SOFTCORE UNIVERSITY

School of Electrical and Electronic Engineering

Regulations and Syllabus for the Degree

Of

Bachelor of Technology

in

Electrical and Electronic Engineering

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1 GENERAL INFORMATION

1.1 Vision

To be a top rated University of Technology

1.2 Mission

To provide technological education and training and to contribute towards the advancement of society through research and innovation.

1.3 Philosophy of the University

The Softcore University of Kenya is founded on the belief that economic development of a nation is achievable fundamentally through technological advancement. Such technological progress is feasible through a strong industrial base, which enhances the production of competitive goods and services for both the local and external markets. Industrialization requires a critical mass of personnel with requisite technical skills. In order to produce these personnel, the training and education must be of a practical nature and anchored on solid theoretical foundations. In this regard, The Softcore University of Kenya is a centre of excellence for the training of personnel in technological, creative, business and management skills. The institution plays a leading role in the economic development of Kenya by imparting skills that are appropriate to the real world of work, even as it aims to produce holistic graduates with the flexibility to fit into the demands of a constantly changing world.

1.4 University Admission Requirements

1.4.1 Minimum University Entrance Requirements

An applicant must satisfy any of the following minimum requirements for admission to all Bachelor's degree programmes. Either

(i) Be a holder of Kenya Certificate of Secondary Education (or equivalent examination) certificate with a minimum aggregate of C+; Or

(ii) Be a holder of Kenya Advanced Certificate of Education (or equivalent examination) certificate with a minimum of two principal passes and one subsidiary pass; Or

(iii) Be a holder of a diploma or professional certificate in a relevant discipline from an institution recognized by the Senate of the University; or

(iv) Be a holder of any other qualification accepted by the Senate of the University as equivalent to any of the above. Candidates who hold any of the qualifications (iii) or (iv) above may, at the discretion of the Senate, be exempted from some courses.

1.4.2 Exemption from any Courses in the Programme

(a) The point of entry into the programme for candidates with qualifications other than KSCE, A-Levels, shall be approved by Senate on the recommendations of the Academic Board of the Faculty of Engineering Science and Technology, and shall be based on the qualifications of the applicant.

(b) Where a candidate wishes to be exempted from any course or courses of study, such candidate shall make a written formal application to the Registrar (Academic) justifying the request and attaching evidence of the credentials which support such request. Such a candidate may be required to sit and pass an exemption examination set and administered by the School and approved under the authority of the Senate on the recommendation of the Faculty Academic Board.

(c) Based on the assessment of the exemption examination, the Academic Board of the School of Electrical and Electronic Engineering shall make its recommendation to the Faculty Academic Board. On approval of such recommendation by the Faculty Academic Board, the Board shall forward its recommendation to Senate for further consideration. The decision of the Senate shall be communicated to the Faculty Academic Board who in turn shall communicate the decision to the candidate.

1.5 Procedure of Application for Admission

When the University advertises the program, applicants shall be expected to;

i. Apply to be considered for admission

ii. Attach certified copies of undergraduate degree certificate and transcripts

iii. Ask for letters of reference from at least two referees

iv. Attach a copy of bank-in slip for application fee

1.6 Academic Resources

1.6.1 Facilities and Equipment

Item	**Number**	**Capacity**	**Usage**	
			Specific to Department	**Shared**
Lecture Rooms	4	20	4	Yes
Seminar Room	1	20	1	Yes
Lecturer's Offices	3	6	3	Yes
Laboratories - Machines Lab. -Power Systems Lab - Control Lab -Power Electronics Lab	 1 1 1 1	 20-100 20-100 20-100 20-100	 1 1 1 1	 Yes Yes Yes Yes
Workshops	1	20-100	1	Yes
WiFi Router	4	20-100	1	Yes
Internet Access Points	10	20	10	No
Others- library sitting space	1	500 per seating	-	Yes

1.6.2 Equipment and Teaching Materials (For The Department)

Item	Type	Number	Capacity	Usage	
				Specific to Department	Shared
Computers (PCs)	Dell	10	20	10	Yes,
Lap Tops	HP/ Toshiba	4	20	4	Yes
LCD Projectors	Sony	4	20	4	0
Computer Software	PSAT OCTAVE	20 20	20 20	20 20	Yes Yes

1.6.2 Academic Staff

S/NO	NAME	PROFFESIONAL QUALIFICATION	Designation
1	PROF. STEPHEN MUSYOKI	PhD, M.Eng, B.Eng	Associate Professor
2	PROF. DOMINIC B. O KONDITI	PhD, M.Sc, H.Dip	Full Professor
3	DR. CHRISTOPHER M. MURIITHI	PhD, M.Sc, B.Sc	Senior Lecturer
4	PETER J. MIANO	M.Sc H.Dip	Lecturer
5	JOSEPH M. KARANJA	M.Sc, B.Sc(Elec)	Assistant Lecturer
6	JOSEPH ABOK	M.Sc, B.Sc(Elec)	Assistant Lecturer
7	SAMUEL K. CHEGE	M.Sc,BPhil, H.Dip	Technologist
8	ANTONE MUBINYA	Mtech, B.Tech, H.Dip	Lecturer
9	WINSTONE O. OJENGE	M.Sc, B.Ed.Tech	Lecturer
10	JACOB MUSEMBI	MS.c, B.Ed	Lecturer
11	BENARD MUTAI	M.Sc (Elec)	Lecturer
12	JOHN B. MWANZA	Mphil, B.Ed.Tech	Assistant Lecturer
13	ALFRED ORERO	M.Sc, B.Sc (Elec)	Tutorial Fellow
14	RITA LAIBUTA	M.Sc, B.Sc (Elec)	Tutorial Fellow
15	BILL MAKAYOTO	B.Sc (Elec)	Tutorial Fellow
16	LONAH SEGERA	BSc (Elec)	Graduate Assistant
17	DICKSON G. WAMBAA		Assistant Lecturer

18	GORDON O. AGUTU		Tutorial Fellow
19	STEVEN OMONDI		Tutorial Fellow
20	FLORENCE CHELANGAT	B.Eng (Elec)	Graduate Assistant
21	MARGRET K. GECHANGA	B.Eng (Elec)	Graduate Assistant
22	DANIEL E. WEKESA	B.Eng (Elec)	Graduate Assistant

1.6.3 Programs Offered

a) List of programs

i. Certificate in Electrical Installation Technician I

ii. Certificate in Electrical Installation Technician II

iii. Certificate in Electronics Technician I

iv. Certificate in Electronics Technician II

v. Certificate in Electronics Technician Part III (CET III)

vi. Electrical Installation Electrician III

vii. Electrical Installation Electrician II

viii. Electrical Installation Electrician I

ix. Electrical Installation Technician III

x. Diploma in Technology: Electrical and Electronic Engineering

xi. Bachelor of Technology: Electrical and Electronic Engineering

xii. Bachelor of Philosophy: Electrical and Electronic Engineering

b) Definitions of:

i. Credit hours – the total hours required for the program

ii. Lecture hours – physical hours that each lecture takes

iii. Contact hours – hours that the lecturer and student work together

iv. Course units – titles of study for each program

c) The program shall be organized in semesters and the academic year set as follows:

1st semester – September to December

2nd semester – January to April

3rd semester – May to August shall be dedicated to activities such as research, industrial based learning (IBL) and academic trips.

2 THE CURRICULUM

2.1 Title of the Program

The program of study is Bachelor of Technology in Electrical and Electronic Engineering.

2.2 Philosophy of the Programme

The philosophy of Softcore University of Kenya is founded on the belief that economic development of a nation is achievable fundamentally through technological advancement. As such, the school of Electrical and Electronics Engineering strives to produce personnel with requisite technical skills applicable in all engineering sectors. The training and education is of a practical nature and anchored on solid theoretical foundations. In this regard, the aim of the degree of Bachelor of Technology in Electrical and Electrical Engineering is to produce electrical technologists having strong theoretical foundation, good design and practical experience and exposure to project development and implementation. This course plays a leading role in the economic development of Kenya by imparting skills that are appropriate to industries, internationally and locally, even as it aims to produce holistic graduates with the flexibility to fit into the demands of a constantly changing world.

2.3 Rationale of the Programme

An Electrical Engineering Technologist will be competent to design, implement and control production, testing, planning, construction, commissioning and maintenance in the field of Electrical Engineering by applying technical knowledge, engineering principles, innovative design, problem-solving techniques and managerial skills. He/she will be capable of exercising independent technological judgement and responsible decision making by taking into account the relevant financial, economic, commercial, social, environmental and statutory factors.

On completion of this degree, the student will have met the academic requirements of technical expertise which are in alignment with Vision 2030 core priorities for the 2nd Medium Term Plan. The degree gives the Graduates the ability to find solutions to practical engineering problems by applying proven techniques and procedures. The graduates may also be responsible for technical decision making.This career route offers challenging work in all areas of electrical engineering.

Vision 2030 recognizes the need to alter the structure of the Kenyan economy to take advantage of global opportunities as well as meet the needs of the Kenya's growing population. Science, Technology and Innovation are areas of significant potential that have been identified under Vision 2030, which will play a fundamental role in achieving the targeted benefits of the long term plan.

It is a major achievement for the Softcore University to be one of the only two public universities in the country offering a Bachelor of Technology in Electrical Engineering. This program offers collaboration between education and training institutions, on one hand, and industry, on the other hand, including a comprehensive framework for industrial attachment and apprenticeship system.

2.3.1 Situation Analysis

In line with the Vision 2030 focus on training in the science and technology areasin particular,with the aim of achieving the Sustainable Development Goals (SDGs), the Bachelor of Technology Program is expected to nurture creativity, critical thinking, and produce innovative and adaptive human resources with appropriate skills, attitudes and values for wealth creation, employment and prosperity.

The programme provides an opportunity for the students who have qualified with a Diploma in Technology from Technical and Vocational Training Colleges and National Polytechnics to advance their studies to degree levels. This increases their employability and builds relevant skills for Industrial Development within the country. It also prepares entrepreneurship for self-reliance therefore adding to the economic growth of Kenya.

Additionally, the mandatory Industrial Based Internship program structured within the syllabusensures that the course is hands – on, competency based, market-driven and addresses the needs of the workplace as well as promoting employability, soft, generic and life skills in partnership with private sector and professional bodies. It also improves collaboration between industry, professional bodies and the university in determining competences of the graduates. As such, graduates are easily assimilated into relevant industries immediately after graduation as Professional Technologists.

2.3.2 Justification of the Program

The programme prepares the candidates to function as engineering technologists. The engineering technologist is normally skilled in **the art of production of artefacts, structures, and systems on the basis of designs prepared by the engineer**. The graduates of this programme shall thus in the first instance be equipped with the skills to understand and accurately interpret engineering designs. Since the special strength of the graduate from this programme is to be a ‘hands-on’ person, considerable emphasis is placed on giving the candidate considerable practical knowledge in engineering technology. Besides, considerable time that has been allocated to laboratory work, the candidate also takes 36 weeks of practical attachment, of which 24 are taken on campus while 12 are taken in industry. In total 66.2% of the contact time is dedicated to practical work leaving 33.8% for theoretical study.

Career Prospects include;

- All power generation, transmission, distribution companies
- Any industry in any sector may be textile, steel, cement, fertilizer, petrochemical, shipping, traction, automobile etc.
- Service sector companies like IT companies, banking, telecommunication etc.
- Consulting companies

2.4 Goals of the Program

The Bachelor of Technology in Electrical and Electronic Engineering program aims to offer:

I. Provide the students with a broad education which includes an appreciation & understanding of current issues of Electrical Engineering & their solutions & impact on social & global issues.

II. Develop Communication capabilities in the students necessary to function effectively in the profession & society.

III. Inculcate in the students an understanding of professional & ethical responsibilities and to prepare them for the complex modern work environment.

2.5 Expected Learning Outcomes

The objective in this programme is to offer education and training in electrical and electronic engineering and to equip the candidate with the skills that will allow for eventual practice as an engineer. At the end of the program, the graduates are expected to have:

i. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

ii. An ability to function on multidisciplinary teams while understanding the need for professional and ethical responsibility.

iii. An ability to communicate effectively and recognize of the need to engage in life−long learning habits.

iv. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice and understand the impact of engineering solutions in a global, economic, environmental, and societal context.

2.6 Mode of Study

The mode of study is full time and evening.

2.7 Academic Regulations for the Program

2.7.1 Admission Requirements

a. Common regulations governing the Bachelor of Technology intake in all Faculties of The Softcore University of Kenya, and those in the School of Electrical and Electronic Engineering shall apply;

b. Candidates shall be eligible for admission into the Bachelor of Technology in Electrical and Electronic Engineering degree in the School of Engineering Science and Technology in the following categories:

KCSE Candidates

The basic admission requirement shall be the minimum entry requirements set for entry into the public universities, which is at least an average grade of C+ in the Kenya Certificate of Secondary Education (KCSE).

In addition, candidates are expected to have obtained at least a grade C+ in each of the cluster subjects in following cluster of subjects in KCSE examinations:

Cluster Subjects

1. Mathematics
2. Physics
3. Chemistry
4. Biology/any Group III/any Group IV/any Group V.

KCSE Subject Grouping

Group I: English, Kiswahili, Mathematics

Group II: Biology, Physics, Chemistry

Group III: History and Government, Geography, Christian Religious Education, Islamic Religious Education, Hindu Religious Education

Group IV: Home Science, Art and Design, Agriculture, Aviation Technology, Computer Studies

Group V: French, German, Arabic, Music, Business Studies

A-Levels or Equivalent

Candidates should have a minimum of two (2) principal passes in Mathematics and Physics and a subsidiary level pass in Chemistry with a credit pass in English at O-Level

2.7.2 Exemption from any Courses in the Programme

(i) Diploma in Technology (Dip.Tech.) or Equivalent

Candidates who possess the Diploma in Technology (Electrical and Electronic Engineering Technology) of the Softcore University of Kenya or an equivalent qualification shall be exempted from most of Part I of the course of study (i.e. the first two years of study) of the programme. The candidates shall be allowed to join the course in the third year of study, except that they shall be required to take any courses of study in the first two years of study on the programme that they might had not covered in their earlier course of study to the satisfaction of Senate.The courses to be taken during the pre-semester can be found in Appendix IV. Any other extra courses to be taken to fulfil this requirement may be taken during a preliminary or a regular semester as the Senate may approve.

