in mining. The simplex algorithm, linear, integer and goal programming. Transportation and assignment problems. Decision analysis. Markov analysis. Simulation. Queuing models. Inventory control models. Production scheduling methods. CPM.

Dynamic programming.

MR 505 Mineral Particle Systems (3)

Creation of particles; brittle fracture theory and review of theories of comminution, crushing and grinding circuit analysis, general method of producing fine powders. Characterization of particles; size analysis methods, evaluation of sizing, data-probability plots. Separation of mineral particles using physical and chemical properties. Agglomeration of particles; forces between microassemblies, technology of agglomeration.

MR 507 Aqueous Processes in Mineral Extraction (3)

Leaching reactions and methods, liquid/solid separation processes. Purification operations, solvent extraction, ion exchange and reverse osmosis, Metal recovery processes, precipitation, crystallization, electrolysis, etc. and carbon adsorption technology.

MR 509 Statistical Models (3)

Sampling theory and techniques. Basic statistical concepts in data analysis. Special distributions. Estimation theory. Testing hypothesis. Analysis of variance (ANOVA). Regression and correlation analyses. Introduction to multiple regression analysis. Mathematical expectations. Experimental design: the strategy of design, factorial experiments, screening design, Taguchi's robust method.

MR 511 Biotechnology in Mineral Engineering (3)

Some basic concepts of microorganisms: their diversity, habitat, their physiology, metabolism, genetics and their influence on the environment. Nitrogen, carbon, phosphorous and sulphur cycles. The role of microorganisms in processes such as biofilm formation, biocorrosion, mineral leaching, acid rock drainage, biosorption, bioremediation of organic pollutants etc and manipulating environmental conditions to enhance or retard a given process.

MR 513 Environmental Management (3)

Environmental Impacts of Mining (an overview). Air quality/pollution. Air quality modeling; water quality/pollution; water quality modeling. Noise. Environmental aspects of ground vibrations and air blasts. Environmental impact assessment methodologies and practices.

Ghana's Environmental Policy.

MR 502 Precious Minerals Beneficiation (3)

Types of gold ores; Alluvial, Free milling and Complex ores, Treatment processes, lixiviants for leaching of gold, pretreatment processes for complex ores, pressure leaching, bacteria oxidation etc. heap leaching. CIL, CIP processes and Zinc precipitation, electrolysis and refining of gold. Environmental issues of tailings disposal; geochemistry of tailings and cyanide detoxification techniques. Platinum. Artisanal mining; environmental and social impacts, poverty alleviation and conflicts.

MR 504 Non Ferrous Metal Beneficiation (3)

Types of bauxite, The Bayer Process. Production of alumina from non-bauxite sources, Production of aluminum from alumina, Re-fining of aluminum. Types of copper ores and beneficiation methods; leaching with ammonia and sulphuric acid. Electrolysis and metal recovery. Environmental issues of bauxite, alumina and copper beneficiation. Types of manganese ores; Beneficiation on MnO_2 and production of manganese compounds from $MnCO_3$. Production of ferromanganese.

MR 506 Economic and Financial Evaluation (3)

Nature of requirements for mining projects. Time value of money and economic equivalence. Estimation of revenue and costs; investment allowances; taxation and royalties. Investment decision methods and criteria. Project cash flow and risk. Case study of project feasibility.

MR 508 Industrial Minerals Beneficiation (3)

Production of salt (NaCl) from sea water, indigenous and commercial ponds. Uses of salt in the petrochemical and chemical industries. Production of limestone and cement manufacture. Beneficiation of diamond and kaolin. Heavy mineral sand; ilmenite, rutile, zircon, etc. Environmental issues of industrial mineral production.

MR 510 Mine Waste Management (3)

Types of mine waste; waste rock and tailings. Impoundment structures; selection and design.

Tailings deposition methods. Water Management, Sampling and analysis of tailings, Effluent treatment for environmental control and monitoring systems, Decommissioning, reclamation and covers. Case studies of cyanide-bearing tailings and acid rock drainage system.

MR 512 Mineral Process Design and Control (3)

Process flowsheet design; metallurgical accounting and process economics. Selection and sizing of equipment from test data; crushers, grinding mills, gravity concentration, hydrocylone and flotation cells. Process control and instrumentation.

MR 515 Seminar (3)

Each student will be required to make at least one seminar presentation on the progress of his/her thesis work. The presentation will be assessed by a Departmental Panel. All Postgraduate students are required to attend the seminar(s).

MR 518 Field Trip and Report (3)

Field trips will be organised and students are required to participate in, at least, one of them and shall submit a written report for assessment.

MR 500 Thesis (15/24)

An independent research work will be carried out by each student on a suitable topic which will constitute a thesis that will be assessed. An oral examination will be conducted on the thesis by a panel of Examiners.

14 DOCTOR OF PHILOSOPHY PROGRAMME IN MINERALS ENGINEERING

14.1 ENTRY REQUIREMENTS

- A candidate shall hold a Master's degree or its equivalent in earth science and related discipline from a recognised institution and shall submit evidence of adequate training and ability to undertake the proposed programme

- A candidate who does not hold a Master's degree shall first register for MPhil degree. If he/she proves himself/herself to be academically capable by the end of the first year of the programme, he/she may be recommended to register for the PhD degree; this registration shall be deemed retrospective from the date of the original registration for the Master's degree
- A candidate, who does not satisfy the requirements stated above but is otherwise adjudged suitable, may be admitted
- For the purpose of assessing his/her suitability, such a candidate may be interviewed or required to take an entrance examination, or both as directed by the School of Postgraduate Studies on the recommendation of the Departmental Board.

14.2 PROGRAMME DURATION

Subsequent to duration, the candidate shall pursue a full-time programme of study and research for at least two years, except that:

- A candidate fully engaged in advanced study and research for his/her degree, who, before registration, was engaged in research to the satisfaction of the Department concerned, may be exempted for not more than one academic year.
- In special circumstances, the Department may recommend that a candidate be allowed to spend not more than one academic year of his/her programme in advanced study research at another institution, provided that his/her work can be supervised in a manner satisfactory to the Department and the School of Postgraduate Studies.
- A Full-Time candidate who is engaged in research for the degree shall present himself/herself for examination not later than three years from the date of his/her registration.
- A Part-Time candidate shall present himself/herself for examination not later than four years from the date of registration.

In special cases, an extension of these time limits may be granted on the recommendation of the Department.

14.3 AREAS OF RESEARCH

A candidate may be required to audit appropriate course(s)/modules and also submit a thesis

under the supervision of an academic staff in any of the following areas of research:

- Mine Water Characterization
- Mine Water Management
- Aqueous Processes and Studies
- Water Quality
- Environmental Monitoring and Management
- Gold Benefication
- Biohydrometallurgy
- Environmental Biotechnology
- Geometallurgy
- Acid Mine Drainage
- Microwave Processing
- Plant Design
- Materials Engineering
- Industrial Waste Management

14.4 AVAILABLE RESOURCES

a) Academic Staff

The Department has qualified staff to manage the programme (see list of academic staff and their areas of specialisation)

b) Equipment

The Department has good laboratory facilities for physical mineral separation. Other facilities needed to run the programme can be accessed from allied industries and universities in the country.

c) Reading Materials

The Department and University libraries have relevant books and computer facilities. Students can use these facilities to access information.

14.5 EMPLOYMENT OPPORTUNITIES

There are employment opportunities in the following areas:

- The Universities and other Educational and Research Institutions
- Environmental Protection Agencies
- Financial Institutions
- Minerals Commission
- Large and Small Scale Mining and Allied Companies
- Other Government and Non-Governmental Organisations

Table 13.1 List of Academic Staff and Areas of Specialisation

NAME	DEGREE AND WHERE EARNED	AREA OF SPECIALISATION
Dr. J. R. Dankwah	PhD (UNSW), MSc (NTNU), BSc (KNUST)	Ferrous Metallurgy, Application of Waste Polymers into Metal Extraction, High Temperature Metallurgical Processes, Nonferrous Metallurgy, Electrometallurgy, Aqueous Processes, Solid Waste Management,
Prof. R. K. Amankwah	PhD (Queen's), MPhil, BSc (KNUST), MGhIE, MSME	Biohydrometallurgy, Environmental Biotechnology, Application of Microwaves in Mineral Extraction, Gold Ore Processing, Geometallurgy
Assoc. Prof. E. K. Asiam	PhD, BSc (KNUST), MCIM, MMMPSG	Beneficiation of Precious Minerals, Mine Waste Management, Mineral Process Design and Operation, Acid Rock Drainage.
Assoc Prof W. K. Buah	PhD (Leeds), MSc (Krivoy Rog Min. Inst), MSME, MMMPSG	Mineral Processing, Waste Management, Pyrolysis - Gasification.
Dr. G. Ofori Sarpong	PhD (Pennstate), MSc, BSc (KNUST)	Sampling, Process Control and Instrumentation, Environmental Protection, Biohydrometallurgy

Mr. J. J. K. Gordon	MPhil, BSc (KNUST)	Biotechnology, Mineral Processing
Prof. D. Mireku-Gyimah	DSc (KNUST), PhD, DIC (London), MSc (Mos Min Inst), CEng, MIMM, MSME, MNYAS, FGhIG, FGA	Mine Design and Planning, Operation Research, Mine Economic and Financial Evaluation, Mineral Resource Estimation, Mine Feasibility Study and Environmental Impact Assessment.
Prof. Newton Amegbey	Dr Ing (TUBerlin), MSc (Pet Min Eng Inst), FMVS, MGDMB, MSME	Mine Ventilation, Environmental and Safety Engineering/Human Factors, Mining Regulations, Mine Machinery
Assoc. Prof. Victor A. Temeng	PhD (Michigan Tech.), MSc (Zambia), BSc, PgD (KNUST)	Operation Research, Materials Handling, Mine Economic Evaluation, Mine Planning
Assoc. Prof. Sulemana Al-Hassan	PhD (Wales), BSc, PgD (KNUST), MIMM	Mine Planning and Design, Surface and Underground Mining Technology, Geostatistics, Mineral Economics
Assoc Prof. P. A. Eshun	PhD, MPhil, PgD, BSc (KNUST), MSME	Computer Application, Operation Research, Mine Economic and Financial Evaluation, Mine Management, Mine Machinery
Dr B. Kumi-Boateng	PhD (UMaT), MSc (ITC), MSc, BSc (KNUST)	Research Methods
Dr. S. A. Ndur	PhD (New Mexico Tech), MSc (Moscow), MSME, MMMPSG, MSEGH	Mine Waste Characterization, Mine Waste Management, Aqueous Processes and Studies, Water Quality, Environmental Monitoring and Management
Dr. G. Adjei	PhD (Havana), MSc (Mao), PgEd (Havana), Cert. in French Language (Mao),	Mineral Processing, Industrial Minerals, Surface Mining

	MCSG	
Mrs. V. E. Frimpong	MPhil (UMaT), BSc (KNUST)	Alluvial Mining and Processing, Acid Mine Drainage

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DEPARTMENT OF MECHANICAL ENGINEERING

15 MASTERS (MODULAR) PROGRAMME IN MECHANICAL ENGINEERING

15.1 TITLES OF PROGRAMMES

The title of the programme is MSc/MPhil Programme (Modular) in Mechanical Engineering.