(ii) Higher Diploma in Technology

Candidates who possess the **Higher Diploma** in Technology (Electrical and Electronic Engineering Technology) of the Softcore University of Kenya or an equivalent qualification shall be exempted from Part I of the course of study (i.e. the first two years of study) of the programme. The candidates shall be allowed to join the course in the third year of study.

(iii) Other Qualifications

(a) The point of entry into the programme for candidates with qualifications other than KSCE, A-Levels, or DipTech shall be approved by Senate on the recommendations of the Academic Board of the Faculty of Engineering Science and Technology, and shall be based on the qualifications of the applicant.

(b) Where a candidate wishes to be exempted from any course or courses of study, such candidate shall make a written formal application to the Registrar (Academic) justifying the request and attaching evidence of the credentials which support such request. Such a candidate may be required to sit and pass an exemption examination set and administered by the School and approved under the authority of the Senate on the recommendation of the Faculty Academic Board.

(c) Based on the assessment of the exemption examination, the Academic Board of the Faculty of Engineering Science and Technology shall make its recommendation to the University Senate.
The decision of the Senate shall be communicated to the Faculty Academic Board who in turn shall communicate the decision to the candidate.

2.7.3 Course Requirements

a) Students class attendance

A candidate shall be required to attend not less than 75% of the total contact hours of each of the prescribed courses. The fulfilment of the requirement shall be a condition for admission to the examinations for the course at the end of the respective semester of study.

b) Obligation of the Lecturer

A lecturer is mandated by the University to give lectures to students as stipulated by the curriculum of study. The lecturer shall provide all course instructional materials in time; and shall also examine, mark and award scores as is common practice in all institutions of learning, based on the curriculum. The lecturer shall ensure that all work destined for a semester is covered in time and that students are ready to take examinations.

2.7.4 Student Assessment Policy/Criteria

1) Course Units

a) Courses shall be evaluated in terms of course units. A course unit shall be defined as comprising of 48 contact hours made up as four (4) hours of lecture/tutorial/practical per week for twelve (12) weeks. All other course units shall be taken as a proportion of one unit of 48 contact hours.

b) The complete assessment of a course unit shall consist of Continuous Assessment Tests (CATs), course/laboratory/field assignments and relevant end of semester written/performance examinations where applicable.

c) Continuous assessment tests shall constitute:

    i. 30% while written end-of semester examinations constitute 70% of the total marks in the lecture-based course units;

    ii. 100% of the marks in the practical oriented course units.

2) Course Work

a) Overall continuous assessment marks shall be attained from grades achieved within the semester's term papers (assignments), written assignments, field assignments, and attendance, or any combination of these relevant to each course.

b) Practical exercises and industrial attachment assignments shall be examined as part of the respective year of study. A candidate shall complete all such exercises satisfactorily before graduating.

c) The respective weights in the final course assessment as made up of *coursework* and the *end of semester examination* shall be as specified in the approved curriculum for the respective courses of study. Details of the distribution of marks in this respect for the various courses in this programme are as given in section 8 of these regulations

d) In the total assessment of the lecture-based coursework, the various components shall be weighted as follows:

Laboratory/Course work	–	15%
Continuous assessment tests	–	10%
General assignments	–	5%

3) End of Semester Examinations

a) All courses taken in a given semester shall be examined by ordinary university examinations at the end of that semester unless otherwise stated.

b) A written examination for one course unit, where it applies, shall extend over a minimum of two (2) hours.

c) The pass mark in each course of study shall be forty percent (40%) of the maximum mark possible in the course.

4) Special Examinations

a) A candidate who fails to take prescribed examinations on medical grounds or other justifiable grounds, may, on the recommendation by the School Board of Examiners and the Faculty Academic Board, be allowed by Senate to take special examinations on a date prescribed by the Faculty Academic Board.

b) Examinations taken under this clause shall be treated in the same way as an ordinary university examination and shall be graded in full.

5) Supplementary Examinations

c) A candidate who obtains an aggregate mark of not less than 40%, and has failed in not more than the equivalent of one-third (1/3) of all the course units for the particular year of study taken shall, on the recommendations of the School Board of Examiners and the Faculty Academic Board and approval by the Senate, be allowed to take supplementary examinations in the failed courses within three months from the date the examination results are declared by the School Board of Examiners.

   (a) A pass obtained in a supplementary examination shall be entered as 40%, which shall then also be the mark entered in the candidate's official academic record.

   (b) There shall be no supplementary in the practical courses.

(c) A candidate who fails in a practical course shall re-take the course when next offered.

6) Re-Take Examinations

(a) A candidate who:

(i) has failed in more than the equivalent of one-third (1/3) but in not more than the equivalent of two-thirds (2/3) of the course units taken and has obtained an aggregate mark of not less than forty percent (40%),

OR

(ii) has an aggregate mark of less than forty percent (40%) and has failed in not more than two-thirds (2/3) of the course units taken,

OR

(iii) has failed a supplementary examination

shall, on the recommendations of the School Board of Examiners and the College Academic Board and approval by the Senate, not be allowed to proceed to the next year of study, or in the case of a final year candidate, not be allowed to graduate, but shall instead be required to *re-take* the failed courses in the next academic year.

(b) A re-take examination shall consist in the candidate taking the full prescribed course of study for the course unit including lectures, coursework, continuous assessment tests, all other assignments, and the examination.

(c) A pass obtained in a re-take examination shall be entered as 40%, which shall then also be the mark entered in the candidate's academic record.

(d) Where a candidate has obtained a pass in a re-take examination, the mark as adopted at 40% shall be used to calculate a new aggregate mark for the candidate; such aggregate mark shall then be the one to be officially adopted.

7) Discontinuation from Course of Study

A candidate who:

(a) has failed to take prescribed examinations without good cause,

OR

(b) has failed in more than two-thirds (2/3) of the course units taken in the respective year of study,

OR

(c) has failed in any course after four attempts,

OR

has exhausted the maximum period allowed for registration on the course or part thereof without passing the prescribed examinations, shall, on the recommendation of the School Board of Examiners and the approval of Senate, be discontinued from the course of study.

2.7.5 Grading System

a) The aggregate mark (X) obtained for any given course shall be graded as follows:

$X \geq 70\%$	-	A
$60\% \leq X < 70\%$	-	B
$50\% \leq X < 60\%$	-	C
$40\% \leq X < 49\%$	-	D
$X < 40\%$	-	FAIL

b) Except as may be hereinafter provided, in order to be allowed to proceed to the next year of study, a candidate shall have passed in each of the core courses taken in the current year of study.

2.7.6 Compensation Marks

(a) In the final year of study, a mark between 38% and 39% inclusive may be considered qualified for the rule of compensation, provided that the candidate has an aggregate mark of at least 50%.

(b) Compensation may be allowed in a maximum of equivalent of two course units only and shall be applied by taking two marks in a passed subject with a mark above 50% to make up for every failed mark, provided that the grade in accordance with 4.5 (c) of the subject from which the marks have been removed shall not be degraded.

(c) After compensation, the candidate's new aggregate mark shall be calculated on the basis of the individual course marks given after compensation and a candidate's degree shall be graded according to the newly calculated aggregate.

2.7.6 Examination Regulations

a) Examination and Research Malpractices

The following academic malpractices are considered serious and any student found guilty of committing any of them shall be liable to discontinuation or expulsion from the University:

i) Copying or reading from another candidate's script or from any other unauthorized source.

ii) Bringing into the Examination Room any unauthorized materials relevant to the examination, e.g. books, notes, electronic devices with pre-set formulae, mobile phones, pre-written answers, etc.

iii) Abetting, aiding or covering up an examination malpractice.

iv) Seeking or obtaining a deferment of examination on false pretence.

v) Plagiarism

vi) Giving false or forged research data and/ or results and purporting them to be true.

vii) Any deviation from the research/project procedures as prescribed in the approved research proposal without consent of the designated supervisors.

viii) Any other misconduct relating to Research and Examinations.

b) Disciplinary Procedures and Penalties

i) Any examination malpractices shall be reported to the administrators where the course is taught. The report should include statements by the student involved, invigilators and examiners.

ii) On receiving the report, the Executive Dean of the faculty shall convene within two weeks after the report, a faculty disciplinary committee to deliberate on the case.

iii) A sub- committee shall be set up to conduct its procedures in accordance with protocols stipulated by the faculty students' disciplinary committee.

iv) The recommendations of the sub-committee shall be reported to the Faculty Board of Examiners and the Senate as soon as possible, but before the Senate deliberates on the relevant examination results.

v) After Senate deliberation, the recommendation shall be forwarded to the Vice Chancellor for consideration.

vi) Discontinued or suspended students may appeal to the Senate through its chairman within a period of thirty days from the day of discontinuation/suspension. An appeal not submitted within the period shall not be considered.

vii) The University may rescind any degree, diploma or certificate awarded to any person who, while registered in a particular program, committed an academic offence which, if it had been detected before graduation, would have resulted in expulsion. Notification of a rescinded degree, diploma or certificate shall be communicated to all relevant parties.

2.7.7 Moderation of Examinations

The lecturers will deliberate on the following to moderate the examinations;

i) Coverage of course content in the relevant semester

ii) Adherence to Blooms taxonomy- Knowledge, Comprehension, Application, Analysis and Evaluation.

iii) Validity of the questions: Do they measure? What are they supposed to measure? How broad is the domain to be tested? How complete is the coverage?

iv) Utility - The purpose of the assessment and what to be assessed. - The duration of the examination - The group to be assessed

v) Credibility - Are the scores to be reported in relation to those of other examinations on fixed standard? - Are the results believable?

vi) Fairness - This involves provisions made for students with limited proficiency e.g. language.

vii) Reliability - consistency between test items, between earlier and later measures, between skills and qualities

Formatting question items:

i) Objective questions – multiple choices, matching, etc.

ii) Subjective questions – short answer, fill-in

iii) Item analysis – difficulty verses easy, discrimination

iv) Alternative assessment –attachment

v) Portfolio assessment –Research Projects.

Internal examiner:

i. Is the unit lecturer, who shall award CAT marks and examination marks following the laid down criteria.

ii. Shall hand in marks for moderation by the department.

iii. The internal examiner may be asked by the department to review the marks upwards or downwards depending on the circumstances that warrant such a review.

External examiner:

i. Shall receive all the departmental scripts, and their marking schemes

ii. Shall go through the scripts to ascertain the validity of the scores

iii. May review the marks upwards or downwards if necessary

iv. Write a report about the examination to the department to assist in examination marking and moderation in future

v. Reviewed marks by the external examiner shall be taken as final marks in a particular course unit.

2.7.8 Graduation Requirements

A candidate shall be awarded a Bachelor of Technology degree in Electrical and Electronic Engineering of the School/Faculty, if:

i) He/she has been registered for the Bachelor of Technology in Electrical and Electronic Engineering as a student in The Softcore University of Kenya for a period of at least 2 academic years (6 semesters).

ii) He/she has performed such other work and complied with such other conditions as may be stipulated, or after satisfying the requirements for the award of the Bachelor of Technology in Electrical and Electronic Engineering, in the School/Faculty concerned after being admitted as a student.

iii) Senate may extend the period of study only on special circumstances as Senate may from time to time determine.

2.7.9 Award, Designation and Classification of the Degree

a) Designation of the Bachelor degree to be awarded under these regulations shall be the Bachelor of Technology in Electrical and Electronics Engineering and shall be abbreviated as BTech. Electrical and Electronics Engineering.

b) The Final Aggregate Mark

The final award for the degree shall be based on assessment of the performance of the candidate in the last 2 years of study. The total aggregate mark shall be calculated by adding up all the marks scored by the candidate in the individual courses in the last 2 years of study as weighted in accordance with the respective subject units. The final mark shall be represented as a percentage of the total mark and shall be adopted as rounded to the nearest integer.

c) Classification of the Bachelor of Technology Degree

A candidate who qualifies for the award of the Bachelor of Technology in Electrical and Electronics Engineering Degree shall be placed in one of the classes to be described as

i. First Class Honours,

ii. Second Class Honours (Upper Division),

iii. Second Class (Lower Division) and Pass.

The classification of the final award shall be based on aggregate score obtained as follows

i.	First Class Honours	- 70% to 100%
ii.	Second Class Honours (Upper Division)	- 60% to 69%
iii.	Second Class (Lower Division)	- 50% to 59%
iv.	Pass	- 40% to 49%

Provided that no candidate who has at any stage in the programme failed in an ordinary university examination shall qualify for the award of the First Class Honours Degree.

2.7.10 Description of project

(a) Description of project

During the 4th year of study, every student shall undertake a final year project. The student is expected to complete the design, assembly and testing of the project and submit the design phase report and give an oral presentation and a demonstration on the functioning of the project to a panel of examiners. The number of students undertaking a particular project shall be limited to a maximum of two students. The project seminar presentation is expected to cover any or all of the following topics: Electronics, Communication, Electronic instrumentation, power systems.

(b) Rationale of the project in the programme

(i) appreciate the applications of the theory learnt in class in addressing real world problems
(ii) develop the ability to identify and dene real world engineering problems
(iii) develop the ability to design an engineering system, component or process that meets a desired need
(iv) develop the ability to design, implement and test the product, using appropriate tools and techniques
(v) develop the ability to analyse, demonstrate and orally present experimental results/research findings

(c) Facets of the project

(i) develop an electrical/electronic engineering project, manage and execute it
(ii) use relevant tools and demonstrate practical skills in implementing the project objectives
(iii) test and commission the designed product
(iv) produce a project report
(v) present the project work to the departmental examination board

(d) Regulations of the project

(i) Project proposal and examination. Examinable components include proposal write up and oral presentation

(ii) Project implementation in consultation with the supervisor

(iii) Project final examination. The examinable components include dissertation write up, oral presentation and project demonstration

2.8 Course evaluation

The course shall be evaluated through the following mechanism:

a) Student surveys which shall be conducted every semester

b) External examiners report

c) Periodic departmental workshops to evaluate the courses offered after every four years.

2.9 Management and Administration of the Program

i. The program is housed in the Department of Electrical and Power Engineering under the School of Electrical and Electronics Engineering in the Faculty of Engineering Sciences and Technology.

ii. The Chairman of the Department and staff shall take charge of administering of the program.

iii. Quality assurance mechanisms will be put in place through, coverage of course content, preparation of course outlines, coursework, end of semester examinations, external examination benchmarking and lecturer appraisal.

2.10 Courses/Units offered for the Program

The programme is covered in 4,488 hours and 80 course units. Considering then that a nominal hour for a practical semester is counted as only half a contact hour, the total contact hours on the programme comes to 3,840 of which 1,268 are dedicated to lectures while 2,572 shall be taken up by practical and tutorial work. Thus on the programme, 33.0% of the contact time shall be allocated to lectures while 67.0% shall be taken up by practical and tutorial work.

Students will be admitted into the four options, namely *power systems engineering*, *telecommunication systems engineering*, *instrumentation and control engineering*, e*lectronic and computer engineering. The option taken shall be determined at entry into the programme* Select a particular subject area of specialisation and then take all the respective cluster.

The units of study in the first, second, and third years of study are all common to all options, while in the fourth year of study, a student takes ten common units with six units being option dependent. The common courses constitute four units of project. The option dependent units are grouped into the four subject areas, namely, *power systems engineering*, *telecommunication systems engineering*, *instrumentation and control engineering*, and *electronic and computer engineering*. Each of these subject areas has six units, with three units to be taken in the second semester while the other three are to be taken in the third semester.

In addition, the student is required to cover two non-credit units on 'Health and Emerging Diseases' and 'Drug and Substance Abuse' each of which is to be covered in 24 hours. These non-credit courses shall have to be taken and passed in Part I of the course of study. The two courses shall be assessed on the basis of 'pass' and 'fail' and a student shall not be allowed to proceed to the second part of the course without having obtained a 'pass' in each of the courses. The marks obtained in each of the courses shall however not be used in determining the final grade of the student in any of the examinations.

The distribution of the contact hours by subject areas is as indicated.

Subject Area	Nominal Hours	Contact Hours	Units	% Nominal Hrs / Units	% Contact Hrs / Units
Engineering Science and Technology	1632	1632	34	36.4%	42.5%
Engineering Projects	1536	1104	23	34.2%	28.8%
Mathematics	288	288	6	6.4%	7.5%
Basic Sciences	432	432	9	9.6%	11.3%
Industrial Attachment	432	216	4.5	9.6%	5.6%
Social Sciences	96	96	2	2.1%	2.5%

Professional Engineering Studies	72	72	1.5	1.6%	1.9%
Total	**4488**	**3840**	**80**	**100%**	**100%**

The various courses of study on the programme shall be assessed on the basis of coursework and written examination. For the entire programme coursework shall account for 54.5% while written examinations shall be responsible for 45.5% of the total marks a student may earn.

2.9.1 Summary of the Programme of Study

Year I **Semester I**

EEEI 101	Mathematics IA	48	1
EEEI 111	Physics A	60	1.25
EEEI 113	Chemistry A	48	1
EEEI 115	Biological Science	48	1
EEEI 117	Introduction to Computing	60	1.25
EEEI 121	Introduction to Engineering Technology	36	0.75
EEEI 123	Engineering Graphics A	60	1.25
EEEI 181	Communication Skills	24	0.5
		384	**8**

Semester II

EEEI 102	Mathematics IB	48	1
EEEI 112	Physics B	60	1.25
EEEI 114	Chemistry B	48	1
EEEI 116	Earth and Environmental Science	48	1
EEEI 118	Computer Programming	60	1.25
EEEI 122	Introduction to Electrical Engineering	36	0.75
EEEI 124	Engineering Graphics B	60	1.25
UCCC1102	Critical and Creative Thinking	24	0.5
		384	**8**

		768	**16**

Year II **Semester I**

EEEI 290	Workshop Practice	432	4.5
		432	**4.5**

Semester II

EEEI 201	Mathematics IIA	48	1
EEEI 221	Fluid Mechanics	48	1
EEEI 223	Solid and Structural Mechanics	48	1
EEEI 225	Thermodynamics	48	1
EEEI 231	Electric Circuit Theory IA	60	1.25

		EEEI 233	Analogue Electronics A	60	1.25
		EEEI 291	Electrical Engineering Laboratory IA	96	2
				408	**8.5**
	Semester III	EEEI 202	Mathematics IIB	48	1
		EEEI 222	Energy Resources	48	1
		EEEI 224	Mechanics of Machines	48	1
		EEEI 226	Material Science	48	1
		EEEI 232	Electrical Circuits and Networks	60	1.25
		EEEI 234	Analogue Electronics B	60	1.25
		EEEI 292	Electrical Engineering Laboratory IB	96	2
				408	**8.5**
				1248	**21.5**
Year III	**Semester I**	EEEI 390	Project Design and Fabrication	432	4.5
				432	**4.5**
	Semester II	EEEI 301	Probability and Statistics	48	1
		EEEI 331	Digital Electronics	60	1.25
		EEEI 333	Analogue and Digital Control Systems	60	1.25
		EEEI 335	Computer Aided Design	60	1.25
		EEEI 337	Instrumentation and Measurement	48	1
		EEEI 339	Electromagnetic Fields and Waves	48	1
		EEEI 391	Electrical Engineering Laboratory IIA	96	2
				420	**8.75**
	Semester III	EEEI 302	Numerical Methods	48	1
		EEEI 332	Electrical Installation Technology	48	1
		EEEI 334	Signals and Systems	48	1
		EEEI 336	Digital Circuit Design	60	1.25
		EEEI 342	DC Machines and Transformers	60	1.25
		EEEI 372	Microprocessor Architecture and Interfacing	60	1.25
		EEEI 392	Electrical Engineering Laboratory IIB	96	2
				420	**8.75**
				1272	**22**
Year IV	**Semester I**	EEEI 490	Industrial Attachment	432	4.5
				432	**4.5**

Semester II **Core**

EEEI 471	Microprocessor Systems and Applications	48	1
EEEI 473	Computer Hardware and Maintenance	48	1
EEEI 491	Electrical Engineering Laboratory IIIA	48	1
EEEI 493	Technical Project A	96	2
		240	**5**

Electives

Power Systems Engineering

EEEI 441	Power Systems Engineering A	48	1
EEEI 443	Control Systems Engineering	48	1
EEEI 445	AC and Special Machines	48	1
		144	**3**

Telecommunication Systems Engineering

EEEI 451	Data Communication Networks	48	1
EEEI 453	Microwave Engineering	48	1
EEEI 455	Digital Signal Processing	48	1
		144	**3**

Instrumentation and Control Engineering

EEEI 461	Optical Instrumentation	48	1
EEEI 463	Control Systems Engineering	48	1
EEEI 465	Computer Vision	48	1
		144	**3**

Electronic and computer engineering

EEEI 471	Data Communication Networks	48	1
EEEI 475	Computer Networks	48	1
EEEI 473	Computer Vision	48	1
		144	**3**

Semester III **Core**

EEEI 431	Systems Reliability and Maintainability	48	1
EEEI 482	Management and Entrepreneurship	48	1
EEEI 492	Electrical Engineering Laboratory IIIB	48	1
EEEI 494	Technical Project A	96	2
		240	**5**

Electives

Power Systems Engineering

EEEI 442	Power Electronics	48	1

EEEI 444	Electrical Machine Drives	48	1
EEEI 446	Power Systems Engineering B	48	1
		144	**3**

Telecommunication Systems Engineering

EEEI 452	Telecommunications and the Internet	48	1
EEEI 454	Digital Broadcasting	48	1
EEEI 456	Multimedia Information Networking	48	1
		144	**3**

Instrumentation and Control Engineering

EEEI 462	Microprocessors and Digital Design	48	1
EEEI 464	Robotics and Automation	48	1
EEEI 466	Digital Control Engineering	48	1
		144	**3**

Electronic and computer engineering

EEEI 472	Microprocessors and Digital Design	48	1
EEEI 474	Database Management System	48	1
EEEI 476	Multimedia Information Networking	48	1
		144	**3**

		1200	**20.5**

		4488	**80**

In addition to the above courses, the student shall be required to take the following as non-credit courses. The candidate shall be required to have passed in the courses in order to be admitted into Part II of the programme of study. Students are encouraged to take the modules in the first year of study. The courses shall be appropriately certificated.

Code	Course Title	Hours	Unit
UCC001	Health and Emerging Diseases	24	0.5
UCC 002	Drug and Substance Abuse	24	0.5
		48	**1**

3 Description of Courses

3.1 Year I

3.1.1 Semester I

EEEI 101 Mathematics IA **48 hrs, 1.0 units**

(General mathematical concepts) ***48 hrs, 1 unit***

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. learn laws of algebra
2. understand mathematical manipulation involving power series and complex numbers
3. gain knowledge about complex numbers and their application to trigonometry

Learning Outcomes

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

1. use linear laws to interpret experimental data
2. solve mathematical problems involving finite and infinite power series
3. perform mathematical operations involving complex numbers and application to trigonometric identities

Course Description

Numbers and simple functions; the real number system functions. Complex numbers, inequalities, exponents; trigonometric functions, graphing of elementary trigonometric formula; sine and cosine rules. Analytical geometry; lines and elementary conic sections;graphs and graph sketching. Differential calculus:the derivative; derivatives of sums, products, quotients, chain rule, implicit differentiation, higher derivatives, rates of change. Applications of differential calculus: trigonometric functions; their derivatives, stationary points, minima and maxima problems. Increasing and decreasing functions:small increments; tangents. Applications of differentiation to curve sketching; inflexion points. Polar co-ordinates. Definite integral calculus: integration as inverse of differentiation; integral as limit of sum standard forms. Application of integration to areas and volumes.

Teaching Methodology

3 hour lectures and 1 hour tutorial per week

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Text Books

1. Ron Larson, (2017), Algebra and Trigonometry, Cengage Learning.
2. Michael Sullivan, (2015) Algebra and Trigonometry, Pearson.

Course journals

1. Journal of Algebra and Its Applications (JAA)
2. International Journal of Algebra

References Text Books

1. Margaret L. Lial, John Hornsby, David I. Schneider, Callie Daniels (2016), *College Algebra and Trigonometry,* Pearson.
2. Harold R Jacobs, (2016), Elementary Algebra, Master Books.
3. Wallace C. Boyden (2014), *A First Book in Algebra,* CreateSpace Independent Publishing Platform**.**

References journals

1. The Journal of Algebraic Geometry.
2. Journal of Algebraic Combinations
3. Journal of Algebra, Elsevier

EEEI 111 Physics A **60 hrs, 1.25 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. understand the physical concepts in basic mechanics and thermal physics
2. gain foundation of engineering applications
3. know the basic principles of optics and quantum concepts
4. understand the basic principles of operation of optical devices

Learning Outcomes

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

1. solve simple problems of kinetics, kinematics and dynamics of particles and rigid bodies
2. derive and apply the various scientific formulae for gravitation, elasticity, momentum, circular motion and energy
3. explain expansion of matter and mechanisms of heat transfer
4. describe the principles of optics as applied to mirrors, lenses and propagation

COURSE DESCRIPTION

Introduction to physics: the definition and scope of physics - measurements, units, vectors and coordinate systems. Mechanics: speed, velocity, and acceleration; motion in one and two dimensions; Newton's laws of motion; work and kinetic energy; potential energy and conservation of energy; linear momentum and conservation of momentum; rotation of a rigid body; rolling motion and angular momentum; static equilibrium of a rigid body; oscillatory motion; gravity – Newtonian; solids and elasticity; fluid mechanics. Mechanical waves: wave motion; sound waves – acoustics, production and propagation of sound; superposition and standing waves. Thermodynamics: thermal properties of matter; heat and thermal energy; the first law of thermodynamics; the kinetic theory of gases; heat engines and the second law of thermodynamics.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Physics laboratories
2. Computer laboratory

Course Text Books

1. Young H. D. & Freedman R.A (2015), University Physics with Modern Physics, Pearson.
2. Ohanian H. C. & Markert J (2007), *Physics for Engineers*, W. W. Norton & Co Ltd

Course journals

1. Journal of Physics A: Mathematical and General
2. Journal of Physics B: Atomic, Molecular and Optical Physics

References Text Books

1. Hugh D. Young , Philip W. Adam, Raymond Joseph Chastain, (2015), *College Physics*, Pearson.
2. Knight R. D. (2016), *Physics for Scientists and Engineers, A strategic approach*, Addison Wesley

References journals

1. Journal of Physics: Condensed Matter
2. Journal of Physics D: Applied Physics
3. Journal of Physics G: Nuclear and Particle Physics

EEEI 113 Chemistry A **48 hrs, 1 unit**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. appreciate the basic underlying processes and concepts of inorganic chemistry
2. Have in-depth understanding of the under-lying principles and concepts of physical chemistry

Learning Outcomes

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

1. state the fundamental properties of matter, number of protons, neutrons, and electrons
2. describe the periodic table arrangement of elements and the elements' chemistry characteristics for groups along periods and down periodic table
3. describe the characteristics of and significance of some salts and elements

Course Description

Inorganic chemistry: Solubility, precipitation, ion-exchange nitrification and denitrification, oxidation - reduction reactions, adsorption, characteristics and significance of some salts and elements (ammonia, nitrates, phosphates, sulphates, silicates, chlorine, oxygen, ions, carbon, etc). Physical chemistry: ions in solution, ionization energy, chemical energetics and bonding, chemical equilibrium kinetics.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Chemistry laboratories
2. LCD projector

Course Text Books

1. Lawrence S. Brown, Tom Holme, (2014), *Chemistry for Engineering, Cengage Learning.*
2. Andrew Parsons, Gareth Price, (2017), Chemistry3*: Introducing Inorganic, Organic and Physical Chemistry,* Oxford University Press.