15.2 PROGRAMME OBJECTIVES

The main objectives of the programme are to produce graduates with a wide range of knowledge of modern engineering enterprise and to develop skill in advanced mechanical engineering in the field of thermal power and fluid engineering.

15.3 ENTRY REQUIREMENTS

The entry requirements for the Master's degree in Mechanical Engineering are:

i) Applicants must have BSc First Class or Second Class (Upper Division) in Mechanical Engineering, Agricultural Engineering and Engineering from a Recognised University.

ii) All applicants who do not satisfy (i) above but have degree in Engineering and Science may be eligible only after passing an interview.

iii) Holders of UMaT Diploma in Mine Mechanical Engineering or Earth Sciences and related Engineering programmes who hold senior positions in a relevant industry and have at least 5 years professional experience with proven ability in their discipline are eligible for admission.

iv) Foreign applicants with proficiency in English language who satisfy the requirements of (i) or (ii) above are eligible for admission after careful consideration of relevant documents.

vi) Applicants who have satisfactorily completed a Postgraduate Diploma programme may be considered for admission on the recommendation of the Departmental Board concerned.

15.4 PROGRAMME REQUIREMENTS

The Department offers two Master's Degree programmes. These are:

- MSc in Mechanical Engineering (Thermal Power and Fluid Engineering).
- MPhil in Mechanical Engineering.

a) Graduation Requirements

i) MSc Mechanical Engineering Degree

- A minimum of 45 credit hours is required for the award of MSc. Degree. The programme is composed of a minimum of eight (8) modules (24 credit hours), Postgraduate Seminar (3 credit hours), Field Trip and Report (3 credit hours) and a Thesis (15 credits).

ii) MPhil Mechanical Engineering Degree

- A student is required to take three (3) core modules outlined in Section 14.5 and two others recommended by the supervisor to facilitate his/her research work. The candidate is also required to present at least one seminar.
- The successful defence of a thesis is required for the award of the MPhil Degree in the chosen area of specialization. The thesis should be an embodiment of independent research conducted by the student under the guidance of a Supervisor on a significant problem in a chosen area of Mechanical Engineering

b) Programme Duration

- Full-time – A maximum of four (4) semesters for coursework and thesis.
- Part-time – A maximum of six (6) semesters.

15.5 PROGRAMME STRUCTURE

a) Core/Compulsory Modules

The MSc Course work comprises 6 core modules namely:

- Engineering Heat Transfer (MC 503)
- Fluid Mechanics (MC 505)

- Computational Fluid Dynamics (MC 507)
- Gas-Turbines and Fuel Cells (MC 502)
- Gas Dynamics (MC 504)
- Advanced Engineering Thermodynamics (MC 506)

In addition, a minimum of two (2) other modules must be selected by the candidate in consultation with his/her Supervisor(s). Applicants without adequate Mechanical Engineering background will be required to register for the module in Introduction to Mechanical Engineering. Research Methods (MC 501) is compulsory for all postgraduate students and none credit.

Numerical Methods and Computer Programming are compulsory non-scoring modules but a candidate may apply for exemption in either of them on satisfactory proof of proficiency in it/them.

Field trips will be organized and all students are required to participate in at least one of them. An essential requirement of the modules is that students devote the afternoons to tutorials, practicals or field trips.

b) Content of Modules

The modules to be run, credit hours and modules numbers are shown in Table 1. The detailed contents of the module follow Table 1.

Table 14.1 Programme Modules for the Master's Programme in Mechanical Engineering

No	Module Number	Name of Module	Credits Hours
		First Year	
1	MC 261	Introduction to Mechanical Engineering	0
2	MC 379	Numerical Methods	0
3	MC 389	Computer Programming	0
		First Semester	

4	MC 501	Research Methods	0
5	MC 503	Engineering Heat Transfer	3
6	MC 505	Fluid Mechanics	3
7	MC 507	Computational Fluid Dynamics (CFD)	3
8	MC 509	Combustion and Internal Combustion Engines *	3
		Second Semester	
9	MC 502	Gas-Turbine and Fuel Cells	3
10	MC 504	Gas Dynamics	3
11	MC 506	Advanced Engineering Thermodynamics *	3
12	MC 508	Renewable Energy Resources *	3
13	MC 510	Engineering Economics *	3
14	MC 512	Environmental Management *	3
		Second Year	
15	MC 515	Postgraduate Seminar	3
16	MC 518	Field Trip and Report	3
17	MC 500	Thesis	15

***** Elective modules

Introduction to Mechanical Engineering (0)

Engineering Materials: Classification of Engineering Materials, Properties of Materials, Testing of Materials. Machine Tools: Lathe, Drilling, Milling, Shaping. Machine Design: Design process, material selection in design. Fluid Mechanics: Properties of fluid, Pascal's Law, Variation of pressure with depth and hydrostatic, energy and its form, Bernoulli's equation, Viscous and turbulent flow. Fluid Machineries: Fluid coupling, Pumps, Compressors, Hydraulic turbine, Hydraulic power plant, Pneumatic machines. Laws of Thermodynamics: Joule apparatus and mechanical equivalent, First Law of Thermodynamics, The Kelvin-Plancks second law of thermodynamics, Clausius statement for Second law of thermodynamics. Internal Combustion Engines: Types of internal combustion engines, working principles for four-stroke petrol and

diesel engines, working principle for two stroke petrol and diesel engines, comparison of petrol and diesel engines, comparison of four-stroke and two-stroke engines, comparison of steam and internal combustion engine. Heat Transfer: Introduction to the three modes of heat transfer; Types of Heat Exchangers. Refrigeration and Air-Conditioning Industrial and Maintenance Engineering: Time and Work Study, Types of Maintenance Schedule.

Numerical Methods (0)

Review of the various numerical techniques of solving linear and non-linear equations. The nature of iterative schemes. The Successive-Over Relaxation method (SOR) for both component and matrix forms. Finite differences. Interpolation. The Taylor's method, the Euler method, Modified Euler method. Runge-Kutta methods. The Shooting method, the finite difference method. Methods for Eleptic equations. Methods for Parabolic and Hyperbolic equations.

Computer Applications: Programming in C/C++ (0)

Introduction to C Programming, Operators and Expressions. Fundamental Data Types and Storage Classes, Standard C/C++ pre-processor. Standard C/C++ library and Conditional Program Execution, Program Loops and Iteration, Modular Programming. Pointer to Objects, Arrays, Structures, Unions. Controlling Devices, Operating System Interaction, Mouse and graphic programming, Lists, Trees, String, Queues and stacks. Object Oriented paradigm and C++ at a glance, Classes and objects. Object initialization and cleanup, dynamic objects. Operator overloading, Inheritance, Virtual functions. Generic programming with templates, Streams computation with streams, Stream computation with files. Exception handling

Name of Module: **Research Methods (0)**

Introduction to research. Epistemology and its implications for research methodology and design. Theoretical framework and Scientific research design. Qualitative data collection and Analysis. Principles of quantitative data analysis (Descriptive Statistics). Quantitative Methods. Sampling, questionnaire design and methods for pre-testing. Research proposal for competitive research grant. Format of research proposal. Reporting and communicating research results.

Engineering Heat Transfer (3)

Introduction to the three modes of heat transfer. Physical laws governing these processes (the three modes of heat transfer). Differential equation of three-dimensional conduction. Complex and unsteady heat conduction. Laminar and turbulent heat convection. Natural and Forced convection. Heat Exchangers. Mass transfer. Boiling and condensation. Radiation and Solar energy.

Fluid Mechanics (3)

Review of laws of fluid mechanics. Derivation of the governing differential equations. Introduction to potential flows. Exact solutions to the Navier-Stokes equations. Laminar boundary layers. Basic theory and description of turbulent flows and turbulent mixing processes. Physics of near-wall turbulent flows. Modeling of turbulent flows. Linear and non-linear eddy-viscosity schemes. Flow Management: active and passive measures to delay or avoid transition to turbulent flow or to reduce turbulent mixing.

Computational Fluid Dynamics (CFD) (3)

CFD activity and Transport equation. Numerical verses analytical solutions. Discretisation techniques to transform governing equations into sets of linear equations. One-dimensional conduction equation, TSE and IOCV methods. Stability and convergence. Solution methods for linear systems (Gauss-Seidel, Tridiagonal Matrix Algorithm). Central and upwind differencing for convection terms, diffusion and pressure-velocity coupling. Two-dimensional boundary layers. Adaptive grid, transformation of coordinates and discretisation. Complex domains; curvilinear grids, unstructured grids.

Combustion and Internal Combustion Engines (3)

Properties of gaseous mixtures: Gibbs-Dalton Law, evaluation of mixture energy, enthalpy and entropy. Properties of gaseous mixtures: gravimetric and molar analyses of mixtures, processes with mixtures. Combustion processes: simple chemistry, stoichiometry, mixtures of reactants. Combustion processes: air/fuel ratios, energy release, and adiabatic flame temperature. Chemical equilibrium and dissociation: equilibrium constant, degree of dissociation. Chemical equilibrium and dissociation: effects on heat release and flame temperature. Chemical kinetics: rate constants, forward and backward (dissociation), law of mass action. Chemical kinetics: relation

to equilibrium constant, forms of rate constant, example of NO, chemical time scales. Flames: premixed, partially premixed and diffusion. Flames: relation to engine output and performance, laminar and turbulent flame speed.

Gas Turbines and Fuel Cells (3)

Gas Turbine as a prime energy converter. Gas turbine plant. Auxiliary devices and Suitable fuels for gas turbines. Review of the relevant thermofluid mechanics for the design and performance analysis. Fuel cell as the primary class of non-heat route energy conversion. Development of constituent materials. Multi-scale modelling. Stack design. Optimization and control. Fuel cell application, fuels and infrastructure.