Course Journals

1. International Journal of Chemical and Biomolecular Engineering, World Academy of Science, Engineering and Technology
2. International Journal of Electrochemical Science, Electrochemical Science Group

References Books

1. Zumdahl S. S. & Zumdahl S. A. (2014), *Chemistry*, Houghton Mifflin Company
2. Epstein L. M. & Krieger P. (2015), *Schaum's Outline of College Chemistry*, McGraw Hill 10^{th} Ed.
3. Pignataro B. (2010), *Ideas in Chemistry and Molecular Sciences: Advances in Synthetic Chemistry*, Wiley.
4. Haynes William M., (2016), *CRC Handbook of Chemistry and Physics*, CRC Press.

Reference Journals

1. Journal of **Analytical Chemistry Insights**, Libertas Academica
2. **Open Analytical Chemistry Journal**, Bentham open
3. **Journal of Automated Methods and Management in Chemistry**, Hindawi Publishing Corporation

EEEI 115 Biological Science **48 hrs, 1 unit**

Prerequisite

None

Purpose

Biological science is taught with the following broad goals in mind:

1. to provide students with a broad perspective of the field of biology;
2. to introduce them to the major kinds of organisms;
3. to introduce them to how these organisms work and interact;
4. to establish a background for further study in advanced biology courses.

Objective

1. To get students to realize that science operates in the real world as defined by the laws of chemistry and physics;
2. To promote the understanding that science relies on external observations, and not internal convictions, for validation, thus separating science from non-science;
3. To promote the understanding that scientific knowledge is based on the outcome of the testing of hypotheses and theories that are under constant scrutiny and subject to revision based on new observations, and not just a collection of facts;
4. to promote an appreciation for the scientific attitude - a basic curiosity about nature and how it works;
5. to promote an appreciation of humans as a part of the world's ecosystems and the relevance of science to contemporary concerns;
6. to provide a working knowledge of the processes of evolution that explain why many organisms share specific similarities and also display great diverstiy of organization, structure, function, and behavior.

Course Description

Diversity of life: ecology, animal effectonthe environment, and conservation. Cell biology and physiology, genetics and microbiology, protein structure and metabolism, Invertebrate form and function.Applications of molecular genetics in biology. Introduction to biochemistry. Proteomics, genomics and bioinformatics. The concept of evolution. Plant life. Entomology. Insect physiology. Hormonal and Neuronal Signaling. Pharmacology and toxicology. Marine ecology and biodiversity.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector
3. Computer laboratory

Course Textbooks

1. Johnson, A.R. (2010), Biology for engineers, CRC press.
2. Scott Freeman, Kim Quillin, Lizabeth Allison, Michael Black, Emily Taylor, Greg Podgorski, Jeff Carmichael, (2016), Biological Science, Pearson.
3. G. Tyler Miller, Scott Spoolman, (2014) Living in the Environment, Brooks Cole.

Course Journals

International Journal of Biological Sciences

Research Journal of Biological Sciences (2015 Volume 10).

Reference Textbooks

1. Elaine N. Marieb, (2014) Essentials of Human Anatomy and Physiology, Pearson.
2. Campbell, Neil, Jane Reese, Martha Taylor, Eric Simon, and Jean Dickey. Biology: Concepts and Connections:

Reference Journals

Journal of Biological Sciences

PLOS Biology

EEEI 117 Introduction to Computing 60 hrs, 1.25 units

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. be equipped with the learner with the necessary computer system skills to operate a computer and lay the foundation of computing
2. understand the general overview and the fundamental components of a computer system
3. understand computer system operations and security.

Learning Outcomes

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

1. explain general overview of computer systems
2. explain interrelationship between system components
3. understand operating systems and to use them to operate, troubleshoot and system security

Course Description

Introduction to Computers:computers as power tools for an information age, computer system, types of computer systems, history of computer processing, social and ethical implication of computerization, computer types and classifications. Computer based information system. The four phases: input, processing, output, and storage. Hardware: input, storage, processing and output hardware. Operating systems:types of operating systems, functions of operating systems, modes of operating systems. DOS: DOS operating system, starting DOS, DOS files, directories, paths and trees. Windows:essential operations in windows, customizing and optimizing windows using the control panel, desk-top applications. Application packages:word processing, spread sheets, data-bases, presentations, desktop publishing. Artificial intelligence:knowledge of systems, software andapplications. Information systems:introduction, distributed computing and networking capabilities, data-base management. Programming languages:low level, high level, 4GLs, structured, visual, and project. Application software and system software, development software, data communications, system development life cycle, data management systems, management information systems, word processing and desk-top publishing systems, database management, spread sheet and typical graphics software, basic programming for the user. Computers and society:human and environmental issues,computers in Kenya.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software

2. LCD projector
3. Computer laboratory

Course Textbooks

1. Norton P. (2002) *Introduction to computers*, Career Education, 5th Ed.
2. Capron H. L., & Johnson J.A. (2004) *Computers: Tools for Information Age*, Prentice Hall, 8th Ed.

Course Journals

International Journal of Computing

Journals of computational science, Elsevier

Reference Textbooks

1. Glenn Brookshear, Dennis Brylow, (2014) *Computer Science: An Overview,* Pearson.
2. Manaullah Abid, Mohammad Amjad, (2015) *Fundamentals of Computers,* I K International Publishing House.

Reference Journals

SIAM Journal on Computing

IEEE Communications Magazine

EEEI 121 Introduction to Engineering Technology 36 hrs, 0.75 units

Prerequisites

- Communication skills
- Physics
- Chemistry
- Biology

Purpose

The aim of this unit is to enable the learner to:

i. understand the impact of engineering solutions in a global, economic, environmental, and societal content
ii. recognize the need for, and an ability to engage in life-long learning.

Learning outcomes

At the end of this unit learner should be able to:

i. communicate effectively.
ii. identify and formulate engineering problems

iii. understand of professional and ethical responsibility
iv. use the techniques, skills, and modern engineering tools necessary for electrical engineering practice.

Course description

Definition of and scope engineering: the profession of engineering, fields of engineering, functions of engineering, the distinction between engineering and technology, levels of personnel in the engineering team - the scientist, the engineer, the technologist, the technician, the craftsman. The engineer as a professional: responsibilities and obligations of the professional engineer, professional recognition, professional organizations, professional ethics. The engineering approach to problem solving, Tools of engineering: calculations and analysis, computers and computer techniques, experimentation and testing, communication. The economic and social dimensions in engineering: economics as a constraint in engineering project design and implementation, the engineer in society, the impact of engineering activities on the environment. Industrial visits, public lectures by practicing engineers and case studies,

Teaching Methodology

- Overhead projector
- Lecture room
- Four Lab per semester

Modes of course assessment

Coursework for the unit shall be by continuous assessment and shall be defined as comprising assignments and continuous assessment tests and University examination to contribute 40% and 60% respectively for the total marks.

Instructional materials/Equipment

- Overhead projector
- Lecture room

Course Textbooks

Robert J. Pond and Jeffrey L. Rankinen. (2009), Introduction to Engineering Technology, Pearson/Prentice Hall, 7th ed

Course Journal

Journal of Applied Science & Engineering Technology.

The Journal of Engineering Technology

Reference Textbooks

1. W.C. Oakes, et al. (2006), Engineering your future: a comprehensive introduction to engineering, Great Lakes Press.

2. V.D. Hawks and A.B. Strong.(2000), Introduction to engineering technology and engineering, Prentice Hall.

Reference Journals

International Journal of Engineering and Technology (IJET)

Journal of Engineering and Technology Management, ScienceDirect

EEEI 123 Engineering Graphics A **60 hrs, 1.25 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. understand basic aspects of engineering drawing practice
2. gain skills of engineering drawing and sketching
3. understand basic electrical and piping drawings

Learning Outcomes

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

1. select and use appropriate drawing instruments for a particular drawing task and construct loci of points in mechanisms commonly encountered in mechanical engineering
2. make orthographic drawings given pictorial drawings, interpret orthographic drawings and make isometric and oblique drawings/sketches for a given orthographic drawing
3. make free-hand sketches

Course Description

Introduction to engineering graphics: definition and application of technical graphics. Engineering graphics aids and equipment:pencil and ink work, graphic paper sizes standardized, paper layout and management, types of line used and conventional representation. Conventional printing techniques: line-work and neatness,construction of triangles and quadrilaterals, construction of polygons, enlargement and reduction of figures and areas, construction of circles and tangents, construction of ellipses, parabolas and hyperbolas, construction of loci,construction of cycloids, involutes and Archimedian spirals, sections and true shapes of sections. Introduction to Computer Aided Design (CAD).

Teaching Methodology

2 hour lectures and 4 hours of practical work per week.

Mode of course assessment: Continuous assessment and written University examinations shall each contribute 50% of the total marks.

Instructional Materials/Equipment

1. Drawing office
2. Drawing instruments
3. Computer laboratory

Course Text Books

1. Morling K. (2012), *Geometric and Engineering Drawing*, Butterworth-Heinmann, 2nd Ed.
2. Eide A. R., Jenism R. D & Mashaw L. H, (2010), *Engineering graphics fundamentals*, Mc Graw_Hill Inc., 2nd Ed.

Course Journals

1. Journal of Engineering Design, **Taylor & Francis**
2. Journal of Engineering, Design and Technology

Reference Books

1. Giesecke F. E., Hill I. L. Norak J. E. & Mitchell A. (2016), *Technical Drawing with Engineering Graphics*, Peachpit Press.
2. Thomas E. F, Jay D.H., Byron U. & Carl L. S., (1997), Mechanical Drawing CAD Communications, Mc Graw-Hill, 11th Ed.
3. David A. Madsen, David P. Madsen (2016), *Engineering Drawing and Design*, Delmar Cengage Learning.

Reference Journals

1. **Research on Distinguishing Character Based on AutoCAD Engineering Drawing**; Computer Technology and Development.
2. Journal of Computer Aided Materials Design
3. Journal of Mechanical Design

EEEI 181 Communication Skills **24 hrs, 0.5 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. gain oral and written communication effectiveness
2. understand information dissemination and information gathering
3. be equipped with information gathering and analysis techniques

Learning Outcomes

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

1. write using appropriate style a technical report, essays, and summaries
2. prepare visual communication aids
3. be able to source and prepare questionnaires

Course Description

The communication process: approaches to the study of communication, information retrieval and library use, listening skills and lecture comprehension strategies, writing skills, direction words, paragraphs and punctuations, methods of taking notes, writing in examinations, writing of assignments, resumes, and reports. Oral representation and public address: information dissemination techniques, communication technology, visual literacy.

Teaching Methodology

3 hour lectures and 1 hour tutorial per week

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Flip charts
2. LCD projector

Course textbooks

1. Davies J. W (2011) *Communication Skills; A Guide for Engineering and Applied Science Students*, Prentice Hall

2. Hybels, (2014) *Communicating Effectively*, HSSL.

Course journals

1. Knut Aspegren (1999) *BEME Guide No. 2: Teaching and learning communication skills in medicine-a review with quality grading of articles*, Medical Teacher
2. European Journal of Cancer (1999), *Effective communication skills are the key to good cancer care*, Elsevier Inc
3. Flavell, John H. (1968), *The Development of Role-Taking and Communication Skills in Children*, John Wiley and Sons

Reference textbooks

1. Brumif C.J & Johnson K. (1980) *Communicative Approach to Language Teaching*, Oxford University Press
2. Leech G. Svartrik J. (2003), Communicative Grammar of English, Longman Publishers

Reference journals

1. Pamela A. Rowland-Morin (2010) *Verbal Communication Skills and Patient Satisfaction,* sage publications
2. Ross, John A., *The Influence of Computer Communication Skills on Participation in a Computer Conferencing Course,*
3. Lucie Morin, Gary Latham (2000), *The Effect of Mental Practice and Goal Setting as a Transfer of Training Intervention on Supervisors' Self-efficacy and Communication Skills: An Exploratory Study*, John Wiley & Sons

UCC001 Health and Emerging Diseases **24 hrs, 0.5 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. Understand health and emerging diseases
2. have an overview of various emerging diseases
3. Have an overview of human anatomy and physiology.

Learning Outcomes

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

1. To get students to understand public health and hygiene
2. To promote the understanding of Sexuality and reproductive health

3. To promote the understanding of the biology of HIV/AIDS - overview of immune system, natural immunity to HIV/AIDS, the AIDS virus and its life cycle,

Course Description

General introduction: an overview of health, emerging environmental health diseases, public health and hygiene, an overview of human anatomy and physiology. Sexuality and reproductive health: a general overview of, urinary tract infections (STI), sexually transmitted diseases (STD). Human Immunodeficiency Virus/Acquired Immune-deficiency Syndrome (HIV/AIDS): the biology of HIV/AIDS - overview of immune system, natural immunity to HIV/AIDS, the AIDS virus and its life cycle, disease progression (epidemiology), transmission and diagnosis; treatment and management - nutrition, prevention and control, anti-retroviral drugs and vaccines, patient management, pregnancy and AIDS; social and cultural practices; Voluntary Counselling and Testing (VCT) services; policies on AIDS; the impact of AIDS on the social set-up and the economy; history and comparative information on trends of AIDS. An overview of various emerging diseases: a general coverage including Ebola virus, H5N1 influenza (bird flu), and H1N1 (swine flu).

Teaching Methodology

3 hour lectures and 1 hour tutorial per week

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Flip charts
2. LCD projector

Course textbooks

Kathy S. Stolley; John E. (2009), **HIV/AIDS**, GlassGreenwood

Course Journals

Journal of Travel Medicine

3.1.2 Semester II

EEEI 102 Mathematics IB **48 hrs, 1.0 units**

Prerequisites

EEEI101 Mathematics 1A

Purpose

The aim of this course is to enable the student to;

1. learn laws of algebra
2. understand mathematical manipulation involving power series and complex numbers
3. gain knowledge about complex numbers and their application to trigonometry

Learning Outcomes

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

1. use linear laws to interpret experimental data
2. solve mathematical problems involving finite and infinite power series
3. perform mathematical operations involving complex numbers and application to trigonometric identities

Course Description

Algebra: sets, unions, intersection, complements. Algebraic structures: rational indices, multiplication, addition and partial fractions. Series: arithmetic, geometric, logarithmic, infinite, summation of infinite series. Matrices: matrix algebra, determinants, rank of a matrix, transpose, inverse of an nxn matrix, eigenvalues and eigenvectors, solution of linear equations, Cramer's rule, elementary row operations; Gaussian elimination method; lower-upper decomposition. Solution of homogeneous equations. Complex numbers: Argand diagrams, arithmetic operations and their geometric representation. Modulus and argument. De Moivre's theorem and its applications to trigonometric identities and roots of complex numbers.

Teaching Methodology

3 hour lectures and 1 hour tutorial per week

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Text Books

1. Ron Larson, (2017), Algebra and Trigonometry, Cengage Learning.
2. Michael Sullivan, (2015) Algebra and Trigonometry, Pearson.

Course journals

1. Journal of Algebra and Its Applications (JAA)
2. International Journal of Algebra

References Text Books

1. Margaret L. Lial, John Hornsby, David I. Schneider, Callie Daniels (2016), *College Algebra and Trigonometry,* Pearson.
2. Harold R Jacobs, (2016), Elementary Algebra, Master Books.
1. Wallace C. Boyden (2014), *A First Book in Algebra,* CreateSpace Independent Publishing Platform**.**

References journals

1. The Journal of Algebraic Geometry.
2. Journal of Algebraic Combinations

Journal of Algebra, Elsevier

EEEI112 Physics B **60 hrs, 1.25 units**

Prerequisites

Physics A

Purpose

The aim of this course is to enable the student to;

1. understand the physical concepts in basic mechanics and thermal physics
2. gain foundation of engineering applications
3. know the basic principles of optics and quantum concepts
4. understand the basic principles of operation of optical devices

Learning Outcomes

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

1. solve simple problems of kinetics, kinematics and dynamics of particles and rigid bodies
2. derive and apply the various scientific formulae for gravitation, elasticity, momentum, circular motion and energy
3. explain expansion of matter and mechanisms of heat transfer
4. describe the principles of optics as applied to mirrors, lenses and propagation

Course Description

Electricity and magnetism: electric fields; Gauss's law; electric potential; capacitance and dielectrics; current and resistance; direct electric circuits; magnetic fields; electromagnetic induction and inductance; electromagnetic waves; alternating current; L-C-R AC networks; electronics. Light and optics: the nature of light; the electromagnetic spectrum; the propagation of light; geometric optics; physical optics. Modern physics: relativity – special and general theories of relativity; quantum mechanics; nuclear physics; high energy physics.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Physics laboratories
2. Computer laboratory

Course Text Books

1. Young H. D. & Freedman R.A (2015), *University Physics with Modern Physics*, Pearson.
2. Ohanian H. C. & Markert J (2007), *Physics for Engineers*, W. W. Norton & Co Ltd

Course journals

1. Journal of Physics A: Mathematical and General
2. Journal of Physics B: Atomic, Molecular and Optical Physics

References Text Books

1. Hugh D. Young , Philip W. Adam, Raymond Joseph Chastain, (2015), *College Physics*, Pearson.
2. Knight R. D. (2016), *Physics for Scientists and Engineers, A strategic approach*, Addison Wesley

References journals

1. Journal of Physics: Condensed Matter
2. Journal of Physics D: Applied Physics
3. Journal of Physics G: Nuclear and Particle Physics

EEEI 114 Chemistry B 48 hrs, 1 unit

Prerequisites

Chemistry A

Purpose

The aim of this course is to enable the student to;

1. appreciate the basic underlying processes and concepts of inorganic chemistry
2. Have in-depth understanding of the under-lying principles and concepts of physical chemistry

Learning Outcomes

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

1. state the fundamental properties of matter, number of protons, neutrons, and electrons
2. describe the periodic table arrangement of elements and the elements' chemistry characteristics for groups along periods and down periodic table
3. describe the characteristics of and significance of some salts and elements

Course Description

Organic chemistry: significance of saturated and unsaturated hydrocarbons, phenols, alcohols, ketones, aldehydes, organic nitrogen compounds, organic halogen compounds structures and characteristics of carbohydrates, proteins and liquids. Applied chemistry: introduction to polymer sciences, hard and soft water (causes and treatment), electro-chemistry, the nitrogen cycle, fuels, fertilizers, soaps and non-soapy detergents, aerobic and anaerobic digestion.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Chemistry laboratories

2. LCD projector

Course Text Books

1. Lawrence S. Brown, Tom Holme, (2014), *Chemistry for Engineering, Cengage Learning.*
2. Andrew Parsons, Gareth Price, (2017), Chemistry3*: Introducing Inorganic, Organic and Physical Chemistry,* Oxford University Press.

Course Journals

1. International Journal of Chemical and Biomolecular Engineering, World Academy of Science, Engineering and Technology
2. Interhl Journal of Electrochemical Science, Electrochemical Science Group

References Books

1. Zumdahl S. S. & Zumdahl S. A. (2014), *Chemistry*, Houghton Mifflin Company
2. Epstein L. M. & Krieger P. (2015), *Schaum's Outline of College Chemistry*, McGraw Hill 10th Ed.
3. Pignataro B. (2010), *Ideas in Chemistry and Molecular Sciences: Advances in Synthetic Chemistry*, Wiley.
4. Haynes William M., (2016), *CRC Handbook of Chemistry and Physics*, CRC Press.

Reference Journals

1. Journal of Analytical Chemistry Insights, Libertas Academica
2. Open Analytical Chemistry Journal, Bentham open

Journal of Automated Methods and Management in Chemistry, Hindawi Publishing Corporation

EEEI 116 Earth and Environmental Science **48 hrs,   1 unit**

Aims

The aim of the Earth and Environmental Science Syllabus is to provide learning experiences through which students will:

1. acquire knowledge and understanding about fundamental concepts related to planet Earth and its environments, the historical development of these concepts and their application to personal, social, economic, technological and environmental situations
2. progress from the consideration of specific data and knowledge to the understanding of models and concepts and the explanation of generalised Earth and Environmental Science terms; from the collection and organisation of information to problem-solving; and from the use of simple communication skills to those which are more sophisticated

3. develop positive attitudes towards the study of planet Earth and its environments, and towards the opinions held by others, recognising the importance of evidence and critically evaluating differing scientific opinions related to various aspects of Earth and Environmental Science.

Learning Outcomes

1. evaluates how major advances in scientific understanding or technology have changed the direction or nature of scientific thinking
2. analyses the ways in which models, theories and laws in Earth and Environmental Science have been tested and validated

3. assesses the impact of particular advances in Earth and Environmental Science on the development of technologies

4. assesses the impact of applications of Earth and Environmental Science on society and the environment

Course Description

Introduction to geology:litho logical constituents of rocks, the geological time-scale; the concept of facies, elements of structural geology. Soil genesis and formation: factors of soil formation, parent material, relief, climate, vegetation, fauna, time and man, and physical properties of soil. Introduction and scope of environment: conservation of natural resources i.e. forest resource, water resource, mineral resource, energy resource, land resource etc, role of individual for resource conservation and sustainable development. Ecosystem and its basic concept:structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids. Biodiversity and its conservation: introduction –definition, genetic, species and ecosystem diversity, national and global scenario. Environmental pollution:definition, causes, effects and control measures. Sustainable development:urban problems related to energy, water conservation, rain water harvesting, watershed management, wasteland reclamation, environmental ethics,climate change, global warming, acid rain, ozone layer depletion, and nuclear accidents.

Teaching Methodology

- Overhead projector
- Lecture room

Modes of course assessment

Coursework for the unit shall be by continuous assessment and shall be defined as comprising assignments and continuous assessment tests and University examination to contribute 30% and 70% respectively for the total marks.

Instructional materials/Equipment

- Overhead projector
- Lecture room

Recommended Books:

1. *Botkin, D.B & Keller, (2014) Environmental Science: Earth as a Living Planet, John Wiley & Sons.*
2. *McKinney, M.L., Schoch, R.M. & Yonavjak, L. (2013) Environmental Science: systems and solutions, Jones & Bartlett Publishers.*
3. *Wright, R.T. & Nebel, B.J. (2016) Environmental Science: Toward a Sustainable Future, Pearson Educational.*
4. *Miller, G., (2005) Environmental Science: working with the Earth, Thomson Learnin*

EEEI 118 Computer Programming **60 hrs, 1.25 units**

Prerequisites

EEEI 117 Introduction to Computing

Purpose

The aim of this course is to enable the student to;

1. understand the basic concepts of programming
2. be equipped with knowledge of writing programs
3. be introduced to the C language

Learning Outcomes

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

1. understand the concepts and principles of good programming practices and techniques.
2. understand algorithmic problem solving processes and basic structure of a program,
3. use basic fundamental data types and control structures and how to break a large problem into smaller parts..

Course Description

Introduction to office applications: word processing, spreadsheets, simple database, advanced Internet-based applications (file transfer, HTML and java programming etc.) Introduction to programming: developing simple computer programs in a high-level programming language. Types and declarations: types – Boolean, character, integer, floating point, void, enumerated, conditional statements and loops. Declarations: structure, multiple names, scopes, initialization, function declaration, argument passing, value return. Classes: objects, private, public and protected variables. Pointers, arrays, constants, reference, pointer to void, new operator, delEEEI operator.Computer applications in engineering: CAD/CAM systems, control systems, robotics, virtual reality, information systems in engineering.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Computer Lab
2. LCD projector

Course Textbooks

1. Jayasri J. (2002), *The C Language Trainer With Graphics and C++*, New Age International (p) Ltd.

Course Journals

International Journal of Computing

Journals of computational science, Elsevier

Reference Textbooks

1. Douglas B., (1995), *From Pascal to C: Introduction to the C Programming Language*, Wadsworth Pub. & Co.
2. Balagurusamy E. (1992), *Programming in ANSI C*, Tata McGraw-Hill
3. Kerninghan B. W., & Dennis M. R., (1988), *The C Programming Language*, Englewood Cliffs, N.J, Prentice Hall, 2nd Ed.

Reference Journals

SIAM Journal on Computing

EEEI 122 Introduction to Electrical Engineering **36 hrs, 0.75 units**

Prerequisites

- Introduction to engineering
- Physics
- Biology
- Communication skills

Purpose

The aim of this unit is to enable the learner to:

i. Relate pioneers of the field to the present engineering
ii. acknowledge contemporary issues within and outside the electrical engineering profession.
iii. be conversant with the various professional bodies concerned with electrical
iv. use the techniques, skills, and modern engineering tools necessary for electrical engineering practice.

Learning outcomes

At the end of this unit learner should be able to:

i. Define voltage, current, and resistance.
v. Identify nodes and branches in a circuit.
vi. Distinct the various types of energy sources, transmission and distribution methods

Course description

History of electricity. Electricity and development. Scope of electrical and electronic engineering, fields of specialization,international variation in specialization, emerging areas in electrical and electronic engineering. Tools of electrical engineering. Economics and social elements in electrical and electronic engineering. Professional societies and registration. The future of the profession.

T**eaching Methodology**

Lecture: 3, Tutorial: 1, Lab: 2 hour Lab sessions organised on rotational basis per group (Hours/week)

Modes of course assessment

Coursework for the unit shall be by continuous assessment and shall be defined as comprising assignments and continuous assessment tests and University examination to contribute 40% and 60% respectively for the total marks.

Instructional materials/Equipment

- Physics Lab
- Overhead projector
- Lecture room

Course Textbooks

- Rizzoni, G. 2009.fundamentals of electrical engineering, 1st ed. McGraw-Hill,
- The experimental and historical foundations of electricity, André Koch Torres Assis Published by C. Roy Keys Inc., First Published 2010.
- David V. Kerns Jr. & J. David Irwin, Essentials of Electrical and Computer Engineering, Prentice Hall, 2004.