Gas Dynamics (3)

Thermodynamics concepts of compressible flow. Energy equation: static and stagnation temperatures. Elastic waves, the mach cone and the propagation of finite waves. Compressible flow around a body. One dimensional compressible flow in a duct. Subsonic flows. Supersonic flows. Isothermal flow in a pipe. Adiabatic flow in a pipe. Case Studies.

Advanced Engineering Thermodynamics (3)

Classical thermodynamics of a general reactive system. Conservation of energy and principles of increase of entropy. Fundamental relation of thermodynamics. Availability and maximum work potential. Reversible work and irreversibility. Second-law efficiency; second law analysis of closed systems. Heat transfer with other systems or bodies. Second-law analysis of steady-flow systems. Second-law analysis of unsteady-flow systems. General unsteady-flow processes.

Renewable Energy Resources (3)

Energy and the economy. Solar radiation production. Transmission and conversion. Photovoltaic. Solar panel and its accessories. Installation and maintenance of Solar panel. Biomass. Wind. Wave and tide. Hydropower conversion.

Engineering Economics (3)

Nature of and Requirements for Engineering Projects. Time value of Money and Economic Equivalence. Estimation of Revenue and Costs. Choosing among Investment Alternatives.

Financing Alternatives. Cash Flow Models and Analysis. Sensitivity and Risk Analysis. Equipment Replacement and Retirement. Feasibility Study. Case Studies.

Environment Management (3)

Environmental Impact of Mechanical Engineering Activities (an Overview). Emissions/Pollutants from Internal Combustion Engines. Air Quality Modeling. Water Quality/ Pollution. Water Quality Modeling. Noise. Environmental Aspects of Ground Vibrations. Environmental Impact Assessment Methodologies. Environmental Impact Assessment Practices. Ghana's Environmental Policy.

Postgraduate Seminar (3)

Students will be required to make a minimum of one presentation on the progress and research underway in their areas of specialization. The seminar will be assessed by a Departmental Panel. Postgraduate students are required to attend.

Field Trip and Report (3)

Field trips will be organized and all students will be required to participate in at least one of them. Candidates are required to submit a written report and make oral presentation(s) on it/them.

Thesis (15/24)

The thesis must be an embodiment of independent research work under the guidance of Supervisor(s) on a topic in the student's area of specialization. A thesis embodying the results of the research will be presented to the Department for assessment. A panel of examiners will assess the thesis.

15.6 AREAS OF RESEARCH

A candidate may submit a thesis under the Supervision of an academic staff in any of the following areas and related topic:

- Thermal power engineering.
- Fluid engineering.

- Renewable energy systems
- Application of Computational Fluid Dynamics to the solution of complex flow phenomena including heat and mass transfer in single and multi-phase.

15.7 EMPLOYMENT OPPORTUNITIES

There are employment opportunities in the following areas:

- Oil and gas industry.
- Thermal and hydro power generation industries.
- Water and thermal engineering industries.
- Manufacturing industries using systems involving transport of heat and mass e.g. cocoa processing factories and the breweries.
- Universities, Polytechnics and other Educational and Research Institutions.

Table 14.1 List of Academic Staff and Areas of Specialisation

Name	Qualification	Areas of Specialisation
Prof. D. Mireku-Gyimah	DSc (KNUST), PhD, DIC (London), MSc (Moscow Min. Inst.), CEng, MIMM, MSME, MNYAS, FghIE	Mine Design and Planning, Operation Research, Mine Economic and Financial Evaluation, Mineral Resource Estimation, Mine Feasibility Study and Environmental Impact Assessment.
Prof. N. Amegbey	Dr Ing (TU Berlin), MSc (Romania), FMVS, MGDMB, MSME	Mine Ventilation, Environmental and Safety Engineering/Human Factors, Mining Regulations, Mine Machinery
Assoc Prof. I. A. Adetunde	PhD (Ilorin), Nigeria, MSc (Ilorin), Nigeria, BSc (Ilorin), Nigeria, NCE (Ibadan), Nigeria	Analytical Dynamics, Numerical Analysis, Statistics.

Assoc Prof. V. A. Temeng	PhD (Michigan Tech), MSc (Zambia), PgD, BSc (KNUST)	Operation Research, Materials Handling, Mine Economic Evaluation, Mine Planning
Seth P. Agbomadzi	MSc Eng., Univ. of Newcastle Upon Tyne, UK, BSc (Hons) Eng., UST, Ghana	Thermofluid Engineering, Hydraulic Structures and Design
Dr. Anthony Simons	PhD, St. Petersburg State Mining Institute, Russia, MSc Eng., Mogilev Machine Building Institute, Mogilev, Belarus	Internal Combustion Engines, Heat Transfer, Mining Transport Machinery
Stephen K. Adzimah	MSc Eng., Volgograd Polytechnic Institute, Russia.	Production Engineering
Emmanuel Seckley	MSc Eng., KNUST, Ghana, BSc Eng., UST, Ghana	Solid Body Mechanics and Strength of Materials

15.8 AVAILABLE FACILITIES

There are up-to-date facilities in the University, the mining industry and allied industries and other research institutions in the country to allow for a comprehensive and detailed work in the programmes. The facilities include:

- A refrigeration and air-conditioning teaching laboratory with work stations.
- A power hydraulics teaching laboratory with work stations.
- A power pneumatic teaching laboratory with work stations.

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

16 MASTER'S (MODULAR) PROGRAMME IN ELECTRICAL AND ELECTRONIC ENGINEERING

16.1 TITLE OF PROGRAMME

The title of the programme is Masters (Modular) Programme in Electrical and Electronic Engineering.

16.2 PROGRAMME OBJECTIVES

Electrical and electronic engineering is essential for maintaining and developing a modern society. From the production of electricity through the multiplicity of electrical and electronic apparatuses to communications and robotics, electrical and electronic engineering is fundamental to many of the technical systems that are used every day at work and at home. Electrical and electronic engineering is also changing rapidly.

The Masters programme is designed for Electrical/Electronic Engineering graduates who are practicing engineers, designers or industry planners who seek a further understanding of areas of electrical and electronic engineering such as power systems, mechatronics and industrial automation and communications engineering. The programme is intended to equip the student so as to adapt to the challenging demands of the modern electrical and electronic engineering industries.

The main objectives of the programme are to:

- Give candidates professional training in the theoretical and practical aspects of electrical and electronic engineering so as to turn out competent postgraduates to meet the current demands of analysis, synthesis and design of systems of the electrical and electronic engineering industries.
- To provide an academic environment for study and research for the engineer wishing to follow a MSc/PhD programme, in order to contribute in solving the problems of electrical and electronic engineering by the use of appropriate technologies.

- To enrich the capacity of the student to continuously adapt to the constant changes of the state of the art in electrical and electronic engineering

16.3 ENTRY REQUIREMENTS

a) The entry requirements for the Master's Degrees in Electrical and Electronic Engineering are:

i. Applicants must have B.Sc. First Class or Second Class (Upper Division) or its equivalent in Electrical and/or Electronic Engineering or in related Engineering disciplines from a recognised University.

ii. All other applicants who do not satisfy (i) above but have degrees in engineering & Science may be eligible only after passing an interview.

iii. Holders of UMaT Diploma in Mine Electrical Engineering who hold senior positions in a relevant industry and have at least 5 years professional experience with proven ability in their discipline are eligible for admission.

iv. Foreign applicants with proficiency in English language who satisfy the requirements of (i) or (ii) above are eligible for admission after careful consideration of relevant documents.

v. Applicants who have satisfactorily completed a Postgraduate Diploma programme may be considered for admission on the recommendation of the Departmental Board concerned.

16.4 PROGRAMME REQUIREMENTS

The Department offers two Master's Degree Programmes. These are:

i. MSc Electrical and Electronic Engineering Degree Programme

ii. MPhil Electrical and Electronic Engineering Degree Programme

a) Graduation Requirements

i. MSc Electrical and Electronic Engineering Degree

- A minimum of 45 credit hours is required for the award of MSc. Degree. This is made up of a minimum of eight (8) modules (at least 24 credit hours) in five (5) core modules and at least three (3) other modules which must be selected by the candidate in consultation with his/her supervisor, a Graduate Seminar (3 credit hours), Field Trip and Report (3 credit hours) and a Thesis (15 credit hours).

ii. MPhil Electrical and Electronic Engineering Degree

- A student is required to take four (4) core modules outlined in Section 15.5a. In addition, the student should take modules recommended by the Supervisor to facilitate the student's research work. The candidate is also required to present at least one seminar.
- The successful defence of a thesis is required for the award of the MPhil degree. The thesis should be an embodiment of independent research conducted by the student under the guidance of a Supervisor on a significant problem in a chosen area of Electrical and Electronic Engineering.

b) Programme Duration

- Full-time: A maximum of four (4) semesters for coursework and thesis.
- Part-time: A maximum of six (6) semesters of coursework and thesis.

16.5 PROGRAMME STRUCTURE

a) Core and Compulsory Modules

The MSc course work comprises 4 core modules namely:

- Power System Operation, Protection and Planning (EL 505)
- Economic and Financial Evaluation (EL 506)
- Intelligent Systems in Manufacturing (EL 507)
- Advanced Signal Processing (EL 508)

Research Methods (EL 501) is compulsory but does not earn any credit for all postgraduate students

- Introduction to Computer Applications and Computer Applications: C++ and MATLAB/SIMULINK for engineers are compulsory but a candidate may apply for exemption. A minimum of three elective modules must be completed by each student.
- Field trips will be organised and all students will be required to participate in at least one of them. An essential requirement of the modules is that students devote the afternoons to tutorials, practicals or field trips.

b) Content of Modules

The modules to be run, credit hours and module numbers are as follows:

Table 1 Programme Modules for the Master's Programmes in Electrical and Electronic Engineering

S/No	Module No	Name of Module	Credit Hours
		Semester 1	
1	EL 351	Introduction to Computer Applications*	0
2	EL 263	Computer Applications: C^{++} and MATLAB/SIMULINK for Engineers*	0
3	EL 501	Research Methods	0
4	EL 503	Operations Research	3
5	EL 505	Power System Operation, Protection and Planning**	3
6	EL 507	Intelligent Systems in Manufacturing**	3
7	EL 509	Statistical Models	3
8	EL 511	Computer Control Systems	3
9	EL 515	Postgraduate Seminar	3
10	EL 517	Advanced Robotics	3
11	EL 519	Factory Automation	3
12	EL 521	Microwave Engineering and Optical Communication Systems	3
Semester 2			
13	EL 500	Thesis	15
14	EL 506	Economic and Financial Evaluation**	3
15	EL 508	Advanced Signal Processing**	3
16	EL 510	Microprocessor Systems	3
17	EL 512	Power System Stability, Modelling and Control	3
18	EL 514	Power Electronics and Industrial Drives Systems	3
29	EL 516	Mechatronic System Modelling and Design	3
20	EL 518	Field Trip and Report	3
21	EL 520	Mobile Communications and Wireless Technology	3
22	EL 522	Broadcasting Technologies	3
23	EL 524	Environmental and Safety Engineering	3
24	EL 525	Modelling and Simulation	3

*Preparatory Module ** Core module

EL 351 Introduction to Computer Applications
Credits: 0
Introduction to the PC, Basic hardware components of the PC, Operating systems software DOS, Operating systems hardware (DOS shell, Windows, File Managers and Utilities), Word processing, Data processing, Database, Graphics, Software installation and interfacing, Summary.