Reference Textbooks

- A.S. Sedra and K.,C. Smith Microelectronic Circuits, 4th Edition, 1996, Oxford University Press.
- K.C. Smith, KC's Problems and Solutions for Microelectronic Circuits, 1996, Oxford University Press.
- Bird, J .2010. Electrical Circuit Theory and Technology Fourth edition, Published by Elsevier
- Vodovozov, V. 2010. Introduction to electronic engineering, Ventus publishing APS

EEEI 124 Engineering Graphics B **60 hrs, 1.25 units**

Prerequisites

Engineering Graphics A

Purpose

The aim of this course is to enable the student to;

1. understand basic aspects of engineering drawing practice
2. gain skills of engineering drawing and sketching
3. understand basic electrical and piping drawings

Learning Outcomes

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

1. select and use appropriate drawing instruments for a particular drawing task and construct loci of points in mechanisms commonly encountered in mechanical engineering
2. make orthographic drawings given pictorial drawings, interpret orthographic drawings and make isometric and oblique drawings/sketches for a given orthographic drawing
3. make free-hand sketches

Lines in space and true lengths of lines, auxiliary views and projections,construction of helices, fasteners and locking devices, types of screw thread form including right hand and left hand threads, single start and multi-start threads, standard conventional representation according to ISO specifications,construction of cam profiles,construction of involute gear tEEEIh profiles, interpenetration and surface development. Construction,scales,pictorial graphics: isometric, oblique, exploded and perspective projections. Orthographic projection: first and third angles, BS 308 conventional representation, Assembly graphics from working machine drawings,free-hand sketching, importance of proportionality and neatness,further work on Computer Aided Design graphics.

Teaching Methodology

2 hour lectures and 4 hours of practical work per week.

Mode of course assessment: Continuous assessment and written University examinations shall each contribute 50% of the total marks.

Instructional Materials/Equipment

1. Drawing office
2. Drawing instruments
3. Computer laboratory

Course Text Books

1. Morling K. (1974), *Geometric and Engineering Drawing*, Butterworth-Heinmann, 2nd Ed.
2. Eide A. R., Jenism R. D & Mashaw L. H, (1965), *Engineering graphics fundamentals*, Mc Graw_Hill inc, 2nd Ed.

Course Journals

Journal of Engineering Design, Taylor & Francis
Journal of Engineering, Design and Technology

Reference Books

1. David A. Madsen, David P. Madsen, (2016) Engineering Drawing and Design, Delmar Cengage Learning.
2. Giesecke F. E., Hill I. L. Norak J. E. & Mitchell A. (2016), *Technical Drawing*, Peachpit Press.
3. Thomas E. F, Jay D.H., Byron U. & Carl L. S., (2002), Mechanical Drawing CAD Communications, Mc Graw-Hill, 11th Ed.
4. Cecil H. Jensen**,** Jay D. Helsel**,** Dennis Short (2007), *Engineering Drawing And Design*, Mc Graw-Hill

Reference Journals

1. Research on Distinguishing Character Based on AutoCAD Engineering Drawing; Computer Technology and Development.
2. Journal of Computer Aided Materials Design
3. Journal of Mechanical Design

UCCC1102 Critical and Creative Thinking 24 hrs, 0.5 units

Purpose of the Course

This course shall equip students with a variety of specific creative and critical thinking skills necessary for them to have in our rapidly changing, technologically oriented world. These skills learn from this course shall promote intellectual growth and foster academic achievement gains.

Expected Learning Outcomes

At the end of the course students should be able to:

i. Experience a climate of openness, mutual respect, and support for undertaking critical and creative though
ii. Develop the foundational knowledge, values, and skills/abilities needed for thinking critically.
iii. Develop the foundational knowledge, values and skills/abilities needed for creative thinking.
iv. Integrate critical and creative dispositions and abilities to meet learning needs and real life challenges.
v. Adapt Instructional approaches learnt to promote thinking skill development which include redirection, probing, and reinforcement.
vi. Develop values, knowledge, and abilities related to: Metacognition; Foundations of critical thinking; Foundations of creative development; integrated critical and creative abilities.

Course Content

Definition, nature and scope of critical and creative thinking: fundamentals of criticality and creativity – Tools, abilities, attitudes, characteristics and process; reasoning skills and argument analysis; fallacies; skillful decision making, creative problem solving models, brainstorming and block busting techniques; language and thinking; criticality and creativity in education; application of advanced critical and creative thinking skills in life and learning; models of critical and creative thinking.

Mode of Delivery

The course work may be taught through Lectures, guided classroom discussions, projectors, student group presentations and relevant videos.

Text Books

1. Halpern, D. F. (2006). The nature and nurture of critical thinking. In R. Sternberg, R.
2. Roediger, & D. F. Halpern (2004). Critical Thinking in Psychology Cambridge, MA: Cambridge University Press.

3. Kuhn, D. (1999). A developmental model of critical thinking. Educational Researcher, 28, 16-25+46
4. Marin, L. M., & Halpern, D. F. (2011). Pedagogy for developing critical thinking in adolescents: Explicit instruction produces greatest gains. Thinking Skills and Creativity, 6, 1-13.

UCC 002Drug and Substance Abuse **24 hrs, 0.5 units**

This course provides an overview of the epidemiology of drug abuse, the physiological and socio-economic effects of the supply and the use of drugs. The course also discusses issues related the toxicology of substance dependence. The course also exposes the risk factors related to the use and abuse of substances. It also highlights available avenues for treatment, leading to detoxification for the users. The course also does explain some of the policy issues in place to help combat the vice. The course also focuses on the importance of policy and law enforcement agents in curbing substance dependence.

3.2 Year II

3.2.1 Semester I

EEEI 290 Internal Attachment (Workshop Practice) **432 hrs, 4.5 units**

Course learning Objectives

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

- Identify and correctly use different manual workshop tools
- Operate the basic machine tools (lathe, milling machine, drill, welder, tool grinder, etc)
- Explain and implement different types of house wiring
- Explain and implement different sub-assemblies of an automobile

Course Description

An exposure to operation in workshops in the various fields of engineering including electrical and electronic engineering, mechanical engineering, civil engineering, geospatial engineering, automotive engineering, and aeronautical engineering. This course shall be graded by coursework.

Part I

Engineering Design and safety: safety organization and planning, safety inspections, prevention of accidents. Bench work and marking out: use of marking-off table and instruments e.g. scribers, height gauge etc. Basic operation of machine tools; centre lathe, milling machine, drilling machines, shaping and slotting machines, grinding machines etc. Metal joining: riveting, welding, soldering etc.

Part II

Electrical symbols, circuit diagrams layout, documentation. Electrical wiring, tinning and plating. Use of stock and dies, threading and joining of galvanized mild steel pipes, cutting and joining techniques, pipe bending, spring, machine bending etc. Exposure to operations in civil engineering works and engineering surveying.

Mode of Delivery

This will be conducted through short briefing sessions and instruction followed by three or four sessions of hands-on practice

Mode of assessment

Each student is assessed on each element on the basis of the following

Practical Exercises (objects made, weld joints, identification of tools etc)-70%

Written workshop report-30%

Total-100%

3.2.2 Semester II

EEEI 201 Mathematics IIA **48 hrs, 1.0 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. learn basic geometry
2. understand general presentation of equations of various geometries in various coordinate systems
3. be introduced to applications of trigonometry

Learning Outcomes

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

1. solve and manipulate various trigonometric equations and identities
2. relate Cartesian coordinates to polar coordinates for general equations representing circles, ellipses, parabolas and hyperbolas
3. solve various engineering problems using trigonometry as a tool

Course Description

The straight line: equation, parallel, and perpendicular lines; directed and undirected distances. Circle: general equation, equation of a tangent to a circle. Ellipse; parabola and hyperbola: equations in standard form and with change of origin, chord, tangent and normal including parametric form. Vectors: In two and three dimensions; addition, subtraction, multiplication by scalars, resolution, scalar and vector products; velocity and acceleration vectors.Trigonometry: trigonometric and hyperbolic functions, Applications of plane trigonometry, geometry of straight line in two and three dimensions. Applications to mechanics: resultant force, momentum.

Teaching Methodology

3 hour lectures and 1 hour tutorial per week

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Text Books

1. M. A. Alwash (2017), *Ordinary differential equations*,CreateSpace Independent Publishing Platform.
2. Richard K Miller, Anthony N. Michel (2014), *Ordinary Differential Equations*, Academic Press.

Course Journals

1. SIAM Journal on Applied Mathematics
2. Communications in Applied Geometry

Reference Textbooks

1. Underwood R. S. (1983), *Analytic Geometry*, New York, 3rd Ed
2. Hodge W. V. D. & Pedoe D. (1994), *Methods of Algebraic Geometry, Bi-rational geometry,* Cambridge University Press
3. Marsh, Duncan (2005), *Applied Geometry for Computer Graphics and CAD,* Springer

EEEI 221 Fluid Mechanics **48 hrs, 1.0 units**

Prerequisites: Physics B

Course objectives

1. Introduces fluid mechanics and establishes its relevance to Electrical engineering
2. Develops the fundamental principles underlying the subject
3. Demonstrates how these are used for the design of simple hydraulic systems

Course Description

Introduction to fluid mechanics: properties of fluids, dimensions and units. Hydrostatic pressure gauges and manomEEEIrs. Forces and centres of pressure on plane and non-plane surfaces. Floating bodies, metacentre. Free surface correction and suspended loads. Bernouilli's theorem for incompressible flow with proof. Application of Bemoulli' s theorem and momentum equations. Flow measurements: methods of measurement of velocity and discharge, pitot tubes, orifices, nozzles, venturi mEEEIrs and notches. Representation of energy changes in a flowing fluid system. Time to empty tanks, laminar and turbulent flow in pipes, Reynolds number, D'arcy formula for pipe friction, simple boundary layer theory. Piped networks: Hardy-Cross procedure; water hammer.

Mode of Delivery

The course is delivered through lectures and tutorials

Mode of Assessment

Course work (assignments and tests) and final examinations and their relative contributions to the final grade are shown as follows:

RequirementPercentage contribution

Course work	40%
Final Examination	60%
Total	100%

Course Text Books

1. Frank White, (2015), *Fluid Mechanics*,McGraw-Hill Education.
2. Pijush K. Kundu, Ira M. Cohen, David R Dowling (2015), *Fluid Mechanics*, Academic Press.
3. Yunus Cengel, John Cimbala (2017) *Fluid Mechanics: Fundamentals and Applications,* McGraw-Hill Education.

Course Journals

1. Journal of Fluid Mechanics
2. International Journal of Fluid Mechanics

Reference Textbooks

1. Russell C. Hibbeler*, (2014), Fluid Mechanics,* Pearson.
2. David A. Chin, (2016), *Fluid Mechanics for Engineers,* Pearson.
3. William S. Janna, (2015), *Introduction to Fluid Mechanics*, CRC Press.
4. Robert W. Fox, et al. (2015), Fluid Mechanics, 9th Edition

EEEI 223 Solid and Structural Mechanics 60 hrs, 1.25 units

Prerequisites: Physics B

Purpose

This course introduces students to the study of the behaviour of structural and machine members under the action of external loads. It covers basic concepts of stress and strain, tensile and torsion stresses and strain.

Course learning Objectives/ Outcomes

1. At the end of the course, the student should be able to:
2. Explain basic theory of stress and strain
3. Solve for direct and sheer stresses components
4. Analyse simple beam stresses
5. Derive stress-strain constants from test diagrams

Course Description

Overview of continuum theory. Qualitative overview of material idealization, elastic, plastic, viscoelastic, viscoplastic and elastoviscoplastic behavior. Material homogeneity, uniformity and isotropy. Tensor notation. Mechanics of materials loading, static and dynamics forces. Analysis of stress. Analysis of strain. Constitutive relations. Stress and strain in tension, compression and shear. Behaviour of materials under static loading, stress-strain diagrams, linear elasticity, tension, instability, elastic constants. Strain energy in tension, compression and shear. Analysis of design in simple tension and compression, non-uniform and thermal stress and strains. Thin-walled pressure vessels, volumetric strain, pressure effects. Elastic torsion analysis, design of shafts, strain energy in torsion. Bending of beams: reaction by supports, shear forces and bending moments. Simple Bending Theory: loading plane, moment plane and neutral axis, constant strength beams. Combined loading applied to design, eccentric loading, combined bending and torsion. Deflection of beams due to pure bending, statically determine beams, moment-area method, strain energy in bending, constant strength beam theory. Built-in and continuous beam analysis. Plane frame analysis.

Mode of Delivery

This course will be taught by using lectures, tutorials and assignments and practical material testing laboratory sessions

Mode of Assessment

This shall be by practicals, assignments, tests and examination. The relative contribution to the final grade will be as shown below

Requirement	Percentage contribution
Tests/Assignments/Practicals	40%
Final Examination	60%
Total	100%

Resources

1. Laboratory with material testing machines
2. Literature

Course Textbooks

1. Parviz Ghavami, (2014), *Mechanics of Materials: An Introduction to Engineering Technology*,Springer.
2. C. Hartsuijker, J.W. Welleman (2016), *Engineering Mechanics: Volume 2: Stresses, Strains, Displacements*, Springer.

Reference Textbooks

1. Carl Ross, John Bird, Andrew Little (2016), *Mechanics of Solids,* Routledge.
2. Jacob Lubliner, Panayiotis Papadopoulos (2016), *Introduction to Solid Mechanics: An Integrated Approach*, Springer.

EEEI 225 Thermodynamics **48 hrs, 1.0 units**

Prerequisites:

Physics B

Purpose

The aim of this course is to enable the student to:

1. understand the principles of energy conservation and eciency of conversion of heat into work
2. appreciate the principles of energy conservations and understand eciency of conversion of heat into work
3. understand the properties of working uids commonly used in thermodynamic processes.

Learning Outcomes

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

1. select appropriate energy sources
2. apply the rst and second laws of thermodynamics to typical closed and open processes and complete cycles
3. analyze thermodynamic properties of vapors and ideal gases.

Course Description

Fundamentals of thermodynamics, properties of working fluid (steam).Thermodynamic processes and cycles: perfect gas, steady flow processes, non-flow processes, ideal gas cycles, air compressors, internal combustion engines, heat transfer and heat exchangers, fluid properties, density, compressibility, viscosity, fluid statics, hydrostatic pressure, forces and centers of pressure on place and curved surfaces, floating bodies, buoyancy, stability meta-centre, Bernoulli’s and modified Bernoulli’s equation and conservation of energy and momentum, application to pitt tubes, orifices, nozzles, notches, impact and deflection of jets.

Teaching Methodology:

2 hour lecture and 1 hour tutorial per week, and at least three

3-hour laboratory sessions per semester organized on a rotational basis

Instruction materials/equipment

1. Mechanical Engineering Laboratories
2. Projector

Prescribed text books

1. Michael J. Moran , Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey, (2014), Fundamentals of Engineering Thermodynamics, Wiley.
2. William D. Ennis M.E. (2015), Applied Thermodynamics for Engineers, CreateSpace Independent Publishing Platform.

References

1. Michael J. M. & Howard N. S. (2014), Fundamentals of Engineering Thermodynamics, Wiley.
2. Juan H. Vera, Grazyna Wilczek-Vera (2016), Classical Thermodynamics of Fluid Systems: Principles and Applications, CRC Press.

Journals

International Ed. International Journal of Fluid and Thermal Engineering Literature.

EEEI 231 Electric Circuit Theory IA **48 hrs, 1.0 units**

Prerequisites

Mathematics 1A

Purpose

The aim of this course is to enable the student to;

1. know how to analyze the sine waves
2. obtain the skill of analyzing three-phase circuits
3. use various network theorems to analyze complex circuits

Learning Outcomes

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

1. calculate the mean, and r.m.s. values of a sine wave
2. Calculate the circuit parameters of a single and three phase circuits such as equivalent impedances.
3. Reduce complex circuits into simple ones using the various network theorems.

Course Description

Kirchhoff's laws, magnetic circuits, stored energy, magnetic attraction, hysteresis and eddy current, self and mutual conductance, forces between conductors. Electrostatics: permittivity, capacity, electric stress, stored energy. Circuit theory: simple dc transient in LR and RC networks, alternating current, resistance, capacitance and inductance, resonance, Q-factor, balanced three phase circuits; simple ac network problems including parallel circuits.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Electronics Lab
2. LCD projector

Course Textbooks

1. John Bird, (2017), *Electrical Circuit Theory and Technology*,Routledge.
2. Ozgur Ergul (2017), *Introduction to Electrical Circuit Analysis,* Wiley.

Course Journals

Reference Textbooks

1. G. I. Atabekov (2014), *Linear network theory*, Pergamon Press.
2. S.K. Sahdev (2015), *Basic Electrical Engineering*, Pearson.

Reference journals

1. IEEE Transactions on Circuits and Systems
2. Open Electrical and Electronics Engineering Journal
3. International Journal of Circuit Theory and Applications

EEEI 233 Analogue Electronics A 48 hrs, 1.0 units

Prerequisites

EEEI 111 Physics A

Purpose

The aim of this course is to enable the student to;

1. understand the concept of conduction in gases, liquids and solids
2. understand construction, operation and application of BJTs, FETs and basic rectifiers

Learning Outcomes

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

1. design and construct a simple single stage amplifiers
2. design AC rectifiers

Course Description

Characteristics of pn junction: PN-junction diodes, Zener diodes,rectification. Transistor characteristics and biasing. Bipolar junction transistor amplifiers (Common Base; Common Emitter; Common Collector) field effect transistors: biasing and equivalent Circuits, FET amplifiers (Common Gate, Common Source, Common Drain) - two-port representation of a transistor; H ParameterParameters and their determination. Analysis of transistor amplifiers using h-parameterparameters; field effect transistor amplifier resistor-capacitor coupled amplifier and its frequency responses; feedback in amplifiers effects of negative feedback; positive feedback and oscillations- Hartley and Collpitt's oscillators. Large signal amplifiers: analysis of class A, B, AB and C amplifiers (Push-pull and complementary symmetry circuits), power gain and efficiency, estimation of distortion. Thermal variation and device parameterparameters. Design of power amplifiers. Noise in amplifiers: noise sources, types, signal/noise ratio, common electronic circuits. Pulse amplifiers: charge control model, rise time, fall time compensation techniques, cascaded states, radio frequency amplifier models and use of admittance, miller effect, Analysis of broad amplifiers for various circuits configuration design of R.F. tuned and pulse amplifier.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Textbooks

1. Partha K. Ganguly (2015), Principles of electronics, PHI Learning.
2. Jimmie J. Cathey (2002), *Schaum's Outline of Theory and Problems of Electronic Devices and Circuits*, McGraw-Hill, 2nd Ed.

Course Journals

Reference Textbooks

1. Robert L. Boylestad & Louis Nashelsky (2015), *Electronic devices and circuit theory*, Prentice-Hall, 3rd Ed.
2. B L Theraja (2007), *Basic Electronics: Solid State*, S. Chand & Company, 4th Ed.

Reference journals

1. Journal of Electronic Science and Technology
2. Active and Passive Electronics Components
3. Electronics and Communications in Japan (Part II: Electronics)

EEEI 235 Electrical Engineering Laboratory IA **96 hrs, 2.0 units**

Laboratory exercises in electrical circuit theory, digital electronics, and fluidmechanics, solid and structural mechanics.

3.2.3 Semester III

EEEI 202 Mathematics IIB **48 hrs, 1.0 units**

Prerequisites

Mathematics II A

Purpose

The aim of this course is to enable the student to;

1. understand differential calculus
2. learn partial differentiation including first and second partial derivatives and total derivatives
3. appreciate improper and double integrals

Learning Outcomes

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

1. understand the concepts of differential calculus including their application to engineering problems
2. understand the concepts of partial differentiation

Course Description

Introduction to transform methods: Fourier series; periodic functions, odd and even functions. Fourier integral and Fourier transform, Laplace transforms; properties, convolution properties, inverse transforms. First order differential equations: solution of linear differential equations, separation of variables. Second order linear equations: Solution of second and higher order differential equations. Application of Laplace transform to solution of differential equations. Partial differential equations: linear first-order homogeneous partial differential equations, second order partial differential equations, separation of variables, heat and wave equations. Applications of differential equations to engineering problems.

Teaching Methodology

3 hour lectures and 1 hour tutorial per week.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

3. Presentation software
4. LCD projector

Course Textbooks

1. John Bird. (2014) *Engineering Mathematics*, Routledge.
2. Philip Brown (2016), *Foundations of Mathematics: Algebra, Geometry, Trigonometry and Calculus, Mercury* Learning & Information.
1. Jeffrey A. (2004) *Mathematics for Engineers and Scientists*, Chapman & Hall, 4th Ed.

Course Journals

Reference Textbooks

1. Spiegel, M. R. (2009) *Schaum's Outline of Advanced Mathematics for Engineers and Scientists*, McGraw-Hill.
2. Polyanin A. D. & Manzirov A. V. (2006) *Handbook of Mathematics for Engineers and Scientists*, Chapman & Hall/CRC Press.
3. Jerrold E Marsden, Alan Weinstein (2013), *Calculus I, II, III*, Springer-Verlag, 2nd Ed.

Reference Journals

EEEI 222 Energy Resources **48 hrs, 1.0 units**

Thermodynamics

Purpose

The aim of this course is to enable the student to:

1. understand power generation from renewable energy sources
2. understand energy storage technologies.

Learning Outcomes

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

1. explain power generation from renewable energy sources
2. explain the impacts of temperature, insolation and shading on I-V curves
3. determine the performance of PVs and wind turbine generators
4. explain energy storage technologies.

Course Description

Conventional energy sources: fossil fuels; biomass; hydropower; nuclear power. Renewable energy sources: solar power; wind power; tidal power; mini and micro-hydro power. Energy uses: domestic, agricultural, industrial, transport, telecommunication, amenity. Energy quantity, quality and availability. Energy conversion. Energy management: energy conservation, energy audit. Energy related incidents. Environmental, economic and social impacts of energy development.

Teaching Methodology:

2 hour lecture and 1 hour tutorial per week and at least three

3-hour laboratory sessions per semester organized on a rotational basis

Instruction materials/equipment

1. Electrical Machines Laboratory
2. Projector

Prescribed text books

1. Gilbert M. Masters (2014), Renewable and Ecient Electric Power Systems, Wiley-Interscience, John Wiley & Sons.
2. J. F. Manwell, J. G. McGowan & A. L. Rogers (2010), Wind Energy Explained: Theory, Design and Application, 2nd Ed., Wiley.

References

1. The Open University, (2016) Energy resources: Wind energy, The Open University.
2. Roy L. Nersesian, (2016) Energy Economics: Markets, History and Policy, Routledge. Solar Energy, vol.44, no.5, pp. 271-289.
3. Olindo Isabella, Klaus Jäger, Arno Smets, René van Swaaij, Miro Zeman, (2016) Solar Energy: The Physics and Engineering of Photovoltaic Conversion, Technologies and Systems, UIT Cambridge Ltd.
4. Stephen Peake, (2017) Renewable Energy: Power for a Sustainable, Oxford University Press

Journals

International Journal of Renewable Energy Technology

EEEI 224 Mechanics of Machines **48 hrs, 1.0 units**

Prerequisite

Purpose

This course introduces the student to the analysis of machines commonly used in mechanical engineering. The course deals with evaluation of velocity, acceleration, forces and torque associated with the performance of the machines.

Learning Outcomes

By the end of this course, the student should be able to

1. analyze motion of elements of different mechanisms
2. construct and solve mathematical models which describe the effects of force and motion on a variety of mechanisms and machines that are of concern to mechanical engineers.
3. Appreciate the relevance of the study of Mechanical systems to electrical Engineers

Course Description

Location of rigid bodies: kinematic constraint, degree of freedom of translation rotation, surface, line and point contact. Kinematics of plane mechanisms: definition of pair kinematic chain, mechanism, machine, inversion, various type of mechanism; velocity and acceleration diagram; cams. Dynamics and forces in plane mechanism: inertia forces, dynamics of rigid bodies, force analysis of a simple crank-slider engine mechanism, engine torque diagrams, flywheel inertia. Friction and lubrication: surface contact, fluid film lubrication, hydrostatic bearings, anti-friction bearings. Mechanical power transmission: flat belt and V-belt drives, chain drives, gear strain, gearboxes, friction clutches, Hooke's joint and constant velocity joint. Balancing of rotating systems: balancing in one and two planes, moment and force vector diagram, practical balancing machines. The gyroscopic effect: gyroscopic couples for high-speed discs, the gyroscope.

Teaching Strategies:

The course will be taught via lectures and tutorial sessions.

Course Assessment:

Cats,Quizzes, Homework and 30 %

Final Examination 70 %

Textbook:

1. K. J. Waldron and G. L. Kinzel (2016) Kinematics, Dynamics, and Design of Machinery, John Wiley.
2. Erik Oberg, (2016) Machinery's Handbook, Industrial Press.

References:

R. Norton (2013) Design of Machinery, McGraw Hill.

EEEI 226 Material Science **48 hrs, 1.0 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. understand electrical properties of different materials
2. understand the etching and cleaning process

Learning Outcomes

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

1. use electrical materials in design of different electrical electronic devices
2. design etch and effectively clean circuit boards

COURSE DESCRIPTION

Crystal structure and bonding in metals, alloys, ceramics, glasses and polymer. Macro and micro structures of materials and properties. Solidification of metals and alloys. Equilibrium diagrams, heat treatment and thermo – mechanical treatment. Composite materials. Mechanical properties: stress deformation, proof stress, tensile strength, shear strength, hardness, ductility, toughness. Ductile–brittle transition. Fracture toughness. Strengthening methods. Importance of crystal structure in determining properties. Chemical properties: corrosion, photo damage, testing and physical examination of materials. Non-destructive testing. Electrical and magnetic properties of engineering materials; metals, ceramics, polymers, and industrial applications.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Textbooks

1. Charles Gilmore, (2014) *Materials Science and Engineering Properties,* Cengage Learning.
2. James F. Shackelford (2014) *Introduction to Materials Science for Engineers,* Pearson.

Course Journals

Reference Textbooks

1. William F. Hosford (2011), *Materials science: an intermediate text*, Cambridge University Press, illustrated Ed.
2. William D. Callister, (2014), *Materials Science and Engineering*, John Wiley & Sons Inc.