EL 263 Computer Applications: C++ and MATLAB/Simulink
Credits: 0
Introduction to C++ programming for engineers, C++ language basics (Variables, Statements, Data types), Control flow (if/else statements, for and while loops), Object-oriented concepts (classes, objects, creating classes), Arrays, exceptions, more about OOP, input/output, inheritance, abstract classes, polymorphism, Introduction to GUI programming, Introduction to applets, Threads, vector class, string buffer class, Working with files, Analysis of generation and network aspects of marginal cost based on electricity markets.

EL 501 Research Methods
Credits: 0
Introduction to research, Epistemology and its implications for research methodology and design, Theoretical framework and scientific research design, Qualitative data collection and analysis, Principles of quantitative data analysis (descriptive statistics), Quantitative methods, Sampling, questionnaire design and methods for pre-testing, Research proposal for competitive research grant, Format of research proposal, Reporting and communicating research results.

EL 505 Power System Operation, Protection and Planning
Credits: 3
Insulation engineering, Protection systems and control, Diagnosis of causes and modes of power system failure, Performance prediction and design of earthing systems, Measurement and safety evaluation of earthing systems, Introduction to system planning and optimisation, Generation and transmission system planning, System expansion planning and optimisation, Dynamic system security and control optimisation using FACTS devices, Forecasting and scheduling.

EL 506 Economic and Financial Evaluation
Credits: 3
Nature of and requirements for engineering projects, course objectives and expected outcomes, Time value of money and economic equivalence, Estimation of revenue and costs, Investment

allowances, taxation and royalties, Financing alternatives, Cash flow models and analysis, Investment decision methods and criteria, Sensitivity and risk analysis, Feasibility study, Case studies.

EL 507 Intelligent Systems in Manufacturing

Credits: 3

Overview of AI techniques in manufacturing: Overview and survey of AI techniques that has recently been applied to solving/simulating activities in manufacturing engineering, Knowledge-based systems, Expert systems, Fuzzy logic, Artificial neural networks, Adaptive neural controllers and emulators, Commercially available systems: Neuralworks explorer and neural works professional, Case-based learning/ reasoning, Genetic algorithms, Applications of intelligent systems.

EL 508 Advanced Signal Processing

Credits: 3

Scalar random variables and stochastic processes, Linear systems models, Principles of estimation theory, Signal modelling and parametric spectral estimation, Discrete-time signals and systems, Autocorrelation and cross-correlation, MA and AR processes, prediction, DTFT, DFS, DFT, FFT, filter specifications, Filter structures and design, C/D and D/C conversions, Multi-rate practical digital signal processing and applications.

EL 515 Postgraduate Seminar

Credits: 3

Students will be required to make a minimum of one presentation on the progress and research underway in their areas of specialisation. The seminar will be assessed by a Departmental Panel. Postgraduate students are required to attend.

EL 518 Field Trip and Report

Credits: 3

Field trips will be organised and all students will be required to participate in at least one of them. Candidates are required to submit a written report and make oral presentation(s) on it/them. Also, reports on laboratory works shall be defended by the candidate.

EL 500 Thesis

Credits: 15/24

The thesis must be an embodiment of independent research work under the guidance of

Supervisor(s) on a topic in the student's area of specialisation. A thesis embodying the results of the research will be presented to the Department for assessment and defended orally. A panel of examiners will assess the thesis.

EL 503 Operations Research
Credits: 3
Nature of operations research, Linear, the simplex algorithm for integer and goal programming, Transportation and assignment problems, Decision analysis, Markov analysis, Simulation, Queuing models, Inventory control models, Production scheduling methods – CPM, Dynamic programming.

EL 509 Statistical Models
Credits: 3
Basic statistical procedures I, Basic statistical procedures II, Regression and linear models I, Regression and linear models II, Application to multiple regression I, Application to multiple regression II, Application to multiple regression III, Statistical inference and statistical modelling I, Statistical inference and statistical modelling II, Use of transformation, correlation and its relationship with regression.

EL 510 Microprocessor Systems
Credits: 3
Review of basic microprocessor system design fundamentals, Programming techniques, Hardware of microcontrollers, Digital signal processors, Memory system, Design and use of memory management unit, Virtual memory systems, Multiprocessors case studies, Hands-on laboratory sessions.

EL 511 Computer Control Systems
Credits: 3
Mathematical background, Process modelling and identification, Simulation tools, Discrete systems, stability analysis, Digital control system design and implementation, Sensors, Control algorithm implementation, Programme packages for identification, Case study, Hands-on session and laboratory exercises/mini project.

EL 512 Power System Stability, Modelling and Control
Credits: 3
Power quality: concept, voltage fluctuations and variations, Transient over voltages, Harmonic

distortions, Power system stability, Swing equations and its solutions, Application of equal-area criterion to switching transients, Instability due to symmetrical line-ground fault, Improvement in the transient stability, Power system modelling and control, Power system control.

EL 514 Power Electronics and Industrial Drive Systems
Credits: 3
Introduction to electric drives and its components, Fundamentals of power semiconductor controlled electric drives, DC motor drives, Speed control of electric drives, Switched reluctance drives, AC motor drives, Dynamic model of AC and DC machines, Vector control of industrial drives systems, Inverter-fed AC drives, Application case studies.

EL 516 Mechatronic System Modelling and Design
Credits: 3
Physical modelling of mechanical, electrical systems, Thermal, fluid and mixed systems, Bond graphs and response analysis, Overview of a mechatronic design process and specification, development/planning, Conceptual, embodiment, detail designs and integration, Application procedure for patents, Quality function deployment, failure model and effect analysis, Pugh charts, Axiomatic design, Case studies.

EL 517 Advanced Robotics
Credits: 3
Position and orientation transformations and robot kinematics of position, Inverse kinematics problem, Rigid body motion, robot kinematics of velocity, and robot statics, Robot trajectory planning and kinematic robot control, Robot dynamics, Properties of the robot dynamic model, Robot position control, Implementation and robustness issues, Robot compliance and force control, Lab: industrial robot demonstrations.

EL 519 Factory Automation
Credits: 3
Sensors, actuators and switching elements, Programmable logic devices and arrays, Pneumatic valves, Logic operation, Design of sequential control systems, Programmable controllers, Distributed control systems, Supervisory control and data acquisition (SCADA) for factory automation, Modelling and simulation for factory automation, Case studies of factory automation.

EL 520 Mobile Communications and Wireless Technology
Credits: 3
Inverse fourth power, Shadowing and rayleigh fading losses, narrow band system performance, Wide band system principles, Multiple access techniques for wireless communications, GSM system, UMTS system, Wireless technologies and data network, Satellite communication, Placement of a satellite in a geostationary orbit, Modulation and multiplexing techniques for satellite links.

EL 521 Microwave Engineering and Optical Communication Systems
Credits: 3
Microwave power dividers, directional couplers and hybrids, Filter theory, Ferrite properties, wave propagation in ferrite, Noise in microwave systems, Active microwave circuits, Characterisation of microwave communication systems, Budgets for terrestrial microwave systems, Optical communication systems, Optical detectors and optical sources, Advanced optical systems.

EL 522 Broadcasting Technologies
Credits: 3
Conventional FM broadcasting, Digital audio broadcasting (DAB) techniques, Analog TV transmission, Digital terrestrial TV broadcasting (DTTB) techniques, Single frequency networking (SFN), Digital satellite TV broadcasting (DVB-S and ISDB), Digital cable TV transmission, New developments in television broadcasting, Case studies.

EL 524 Environmental and Safety Engineering
Credits: 3
Environmental impact of industrial activity (an overview), Air quality/pollution, Air quality modelling, Water quality/pollution, Water quality modelling, Noise, Ergonomics and industrial safety technology, Accident prevention, Laws on safety, Environmental impact assessment methodologies and practices.

EL 525 Modelling and Simulation
Credits: 3
Overview of Models, Simulation and Techniques of Modelling and Simulation, Modelling and Simulation Software and Packages, The MATLAB User Interface and Simulink, Methods to Solve Formal Problems, Mathematical Modelling and Numerical Methods, Experimental Modelling and Polynomial Methods, Simulation Modelling and Analysis, Regression and

Business Case Modelling, Modelling and Simulation of Power, Electromechanical and Complex Systems, Case Studies.

17 DOCTOR OF PHILOSOPHY PROGRAMME IN ELECTRICAL AND ELECTRONIC ENGINEERING

17.1 ENTRY REQUIREMENTS

- A candidate shall hold a Master's degree in electrical and electronic engineering or its equivalent in a related discipline from a recognised institution and shall submit evidence of adequate training and ability to undertake the proposed programme
- A candidate who does not hold a Master's degree shall first register for an MPhil. If he/she proves himself/herself to be academically capable by the end of the first year of the programme, he/she may be recommended to register for the PhD degree; this registration shall be deemed retrospective from the date of the original registration for the Master's degree
- A candidate, who does not satisfy the requirements stated above but is otherwise adjudged suitable, may be admitted.

For the purpose of assessing his/her suitability, such a candidate may be interviewed or required to take an entrance examination, or both as directed by the School of Postgraduate studies on the recommendation of the Departmental Board.

17.2 PROGRAMME DURATION

A candidate shall pursue a full-time programme of study and research for at least two years, except that:

- A candidate fully engaged in advanced study and research for his/her degree, who, before registration, was engaged in research to the satisfaction of the Department concerned, may be exempted for not more than one academic year.
- In special circumstances, the Department may recommend that a candidate be allowed to spend not more than one academic year of his/her programme in advanced study research at another institution, provided that his/her work can be supervised in a manner

satisfactory to the Department and the School of Postgraduate Studies.

- A Full-Time candidate who is engaged in research for the PhD Degree shall present himself/herself for examination not later than three (3) years from the date of his/her registration.
- A Part-Time candidate shall present himself/herself for examination not later than four (4) years from the date of registration.

In special cases, an extension up to one (1) year of these time limits may be granted on the recommendation of the Department.

17.3 AREAS OF RESEARCH

A candidate may be required to audit appropriate courses/modules and also submit a thesis under the supervision of an academic staff in any of the following areas of research:

- Power systems protection and control
- Control and design of power electronic circuits for alternative energy systems
- Power system operation, planning, management, optimization and economics.
- Power Quality Studies.
- Distribution System Analysis and Automation
- High-Power Power Electronics.
- Flexible AC Transmission Systems (FACTS)
- Robotics and Control
- Electric Drives.
- Microelectromechanical Systems (MEMS).
- Computer Mechatronics and Artificial Intelligence Systems.
- Industrial Automation Systems.
- Power Systems Analysis and Automation.
- Intelligent Control Systems.
- Stochastic modelling, analysis, optimisation and control problems arising in communication networks and distributed systems.
- Analytical and experimental research in traffic modelling, traffic engineering, and quality of service techniques in communication networks.

- Telecommunications Network control and management.
- Optimal Resource Allocation in Wireless Access Networks.
- Distributed Algorithms for Wireless Ad hoc Networks.

17.4 EMPLOYMENT OPPORTUNITIES

There are employment opportunities in the following areas:

* Power generation, transmission and distribution industries e.g. VRA, GridCo, ECG
* Manufacturing industries e.g. Kabelmetal, VALCO, Unilever, Aluworks.
* Automated pharmaceutical and allied industries.
* Mining companies.
* Oil and gas industries.
* Universities and other Educational and Research institutions.
* The Ghana Armed Forces.
* United Nations Industrial Development Organisation (UNIDO).
* Project management consulting firms.
* Process and Plant Automation consulting firms.
* Ghana Broadcasting Corporation, TV3, Metro TV, TV Africa, etc.
* Telecommunications industries, e.g. Vodafone, TIGO, MTN, Kasapa, etc.

17.5 AVAILABLE RESOURCES

a) Academic Staff

See the list of academic staff.

b) Facilities and other Resources

See list of existing facilities.

Table 16.1 List of Academic Staff and Areas of Specialisation

Name	Qualification	Designation	Areas of Specialisation
Mr E. Normanyo	MSc (Kharkov), MGhIE	Senior Lecturer	Automated Electric Drives, Industrial Automation, Instrumentation and Control, Mechatronics
Prof D. Mireku-Gyimah	DSc (KNUST), PhD, DIC (London), MSc (Moscow Min. Inst.), CEng, MIMM, MSME, MNYAS, FghIE	Professor	Operations Research, Economic and Financial Evaluation.
Prof N. Amegbey	Dr. Ing (TU Berlin), MSc (Romania), FMVS, MGDMB, MSME	Professor	Environmental and Safety Engineering
Prof I. A. Adetunde	PhD (Ilorin), Nigeria MSc (Ilorin), Nigeria BSc (Ilorin), Nigeria N.C.E. (Ibadan), Nigeria	Assoc Professor	Numerical Analysis, Operations Research, Statistics.
Prof Sulemana Al-Hassan	PhD (Wales), BSc, PgD (KNUST), MIMM	Assoc Professor	Statistical Models.
Prof V. A. Temeng	PhD (Michigan Tech) MSc (Zambia), PgD, BSc (KNUST)	Assoc Professor	Operations Research.
Mr J. C. Attachie	MSc (Kharkov), MGhIE	Lecturer	Power Systems and Networks, High Voltage Engineering
Mr John Annan	MPhil (UMaT), BSc (KNUST)	Lecturer	Communications and Control Systems, Computer-Aided Design
Mr Solomon Nunoo*	MPhil (UMaT), BSc (KNUST)	Lecturer	Telecommunications, Signal Processing, Computer-Aided Design
Dr C. K. Amuzuvi	PhD (Nottingham) MSc (Kharkov), GMGhIE	Lecturer	Communications and Control Systems
Dr K. A. Asante	PhD (Vermont, USA), MSc Physics (Portland, USA), MSc Theoretical Physics (Sudbury, Canada) BSc (UCC, Cape Coast)	Lecturer	Communication Systems, Renewable Energy, Nanotechnology.
Mr S. Ofori	MSc (London), BSc (KNUST)	Lecturer	Signal Processing, Broadband Networks
Mr P. Blewushie	MPhil (UMaT) BSc (KNUST)	Lecturer	Power Systems Operation, Protection and Control. Instrumentation and Control.

* On study leave

DEPARTMENT OF MATHEMATICS

18 MASTER'S PROGRAMME (MODULAR) IN MATHEMATICS

18.1 TITLE OF PROGRAMME

The title of the programme is Master's Programme (Modular) in Mathematics.

18.2 PROGRAMME OBJECTIVES

The main objectives of the programme are:

- To provide postgraduate level education to support the growing financial institutions and allied industries.
- To train professional Mathematicians capable of solving scientific and technological problems using computational knowledge.
- To train professional Statisticians to meet current statistical demands in various industries.
- To train postgraduates who will be capable of supporting teaching and research at higher levels.

18.3 ENTRY REQUIREMENTS

The entry requirements for the Master's degree in Mathematics are:

i. Applicants must have BSc First Class or Second Class (Upper Division) in Mathematics, Statistics, Economics, Engineering and physical sciences from a recognized University.

ii. All applicants who do not satisfy (i) above but have degrees in Mathematics, Statistics with Economics, any Engineering field or other related Physical Sciences and are adjudged suitable by the departmental board concerned may be interviewed where applicable.

iii. Foreign applicants with proficiency in English language who satisfy the requirements of (i) or (ii) above are eligible for admission after careful consideration of relevant documents.

iv. A student who has satisfactorily completed a postgraduate diploma programme may be considered for admission on the recommendation of departmental board concerned.

18.4 PROGRAMME REQUIREMENTS

The Department offers two Master's degree programmes. These are:

i. MSc Mathematics (Elective Option) Degree Programme
ii. MPhil Mathematics Degree Programme

a) Graduation Requirements

i. ***MSc Degree in Mathematics***

- A minimum of 45 credit hours is required for the award of an MSc degree. This is made up of a minimum of eight (8) modules (at least 24 credit hours), Postgraduate Seminar (3 credit hours) Field trip & Report (3 credit hours) and Thesis (15 credit hours).

ii. ***MPhil in Financial Mathematics, Statistics and Computational Mathematics***

- A minimum of 42 credit hours is required for the award of an MPhil degree. This is made up of a minimum of five (5) modules (at least 15 credit hours), Postgraduate Seminar (3 credit hours) and Thesis (24 credit hours).
- A student is required to take five (5) core modules outlined in Section 18.5 of Guidelines for Postgraduate Studies. In addition, the student may take modules recommended by the supervisor to facilitate his/her research work. The student is also required to present at least one seminar.
- The successful defence of a thesis is required for the award of the MPhil degree. The thesis should be an embodiment of independent research conducted by a student under the guidance of a Supervisor on a significant problem in a chosen area of Financial Mathematics, Statistics and Computational Mathematics.

b) Programme Duration

- Full-time - A maximum of four (4) semesters for course work and thesis work
- Part-time - A maximum of six (6) semesters for course work and thesis work.

c) Registration

- Full-time students will be required to register a minimum of three (3) modules per semester.
- Students should register modules they intend to participate in by the third week of

every semester. Students may, however, pay module participation fee at the time the module is being offered.

- To be of good standing a part-time student must do, at least, three modules per annum.

18.5 PROGRAMME STRUCTURE

1. Each module runs for a maximum of two weeks (10 working days) duration; examinations in each module shall be taken within a week after completion of the module.

2. There shall be a minimum of forty (40) contact hours in each module (4 hrs. /day).

3. A prospective applicant may participate in a module within two years prior to applying for postgraduate programme; the results of such a module shall upon request by the applicant be credited to him/her upon admission.

a) Core and Compulsory Modules

The MSc and MPhil coursework comprises five (5) core/compulsory modules namely:

- Time series and Forecasting (MA 503)
- Numerical Methods for Linear and Nonlinear Equations (MA 502)
- Operations Research (MA 505)
- Computer Programming (MA 507)
- Advanced Probability and Statistics (MA 506)

MSc Students shall specialise in any of the following elective areas.

- Financial Mathematics
- Computational Mathematics
- Statistics

In addition to the core modules, a minimum of 3 (three) other elective modules must be selected by the candidate in consultation with his/her Supervisor(s) with regard to any of the elective areas above.

b) Content of Modules

The modules to be run, credit hours and module numbers are as follows:

Table 1 Programme Modules for the Master`s Programmes in Mathematics

	Course No.	Course Name	Credit Hours
1	MA 275	Numerical Methods	0
2	MA 501	Research methods	0
3	MA502	Numerical Methods for Linear and Nonlinear Equations	3
4	MA 503	Time series and Forecasting	3
5	MA 504	Advanced Probability and Statistics	3
6	MA 505	Operations Research	3
7	MA 507	Computer Programming	3
8	MA 515	Seminar	3
9	MA 518	Field Trip and Report	3
10	MA 500	Thesis	15
Elective Courses			
Financial Mathematics			
11	MA 511	Computational Finance	3
12	MA 512	Optimization Models in Economics and Finance	3
13	MA 513	Investment Analysis and Portfolio Theory	3
14	MA 514	Economics	3
15	MA 516	Risk Analysis and Management	3
Computational Mathematics			
16	MA 521	Application of Numerical Analysis to ODEs	3
17	MA 522	Advanced Numerical Methods	3
18	MA 523	Application of Numerical Analysis to PDEs	3
19	MA 524	Computational Methods in Optimisation	3
20	MA 526	Computational Methods for Optimal Control Problems	3
Statistics			
21	MA 531	Multivariate Analyses	3
22	MA 532	Stochastic Processes with Applications	3
23	MA 533	Design and Analysis of Experiments	3
24	MA 534	Statistical Models	3
25	MA 536	Sample Surveys	3

- Research Methods is a compulsory module for all registered students. Every student is expected to pass this as a prerequisite to continue with the course.
- Students from related fields other than mathematics must take Numerical Methods.

MA 275 Numerical Methods
Credits: 0
Sources and types of error; round-off errors, truncation error, Basic error analysis. Evaluation of functions. Numerical solution of non-linear algebraic equation; one-point methods, simple iteration, secant and Newton-Raphson methods. Acceleration and relaxation. Bracketing methods; Bisection and false-position methods. Numerical solution of sets of linear algebraic equations: elimination back substitution. Matrix inversion. Instabilities and pivoting. Gaussian elimination. Iterative methods for linear systems: Gauss-Jacobi, Gauss-Siedel and successive over relaxation (SOR). Convergence and error analysis. Order of an iterative process. Use of computer essential. Conjugate Gradient. Methods for first-order differential equations: Taylor's method, Euler methods, Runge-Kutta methods, multi-step methods. Methods for higher-order differential equations: Taylor's, Euler and Runge-Kutta methods.

MA 501 Research Methods
Credits: 0
Introduction to research: Research project formulation/management, the research process, literature review and organization. Epistemology and its implications for research methodology and design. Theoretical framework (variable definition and generation of hypothesis). Scientific research design (differences between qualitative and quantitative methodology, measurement issues: reliability and validity). Qualitative data collection (e.g. in-depth interviews, focus groups, observations). Analysis of qualitative data. Principles of quantitative data analysis (descriptive statistics). Quantitative methods (hypothesis testing, inferential statistics). Sampling, questionnaire design and methods for pre-testing. Research proposal for competitive research grant. Research presentation (formatting dissertation). Case studies.

MA502 Numerical Methods for Linear and Non Linear Equations
Credits: 3
Solutions of algebraic equations; Direct methods for linear equations, orthogonal factorization, sparse matrix techniques. Markowitz criterion, Nested dissection, applications. Solutions of non – linear equations; one point iterative methods, Newton's and Brain methods, convergence of

these methods; Multi – step iteration formulae, secant methods, gradient methods, Bracketing methods, convergence and stability of these methods; special methods, applications.

MA 503 Time Series and Forecasting
Credits: 3
Introduction: Examples of Time Series, Objectives of Time Series Analysis, Some Simple Time Series Models, Models with Trend and Seasonality, a general Approach to Time Series Modeling, Stationary Models and the Autocorrelation Function ,Estimation and Elimination of Trend and Seasonal Components. Stationary Processes: Basic Properties, Linear Processes, Introduction to ARMA Processes, Properties of the Sample Mean and Autocorrelation Function, Forecasting Stationary Time Series, The Durbin–Levinson Algorithm , The Innovations Algorithm, Prediction of a Stationary Process in Terms of Infinitely Many Past Values. ARMA Models : ARMA(p, q) Processes, The ACF and PACF of an ARMA(p, q) Process, Calculation of the ACVF, The Autocorrelation Function, The Partial Autocorrelation Function, Forecasting ARMA Processes. Spectral Analysis: Spectral Densities, The Periodogram, Time-Invariant Linear Filters, The Spectral Density of an ARMA Process. Modeling and Forecasting with ARMA Processes: Preliminary Estimation, Yule–Walker Estimation,. Burg's Algorithm, The Innovations Algorithm, The Hannan–Rissanen Algorithm, Maximum Likelihood Estimation, Diagnostic Checking. Nonstationary and Seasonal Time Series Models: ARIMA Models for Non stationary Time Series, Identification Techniques, Unit Roots in Time Series Models, Unit Roots in Autoregressions, Unit Roots in Moving Averages, Forecasting ARIMA Models, The Forecast Function, Seasonal ARIMA Models, Forecasting SARIMA Processes, Regression with ARMA Errors, OLS and GLS Estimation, ML Estimation 213. Forecasting Techniques: The ARAR Algorithm, Memory Shortening, Fitting a Subset Auto regression, Forecasting, Application of the ARAR Algorithm, The Holt–Winters Algorithm, Holt–Winters and ARIMA Forecasting, the Holt–Winters Seasonal Algorithm, Choosing a Forecasting Algorithm.

MA 505 Operations Research
Credits: 3
Introduction to Deterministic methods for Optimization, with focus on mathematical programming (linear, nonlinear, integer) and network methods. Introduction to probabilistic methods for modelling and analysing the performance of complex systems. Topics include Markov chains, queuing, forecasting, discrete event simulation and inventory modelling.

MA 507 Computer Programming
Credits: 3
Input and output procedures. Elementary mathematical functions . User defined functions. Relational and logical operators. Conditional statements . Looping and the switch structure. Solution of Linear and non linear algebraic equations. Application to differential equations. Symbolic processing with MATLAB.

MA 515 Postgraduate Seminar
Credits: 3
Students will be required to make a minimum of one presentation on the progress and research underway in their areas of specialization. The seminar will be assessed by a Departmental Panel. Postgraduate students are required to attend.

MA 518 Field Trip and Report
Credits: 3
Field trips will be organised and all MSc students will be required to participate in at least one of them. MPhil Students may participate. Students are required to submit a written report after the field trip.

MA 500 Thesis
Credit: 15/24
The thesis must be an embodiment of independent research work under the guidance of Supervisor(s) on a topic of the student's area of specialization. A thesis embodying the results of the research will be presented to the Department for assessment. A panel of examiners will assess the thesis.

Elective Option 1: Financial Mathematics Modules

MA 511 Computational Finance
Credits: 3
Option pricing computations. Options on stocks, call option, the long short positions on options. The factors affecting option prices and the concept of the put-call parity. The binomial option pricing model (BOPM). The trading strategies involving options. The Black-Scholes option model. The spot interest rate. The expectations hypothesis of the term structure. The reinvestment risk and the market risk. Value-at-risk.

MA 512 Optimization Models in Economics and Finance
Credit: 3
Overview of Optimization concepts: Modelling-analysis-design loop in financial and economic practice. Linear, non-linear, integer programming applications in finance and economics. Discrete optimization models in finance: Modelling possibilities through binary and integer variables; Relaxation methods; branch-and-bound methods; Quadratic and convex programming, Applications in portfolio management. Using linear and nonlinear programming software. Seminar.

MA 513 Investment Analysis and Portfolio Theory
Credits: 3
Money markets instruments; debts capital markets; term structure models. Bond valuation, duration and convexity; bond ratings; tools of bond portfolio management; Equity markets and instruments; common stock valuation; Mathematics of portfolio selection. Mean-variance and index models. Models of market equilibrium. Models of market equilibrium; market efficiency. Performance measurement and attribution. Active and passive portfolio management. Uses of assets derivative in portfolio management, global investments.

MA 514 Economics
Credits: 3
Concepts of macroeconomics. Money, Inflation, Income, and Unemployment. Banking and financial markets. Exchange rate determination. Emerging markets. Basics of microeconomics. Demand, Supply, and Market Equilibrium. Perfect competition. Imperfect competition. Cooperative and non-cooperative solutions in game theory with financial applications.

MA 516 Risk Analysis and Management
Credits: 3
Principles of risk theory. Credibility premiums and experience rating. Operations research techniques in insurance and reinsurance decision making. Financial innovation. Sources of risk and risk profile. Measuring market risk, credit risk, operational and legal risks. Securitization, hedging and arbitrage fundamentals. Design and financing of life insurance products and retirement plans. Stochastic investment models for life insurance and pension funds. Willkie's model.

Elective Option 2: Computational Mathematics Modules

MA 521 Application of Numerical Analysis to Ordinary Differential Equations (ODEs)
Credits: 3
Initial and Boundary value problems in ODEs, Numerical approximation of solutions. Higher order one step methods, Taylor series. Runge-Kutta (R-K) methods. Convergence and stability of these methods. Multistep methods. Topics in approximation. Chebyshev polynomial approximation. Least – squares approximation. Approximation by series.

MA 522 Advanced Numerical Methods
Credits: 3
Weighted Residual methods. Allocation methods. Orthogonal allocation. Ritz Galerking methods. Nagume's Lemma, applications. Introduction to finite elements. Applications. Finite difference Method.

MA 523 Applications of Numerical Analysis to Partial Differential Equations (PDEs)
Credits: 3
Partial differential equations. Classification, Parabolic equations. Solution techniques by explicit methods. Fourier stability methods. Matrix methods. Stability and convergence analysis. Solution techniques by finite difference methods. Hyperbolic equation, Solution techniques by methods of characteristics. Explicit methods. Hybrid methods.

MA 524 Computational Methods in Optimisation
Credits: 3
Optimization Problems. Examples of Optimization problems. The Optimization in one dimension. Iterative methods of Optimization. Least squares procedures for solving equations, Contraction mapping theorem. Newton's methods. Steepest Descent Methods, Conjugate direction Methods in R, Conjugate Gradient Method Algorithms, Projection Methods.

MA 526 Computational Methods for Optimal Control Problems
Credits: 3
Unconstrained continuous. Optimal Control Problems. Fletcher – Reeves Algorithm. Seminar. Polak–Ribiere algorithm and its application to equality. Constrained control problems. Unconstrained Discrete Optimal control problems and methods of solution

Elective Option 3: Statistics Modules

MA 531 Multivariate Analyses
Credits: 3
Theory of Matrices and their properties. Multivariate Normal Distribution. Multiple and partial correlation. Regression theory. Estimation of parameters. Hotelling's T^2 Mahalanobis D^2Wishart distribution. Tests concerning mean vectors and variance. Confidence bounds. Multi-variance distributions

MA 532 Stochastic Processes with Applications
Credits: 3
Classification of stochastic processes. Random walk models, discrete queueing chain. Inventory model, branching processes. Poison, Birth and Death Processes, waiting time models. Guassian processes. Martingales. Mean covariance and sample functions. Integration and differentiation of SPs. Estimation problems. Tutorials.

MA 533 Design and Analyses of Experiments
Credits: 3
General Linear Models. Generalized inverse of a Matrix, Factorial Experiments: Symmetric and Asymmetric. Balanced and Partially Balanced Incomplete Block Designs. Resolvable, Group Divisible Connected, Lattice Designs. Row – Column Designs; Latin Square, Lattice, Cross Over Design. Response Surface Methodology. Construction of Designs.

MA 534 Statistical Models
Credits: 3
Point estimations, Unbiasedness, Mean-squared error, Confidence interval, Tests of hypotheses, Power calculations. Derivation of one and two-sample procedures. Simple linear regression, Regression diagnoses. Prediction: linear models, Analysis of variance (ANOVA). Multiple linear regressions. Factorial experiments, Analysis of covariance models including parallel and separate regressions. Model building.

MA 536 Sample Surveys
Credits: 3
Use of auxiliary information; Multivariate ratio. Regression estimators and their extension to double sampling procedure. Difference estimators and their extension to double sampling procedure. Quenouille's technique of bias reduction. Sampling on successive occasions. Exampling of Errors. Non–Exampling Errors. Some specialised sampling techniques. Tutorial.

19 DOCTOR OF PHILOSOPHY PROGRAMMES

19.1 TITLE OF PROGRAMME

The Department offers the following Doctor of Philosophy programmes:

- PhD in Mathematics
- PhD in Statistics

19.2 ENTRY REQUIREMENTS

- A candidate shall hold a master's degree in Mathematics or Statistics or its equivalent from a recognized institution and shall submit evidence of adequate training and ability to undertake the proposed programme.
- A candidate who does not hold a Master's degree shall first register for a Master's degree by research. If he/she proves himself/herself to be of sufficient calibre by the end of the first year of the programme, he/she may be recommended to register for the PhD degree; this registration shall be deemed retrospective from the date of the original registration for the Master's degree.
- A candidate, who does not satisfy the requirements stated above but is otherwise adjudged suitable, may be admitted.

For the purpose of assessing his/her suitability, such a candidate may be interviewed or required to take an entrance examination, or both as directed by the School of Postgraduate Studies on the recommendation of the Departmental Board.

19.3 PROGRAMME DURATION

Subsequent to duration, the candidate shall pursue a full-time programme of study and research for at least two years, except that:

- A candidate fully engaged in advanced study and research for his/her degree, who, before registration, was engaged in research to the satisfaction of the Department concerned, may be exempted for not more than one academic year.
- In special circumstances, the Department may recommend that a candidate be allowed to spend not more than one academic year of his/her programme in advanced study research at another institution, provided that his/her work can be supervised in a manner

satisfactory to the Department and the School of Postgraduate Studies.

- A Full-Time candidate who is engaged in research for the degree shall present himself/herself for examination not later than three years from the date of his/her registration.
- A Part-Time candidate shall present himself/herself for examination not later than four years from the date of registration.
- In special cases, an extension of these time limits may be granted on the recommendation of the Department.

19.4 AREAS OF RESEARCH

A candidate may be required to audit appropriate courses/modules and also submit a thesis under the Supervision of an academic staff in any of the following areas of research:

- Financial Mathematics.
- Computational Mathematics.
- Statistics.

Other related topics will be accepted but must be approved by the Department.

19.5 EMPLOYMENT OPPORTUNITIES

There are employment opportunities in the following areas:

- Banking;
- Mining and allied industries;
- Education;
- Bureau of Statistics;
- Research Institutes;
- Non-Governmental Organizations.

19.6 AVAILABLE RESOURCES

a) Academic Staff

See the list of Academic Staff.

Table 19.1: List of Academic Staff and Areas of Specialisation

NAME	DEGREE AND WHERE EARNED	AREA OF SPECIALISATION
Prof. Mireku-Gyimah, Daniel	DSc (KNUST), PhD, DIC (London), MSc (Moscow Min. Inst.), CEng, MIMM, MSME, MNYAS, FGhIE	Mine Design and Planning, Operations Research, Mine Economic and Financial Evaluation, Mineral Resource Estimation, Mine Feasibility Study and Environmental Impact Assessment.
*Prof. Bentil, Daniel. E.	PhD. (University of Oxford), England	Applied Maths, Mathematical Biology
Assoc Prof Sulemana Al-Hassan	PhD (Wales), BSc, PgD (KNUST), MIMM	Geostatistics, Statistical Models, Mineral Economics
Assoc Prof Adetunde, Isaac. A	PhD (Ilorin), Nigeria, MSc. (Ilorin), Nigeria, BSc. (Ilorin), Nigeria, NCE (Ibadan), Nigeria	Analytical Dynamics, Fluid Mechanics, Numerical Analysis, Statistics
Assoc Prof Temeng, Victor. A.	PhD (Michigan Tech), MSc (Zambia), PgD, BSc (KNUST)	Operations Research, Materials Handling, Mine Economic Evaluation, Mine Planning.
Mr. Nyarko Peter Kwesi	MSc (KNUST), Kumasi, BSc (UCC), Cape Coast	Differential Equations, Numerical Methods, Optimisation techniques, Computer Applications to Numerical Methods.
Ms. Nyarko Christian C.	MPhil (University of Ghana) Accra, BSc Maths Education	Bio Statistics, Descriptive Statistics and Probability, Numerical Methods, Differential Equations
Mr. Takyi Appiah Sampson	MSc (KNUST), Kumasi, BSc (KNUST), Kumasi	Differential Equations, Optimal control, Optimisation, Numerical Methods.
Mr. Brew Lewis	MPhil(KNUST), Kumasi, B.Ed. (UCC), Cape Coast	
Mr. Aidoo Steve Jelico	MPhil (UMaT), Tarkwa, BSc (KNUST), Kumasi	Differential Equations, Optimal control, Optimisation, Computer Applications to Numerical Methods.
Mr. Danso - Addo Ernest	MPhil (UCC), Tarkwa, BSc (UCC), Cape Coast	Differential Equations, Numerical Methods, Optimisation techniques, Numerical Methods.
Mr. Acquah Joseph	MPhil(UCC), Cape Coast, BSc (UCC), Cape Coast	Pure Mathematics, Differential Equations, Numerical Methods, Optimisation techniques, Numerical Methods.

- Adjunct Staff

APPENDICES

APPENDIX 1

A1 **Date for Graduation**

There shall be two dates for conferment of degrees for Postgraduate Students, the first in February and the second in June.

A2 **Format for Thesis Synopsis**

THESIS SYNOPSIS

NAME: IBRAHIM YUSSIF

DEPARTMENT: GEOMATIC ENGINEERING

FACULTY: MRT

TITLE OF PROGRAMME: MSc (GEOMATIC ENGINEERING)

DURATION: PART-TIME (3-Yrs)/FULL-TIME (4-Yrs)

ESTIMATED DATE OF SUBMISSION OF THESIS: JUNE, 2014

A. THESIS TITLE

The topic for the research should be selected carefully. It should be specific and worded to show the nature of work involved as far as possible.

B. STATEMENT OF THE PROBLEM

Logically, the first step in any research is to provide a clear statement of the problem. This step is indispensable in the writing process in that it governs the organisation and flow of the thesis. The statement of problem should provide a synopsis of the purpose of the study, briefly define and delimit the specific area of the research, identify the unit of analysis in the study, and foreshadow the hypotheses to be tested or the questions to be raised. In stating the problem, it is also necessary to specify why it is important and what new insights may be found. A problem may be stated in terms of a verbal statement, i.e., "The purpose of this research is to examine..." or "This study aims at ascertaining …." Problem could also be stated in the form of a question like: what has changed? Where and when did the change occur? What is the effect of the land-use/cover changes on carbon sequestration? How can ecosystem failures be averted?

C. OBJECTIVE(S) OF RESEARCH

Broad objectives as visualised to be achieved should be clearly outlined and these should be itemised. These objectives will indicate the major aspects of the study to be undertaken.

D. EXPECTED OUTCOME(S)

This must state the results to be anticipated at the end of the research. You must carefully craft it out of your objectives.

E. METHODS TO BE USED

A plan of work describing the various aspects of the study in a logical sequence along with the actual methods to be employed, are the most important aspects of any research plan. Sufficient details to demonstrate that you have a fairly good idea about the nature of work likely to be involved should be provided.

F. FACILITIES TO BE USED FOR RESEARCH

In order to complete the proposed research some specialised facilities may be required. For example in case of experimental sciences different equipments may be involved. Therefore it is important to identify the place where the research work will be undertaken and whether the resources and facilities required for doing the research are available.

G. SIGNATURES

……... ……..……..

Ibrahim Yussif Dr Bernard Kumi-Boateng

(STUDENT) (SUPERVISOR)

Recommended by Head of Department

Name:…….

Signature:……..

Date:……...

A3 **Format for PhD/MPhil Research Proposal**

[Cover Page]

PhD/MPhil Research Proposal

for

the Degree of Doctor of Philosophy/Master of Philosophy

in

(State Programme)

at

the University of Mines and Technology, Tarkwa

Prepared

by

Candidate's Name

[Tarkwa, Year]

Thesis Title

(The research proposal title should demarcate the main

focus/or theme of the proposed study)

A proposal submitted in fulfilment of the requirements for the Degree of PhD/MPhil

in (State Programme)

Candidate's Name

Proposed Supervisor

Proposed Co-supervisor (if applicable)

Name of the Department

Date of Submission

A. BACKGROUND

The background highlights empirical foundations of research and gives an overview of the subject area. The purpose of this background section is to give the reader the relevant facts about the topic and/or research site so that they understand the material or case in the proposal and how

it links to the questions posed. This should take the form of an abstract of the general subject or study area and identify the discipline(s) within which it falls. From this analysis the problem you wish to research will emerge and constitutes the reason or condition which necessitates the research. You should also indicate here the way in which your background gives you competencies in the chosen area.

B. RESEARCH PROBLEM

From the overview of the subject area follows the research problem, i.e. you have to identify the possible cause(s) of the problem. This section states the problem that you are exploring.

C. RESEARCH QUESTION

The research question is specific, concise, and clear. The research question can be expanded upon by stating sub-questions.

Note: The difference between the research problem and research question is that the problem is broader, while the research question represents the "one question that you will answer at the end of your dissertation".

D. RESEARCH OBJECTIVES

Next, you have to describe the research objectives as it relates to solving the uncertainty or burning question you are interested in. It should explicitly state the contribution you want to make with the intended study. You will in a later section elaborate on the scientific contribution made.

E. METHODS AND PROCEDURES TO BE USED

The methods or procedures section is undeniably the heart of your research proposal. This section normally includes four main areas: the type of study being conducted, data collection procedures, the sample selection and data analysis.

F. PROPOSED CONTRIBUTION TO SCIENCE/KNOWLEDGE

A convincing statement is required as to why your topic merits scientific research, i.e. how it will contribute to and enrich the academic knowledge and understanding of theory and professional

practice. This contribution results from the systematic investigation of your research activities, which are conducted to discover new information, as well as to expand and verify existing knowledge. This contribution does not simply imply the gathering of new data and a description thereof, i.e. the What? questions. There are many things we do not know and that we could find out. This is data-gathering. The contribution to be made by doctoral research goes beyond this and requires the So what? questions, i.e. explanations, relationships, generalisations and theories.

G. LITERATURE REVIEW

The literature review helps relate the proposed study to the larger ongoing discourse in the literature about a phenomenon, filling in gaps in the literature and extending earlier studies. The literature review is neither a chronological summary of related works nor a mere catalogue of previous studies published in the field. Literature review is a well-organized critical appreciation of related and relevant literature conceptually integrated within the logic of the proposed investigation. You are to show whether other researchers have studied the same or similar problems before, from what perspectives have these studies been conducted, and whether these researches have been theoretically or empirically adequate. In fact this is where you demonstrate that you are au fait (Having a good or detailed knowledge of) with the debates and issues raised in related literature. References to key texts and recently published articles should be made to convince that you appreciate their integrative relevance to your research area. A PhD is original research and you should be able to demonstrate that your proposed area has not been studied before. As such, you need to identify how your own research might make a useful contribution to the particular scientific-related area.

H. PROPOSED CHAPTER OUTLINE

Research proposals also contain tentative chapter outline. It indicates the number of chapters the thesis or dissertation is expected to be composed of. You are to give the tentative chapter headings with brief annotations of expected chapter content.

I. REFERENCES

A full list of references to key texts and articles must be included.

BASIC TECHNICAL REQUIREMENTS: As a rule of thumb, the proposal should not exceed 5,000 words (about 15-20 typed, one and half-spaced pages). Nevertheless, the proposal must be of adequate length to describe, in fair detail, the nature of the proposed project as outlined above. For other basic technical requirements (reference format, layout for tables and figures etc) students are advised to consult The UMaT format for the Presentation of Thesis and Project Reports (May 2011).

[Last Page]

J. RESEARCH PROTOCOL

You need to include a preliminary time and work schedule outlining the main phases in your research project. This is referred to as the research protocol. Identify the major tasks involved in your proposed study and place and identify the length of time to complete the tasks and the order in which they will be done in line with the table provided. You are free to modify.

	First Academic Year (20_____/20_____)		
Research activities	**Semester I**	**Semester II**	**Remarks**
Proposal Write-up			
Data collection			
Data Analysis			
Proposal Defence			
Seminar Presentation 1			
Seminar Presentation 2			
Catch-up			
Writing:			
Chapter One			
Chapter Two			
Chapter Three			
Chapter Four			
Consultation with Supervisor(s)			
	Second Academic Year (20_____/20_____)		
Research activities	**Semester I**	**Semester II**	**Remarks**
Proposal Write-up			
Data collection			
Data Analysis			
Proposal Defence			
Seminar Presentation 1			
Seminar Presentation 2			
Catch-up			
Writing:			
Chapter One			
Chapter Two			
Chapter Three			
Chapter Four			
Consultation with Supervisor(s)			
	Third Academic Year (20_____/20_____)		
Research activities	**Semester I**	**Semester II**	**Remarks**
Proposal Write-up			
Data collection			
Data Analysis			
Proposal Defence			
Seminar Presentation 1			
Seminar Presentation 2			
Catch-up			
Writing:			
Chapter One			
Chapter Two			
Chapter Three			
Chapter Four			
Consultation with Supervisor(s)			

A4 **Dates for Submission of Thesis Synopsis**

(a) **MPhil/PhD Programmes (by research):** Submission of research proposal shall be made not later than the end of the SECOND SEMESTER of the First Year of the programme.

(b) **Master's Programmes (Part Taught and Part Research):** Submission of Synopsis shall be not later than the end of the SECOND SEMESTER of the First Year of the programme**.**

(c) **Postgraduate Diploma Programme (with Project):** Synopsis shall be submitted not later than the end of the FIRST Semester of the programme.

A5 **Procedure for Complaint and Redress at Postgraduate Level**

(a) Grounds for Complaint

A student has grounds for complaint based on any of the following:

(i) Inadequacy of supervisory arrangement including the non-availability of the Supervisor at crucial times during the course of study and lack of constructive criticism of the work.

Lack of satisfactory progress for reasons outside the control of the student including lack of facilities to adequately tackle work required.

Lack of effective working relationship between a student and his/her Supervisor(s) including serious difference between the student and Supervisor in the approach to the solution of a problem.

(iv) Any other reasonable ground acceptable to the Board of Postgraduate Studies.

(b) Procedure for Complaint

A student who has grounds for complaint must:

(i) Address his/her complaint in writing to his/her Head of Department, (in the first instance)

(ii) The complaint must contain:

- An explicit statement of the grounds of the complaint.
- The stage at which he/she had reached in his/her research at the time of complaint.
- The expected date of completion of his/her research programme.

(c) Handling of Complaints

If a Department fails in the handling of his/her complaint, he/she shall appeal to the Board by addressing his/her complaint in writing to the Dean, School of Postgraduate Studies.

It shall be obligatory for the Dean of Postgraduate Studies to ask for the Head of Department's comments.

The Board shall then consider the complaint and take the appropriate decision on it.

APPENDIX 2

PROGRESS REPORTS

SECTION A: STUDENT'S SELF ASSESSMENT

(a) BACKGROUND

1. Full Names: ..……
   (Surname first and in capitals)
2. Student ID No.: …….
3. Department: ……..
4. Faculty: ……..
5. Programme: …….
6. Status: (a) Full Time ( ) Part-Time ( )
7. (a) Date of Registration: ……...
   (b) Expected Date of Completion: ……...
   (c) Date of Deferment of Studies (where applicable): …….
8. Number of Semesters Completed So Far:
   (a) Masters: …… Semesters
   (b) PhD ……... Semesters
9. Title of Thesis: …….
   ……
   ……
   ……

(b) EVALUATION

10. State status of Study (Tick appropriate boxes in both columns).

		(% Completed)
(i)	Course Work*	( )
(ii)	Synopsis Defence	( )
(iii)	Seminar	( )
(iv)	Literature Review	( )
(v)	Field Work	( )
(vi)	Laboratory Experiments	( )
(vii)	Data Analysis	( )
(viii)	Thesis	( )
(ix)	Others. Please Specify: ……	

……
……

* List Modules Completed:

……
……
……
……
……
……
……
……
……

11. Evaluation of my progress

In the past 12 months, I have made (thick appropriate box)

(a) Satisfactory progress ( )
(b) Unsatisfactory progress ( )

If 11 (a) is your answer, then go to Q 14

12. What are the probable reasons for your perceived unsatisfactory progress so far? (Tick as many boxes as are appropriate)

(a) ( ) I have to combine my programme with full-time employment
(b) ( ) Interaction with my Supervisor is less than satisfactory
(c) ( ) Library and other resources required for my work are not available
(d) ( ) I need more funds
(e) Others. Please specify: ……
……
……

1. How do you think the School of Postgraduate Studies can assist you in alleviating the problems ticked in 12?

……..
……..
……..
……..
……..
……..
……..

14. Student's Signature: …….

Date:…….

SECTION B: SUPERVISOR'S EVALUATION

(To be completed by Student's Supervisor)

1. Student's Name: ……..
2. I have been supervising him/her since: ……..
3. Evaluation of candidate's research abilities (Tick appropriate boxes).

		Excellent	V. Good	Good	Fair	Poor
(i)	Experimental skills					
(ii)	Creative abilities					
(iii)	Independence					
(iv)	Responsiveness to criticism/advice					
(v)	Persistence/Determination					
(vi)	Approach to problem solving					

4. Proportion of work done (Tick appropriate boxes).

		% Completed
(i)	Experimental/Field Work	
(ii)	Literature Review	
(iii)	Analysis of Data	
(iv)	Thesis	

5. Which of the following best summarises the student's performance in the past 12 months?
   (a) Satisfactory progress ( )
   (b) Unsatisfactory progress ( )

If you ticked Q5(a) go to Q8

6. If your evaluation of the student's performance suggests that his/her progress has been unsatisfactory, can you please suggest possible reasons?

		% Completed
(a)	The student is not devoting sufficient time to the programme	( )
(b)	The necessary resources for the student's work are not available	( )
(c)	The research needs important inputs from:	( )
	(i) Other departments/units within the University	
	(ii) Outside the University	( )
(d)	The orientation of the student's work has changed beyond my interest and/or competence	( )
(e)	The student's financial resources appear inadequate to cope with the research	( )
(f)	Others. Please specify: …….....	

…….
…….

7. Please suggest how best the student can be assisted in the above ticked problem(s).
   …….
   …….
   ……..

8. If the student's current work rate continues, how long might it take to complete the research programme?
   (a) Months……
   (b) I don't know ☐

9. Supervisor's Name:……..

Signature: ……

Date:……

SECTION C: DEPARTMENTAL BOARD'S ACTION

(To be completed by the Head of Department)

Having carefully examined the Student's and Supervisor's evaluation of progress in the past year bearing in mind the University of Mines and Technology's regulations for Postgraduate Studies, the Board recommends as follows (Tick one of the three alternatives):

(a) ( ) The student continues with the programme
(b) ( ) The student be withdrawn from the programme
(c) ( ) The student be put on probation
(d) ( ) The student continues with the programme, provided:
(Tick as many boxes as are appropriate).

(i) ( ) The student spends more time on the research and with the Supervisor(s)
(ii) ( ) The student finds sponsorship or additional funds
(iii) ( ) The student changes research topic
(iv) ( ) A new/additional Supervisor is found
(v) ( ) Student finds additional resources for the research
(vi) ( ) Others. Please specify: ……
……
……

Head of Department's Name: ……..

Signature: ……

Date: ……

Note: Please forward the report directly to the Dean's Office of the Faculty.

SECTION D: FACULTY BOARD'S ACTION

Having carefully examined the Student's, Supervisor's evaluation of progress in the past year and the Departmental Board's recommendation, bearing in mind the University of Mines and Technology's regulations for Postgraduate Studies, the Board recommends as follows (Tick one of the three alternatives):

(a) ( ) The student continues with the programme
(b) ( ) The student be withdrawn from the programme
(c) ( ) The student be put on probation
(d) ( ) The student continues with the programme, provided:
(Tick as many boxes as are appropriate).

(i) ( ) The student spends more time on the research and with the Supervisor(s)
(ii) ( ) The student finds sponsorship or additional funds
(iii) ( ) The student changes research topic
(iv) ( ) A new/additional Supervisor is found
(v) ( ) Student finds additional resources for the research
(vi) ( ) Others. Please specify ……
……
……

Name of Dean: ……..

Signature: ……

Date: ……