Reference Journals

EEEI 232 Electrical Circuits and Networks **60 hrs, 1.25 units**

Prerequisites

Purpose

The aim of this course is to enable the student to;

1. know how to analyze the sine waves
2. obtain the skill of analyzing three-phase circuits
3. use various network theorems to analyze complex circuits
4. Understand the characteristics of elementary signals used in telecommunications
5. Understand the characteristics of modulation techniques used in telecommunications
6. Understand the operation mechanisms of radio transmitters and receivers

Learning Outcomes

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

1. calculate the mean, and r.m.s. values of a sine wave
2. Calculate the circuit parameters of a single and three phase circuits such as equivalent impedances.
3. Reduce complex circuits into simple ones using the various network theorems.
4. Perform convolution and correlation of signals
5. Evaluate Fourier series of periodic signals and calculate the harmonic power content
6. Perform Fourier Transform of signals

Course Description

Network classification and introduction to continuous time signals and systems: Unit step, ramp and impulse signals, example of each signal, differential equation formulation of linear time invariant continuous system, responses for unit ramp, square pulse and impulse function. Review of Laplace transform: initial value and final value theorem, properties and solution of differential equation using LT, time domain analysis of LTI network using Laplace transform, waveform synthesis, LT of complex waveforms, concept of transform impedance, voltage ratio, transfer function, relation between impulse response and system function. Networks theorems: maximum power transfer theorem, superposition, Telligen's, Milliman's, Thevenin's and Norton's theorems, concept of poles and zeros, relation between location of poles, time response and stability. Two port networks :two port network parameters (z, y, T, T', h, g), symmetrical and reciprocal networks, inter-conversion of two port network parameters, interconnection of two port networks, ladder networks, T-π transformation, image and characteristic impedance. Network functions: driving point and transfer functions. Positive real function: definition and properties, synthesis of LC, RL & RC circuits using Cauer and Foster' s first and second form.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Electronics Lab
2. LCD projector

Course Textbooks

1. A.V.Bakshi U.A.Bakshi (2008), *Network Theory*,Technical Publications.
2. Paul M. Chirlian (1969), *Basic network theory*, McGraw-Hill, illustrated Ed.

Course Journals

Reference Textbooks

1. G. I. Atabekov (1965), *Linear network theory*, Pergamon Press.
2. C.L. Wadhwa (2006), *Basic Electrical Engineering*, New Age International.

Reference journals

1. IEEE Transactions on Circuits and Systems
2. Open Electrical and Electronics Engineering Journal
3. International Journal of Circuit Theory and Applications

EEEI 234 Analogue Electronics B **60 hrs, 1.25 units**

Prerequisites

Analogue Electronics A

Purpose

The aim of this course is to enable the student to;

1. understand operation of small signal amplifiers
2. understand application of power devices
3. understand the effect of feedback on amplifier characteristics and performance

Learning Outcomes

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

1. analyze and design small signal amplifiers
2. design of simple firing control circuits

COURSE DESCRIPTION

Ideal operational amplifiers (op-amp): addition, subtraction, differentiation, and integration using op-amp. The difference amplifier: the difference amplifier and its characteristics, the ideal op-amp. Feedback arrangements: concept of virtual ground,offset voltages and bias current, common mode rejection ratio. Frequency response and stability. Compensation techniques. Slew rate and full-power bandwidth, gain, input impedance, output importance, inverting and non-inverting configurations.Linear op-amp circuits: integration, differentiation, stability. Basic op-amp difference amplifier, instrumentation amplifier, instrumentation amplifier. Voltage to current to voltage converters. Non-Linear op-amp circuits: Voltage comparators, multi-vibrators, square-wave generators, function generators, precision rectifiers, Log/antilog amplifier. Integrated circuits: IC design philosophy, special techniques for implementing analogue and digital IC circuits. Medium scale integration (MSCI), Large Scale Integration (LSI), Very large scale integration (VLS) manufacturing techniques and computer aided manufacturing (CAM). Fabrication of IC, computer aided design of IC, special devices e.g. MOSFETS, videos, read only elements, Charge Coupled Devices (CCDs) bubble memories, solid state lasers.Power devices: operation of silicon controlled rectifies (SCR). Uni-junctions Transistors (UJT), triac, Gate-turnoff switch (GTO devices), simple applications of SCR devices.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Electronics Lab
2. LCD projector

Course Textbooks

1. Johan Huijsing, (2016), *Operational Amplifiers: Theory and Design*,Springer.
2. Jimmie J. Cathey (2002), *Schaum's Outline of Theory and Problems of Electronic Devices and Circuits*, McGraw-Hill, 2nd Ed.

Course Journals

Reference Textbooks

1. George Burbridge Clayton & Steve Winder (2003), *Operational amplifiers*, 5th Ed.
2. Robert L. Boylestad, Louis Nashelsky (2015), *Electronic devices and circuit theory*, Prentice-Hall, 11th Ed.
3. Coughlin & Driscoll, (2015), *Operational Amplifiers And Linear Integrated Circuits,* Pearson India

Reference Journals

1. Solid-State Electronics
2. IEE Proceedings: Circuits, Devices and Systems
3. International Journal of Electronics
4. IEEE Transactions on Circuits and Systems
5. New Electronics

EEEI 291 Electrical Engineering Laboratory IB **96 hrs, 2.0 units**

Laboratory exercises in Analogue Electronics II, Thermodynamics, Mechanics of Machines, Material Science, Electric Circuits and Networks and Electrical Principles.

3.3 Year III

3.3.1 Semester I

EEEI390 Programming and Simulation Laboratories (Internal Attachment) 12 Weeks (432 hrs), 4.5 units

Each student should conceive, design, develop and realize an electronic product. The basic elements of product design; the function ergonomics and aesthetics should be considered while conceiving and designing the product. The electronic part of the product should be an application of the analogue and digital systems covered so far. The realization of the product should include design and fabrication of PCB. Study of PCB design (single sided and double sided) may use any available software. The student shall submit the report at the end of the semester. The students will be exposed to practical operations in programming and simulation workshops in the broad areas electrical and electronic engineering. This course shall be graded by coursework.

3.3.2 Semester II

EEEI 301 Probability and Statistics **48 hrs, 1.0 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. introduce students to methods of analyzing data.
2. teach the students to calculate probability using various laws of probability.
3. introduce students to various sampling methods.

Learning Outcomes

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

1. calculate the mode, frequency, mean etc for a given data.
2. determine probability using any of the available laws of probability.
3. analyze a given set of data and determine any parameter that may be required from the data.

Course Description

Data collection and presentation: tabular and graphical presentation of sample data; frequency, relative frequency, absolute frequency and distribution function; sample mean. Sampling: sampling errors, estimation of population parameterparameters. Theory of errors: variance and covariance, standard deviation and standard error, propagation of errors. Correlation: simple linear correlation coefficient, regression models, deterIrmination of regression coefficients, method of least squares, forecasting. Hypothesis testing: null and alternative hypotheses, level of confidence. Random events: Venn diagram, union, intersection, mutually exclusive events, multiplication and complementation rules. Discreet and random variables: probability distribution function, mean and variance of a distribution. Continuous random variables: continuous distributions, binomial distributions, normal probability distribution. Application of statistics and probability in engineering.

Teaching Methodology

3 hour lectures and 1 hour tutorial per week

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Textbooks

1. MacClave J. T., Sincich T. L. & William M. (2016*), First Course in Statistics*, Prentice Hall.
2. Richard A. Johnson, Gouri K. Bhattacharyya, (2014) *Statistics: Principles and Methods*, Wiley.

Course Journals

Reference Textbooks

1. Jay L. Devore, (2015), *Probability and Statistics for Engineering and the Sciences*,Brooks Cole.
2. Levy P.S. & Lemeshow S. (2008), *Sampling of Populations: Methods and Applications*, Wiley.

Reference Journals

1. Electromagnetics
2. International Journal of Numerical Modelling: Electronic Networks, Devices and Fields

EEEI 331 Digital Electronics **60 hrs, 1.25 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. understand number systems and codes and their application
2. understand Boolean algebra and logic gates

Learning Outcomes

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

1. use logic gates to design combinational and sequential circuits
2. understand applications of different electronic devices like BJTs and FETs
3. understand working principle of digital measuring instruments
4. understand the architecture of computer systems

Course Description

Logic gates, symbols, tables and integrated circuit (IC) chip for AND, OR, NOT, NOR and EXOR gates. IC families and their characteristics. Open collector and tristate devices. Switching function; including general circuit design. Digital multiplexer and demultiplexes, encoders and decoders, adders and subtractors, bus types, design and organization. The system bus architecture and characteristics. Flip-flop and their applications in counters and registers. Sequential circuit design general design concepts, design circuits versions. Medium scale integrated combination integrated circuits and their applications, such as decoders, encoders, and multiplexers. Memory devices, including Read Only Memories, Programmable Read Only Memories, Random Access Memories. Design of sequential and timing circuits. Analogue to digital and digital to analogue conversion, devices and characteristics. Introduction to micro-computers and microcomputer organization.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Textbooks

1. Puri (1997), *Digital Electronics: Circuits and Systems: Circuits and Systems*, Tata McGraw-Hill.
2. Roger L. Tokheim (2013), *Digital Electronics: Principles and Applications*,McGraw-Hill Education, 7^{th} Ed.
3. Anil Kumar Maini (2007), *Digital electronics: principles, devices and applications*, McGraw-Hill, illustrated Ed.

Course Journals

References

1. William H. Gothmann (1982), *Digital Electronics: An Introduction to Theory and Practice*, Prentice-Hall.
2. Tertulien Ndjountche (2016), *Digital Electronics*, Wiley.

Reference journals

EEEI 333 Analogue and Digital Control Systems **60 hrs, 1.25 units**

Analogue Electronics B

Purpose

The aim of this course is to enable the student to:

1. understand the generalised performance of control systems
2. understand the use of actuators and transducers in instrumentation and control systems.

Learning Outcomes

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

1. explain the structure and operation of instrumentation and control systems
2. explain the use of actuators and transducers in control systems
3. explain the operation of components used in control systems.

Course Description

Introduction to Control Systems: definition,types of control systems, characteristics of control systems.Control system components: temperature sensors – thermistor, resistive sensor, thermocouple, IC temperature sensor. Strain gauge,phototransistor,photoconductive Cell,optocoupler,opto interrupter device; Hall Effect Device; Digital-to-Analog Converters (DAC); Analog-to-Digital Converters (ADC): Simultaneous ADC, Monotonic ADC, tracking ADC, single-slope ADC, dual-slope ADC, successive approximation ADC.Voltage-to-Frequency and Frequency-to-Voltage Converters. Shaft Position Encoder,solenoid; gas, Linear Variable Differential Transformer (LVDT).Motor: DC generator, DC motor, permanent magnet stepper motor, Single-Stack Variable Reluctance Stepper Motor, Multi-Stack, Hybrid Stepper Motor, static torque, dynamic torque, mechanical resonance.Control system representation: Laplace transforms, transfer functions, block diagrams.Feedback system characteristics and analysis. Time-domain analysis. Frequency-domain analysis.Analog Control Systems. Digital control systems: Digital temperature control systems, Digital DC motor speed control systems, stepper motor position control system.Microprocessor-basedcontrol systems.

Teaching Methodology:

2 hour lecture and 1 hour tutorial per week and at least three 3-hour laboratory sessions per semester organized on a rotational basis.

Instruction materials/equipment

1. Electronics Laboratory
2. Basic Electrical Laboratory
3. Projector

Prescribed text books

1. A. K. Sawhney (2014), A course in Electrical and Electronic Measurement and Instrumentation.
2. Rohit Khurana(2016), Electronic Measurement and Instrumentation, Vikas .

References

1. Peter Török, Matthew R Foreman(2016), Instrumentation and Measurement: Fundamentals, Magnum Publishing LLC.
2. Alan S Morris (2005), Measurement & Instrumentation Principles, Elsevier India.

EEEI 335 Computer Aided Design **48 hrs, 1.0 units**

Prerequisites

EEEE 123 Engineering Graphics

Purpose

The aim of this course is to enable the student to;

1. Provide the student with basic knowledge of AutoCAD,
2. Draw using AutoCAD.

Learning outcomes

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

1. Use AutoCAD for drawing,
2. Apply the knowledge gained in design of electrical circuits for buildings,
3. Construct Objects using AutoCAD.

Course Description

Introduction to the application of CAD in engineering. Electronic industrial standards, electronic drawing symbols, types of electronic drawing, schematic, connection, link and cable diagrams. Use of CAD software in creating electronic diagrams, broaching and CNC control.

Teaching methodology

2 hour lecture and 2 hour practical per week.

Instructional materials/equipment

1. Computer Lab,
2. LCD projector,
3. Handouts.

Course Textbooks

1. Terence M. Shumaker,David A. Madsen, David P. Madsen, (2014)AutoCAD and Its Applications Basics 2015,Goodheart-Willcox.
2. James Leach, (2016) AutoCAD 2017 Instructor, SDC Publications.
3. AElliot Gindis, (2015) Up and Running with AutoCAD 2016: 2D and 3D Drawing and Modeling,Academic Press.

EEEI 337 Instrumentation and Measurement 48 hrs, 1.0 units

Prerequisites

- Electrical Circuits and Networks, Analogue Electronics B

Purpose

The aim of this unit is to enable the learner to:

i. describe common methods for converting a physical parameters into an electrical quantityand give examples of transducers, including those for measurement of temperature, strain, motion, position and light.
ii. explain how to make sensitive measurements using a Wheatstone bridge, includingbalancing and offset compensation.
iii. describe systems for measuring motion, temperature, strain and light intensity.

Learning outcomes

At the end of this unit learner should be able to:

i. understand principle, working and operation of various Electrical and electronic instruments.
ii. learn techniques for measuring electrical parameters and electrical components.
iii. Use breadboards and resistance measurements
iv. Measure voltages and currents
v. use an oscilloscope and function generator
vi. Interpret measurements on AC circuits using multimeters
vii. apply knowledge of mathematics, science, and engineering.
viii. design and conduct experiments, analyze and interpret data.

Course description

Elements of measurement systems: accuracy, precision and sensitivity of instruments. Calibration and errors in measuring instruments. Statistical analysis of measurement data. Electrical and Mechanical measurements. Analogue instruments and digital instruments. Measurement of current, voltage, resistance, frequency and power AC/DC bridges. Transducer types: resistive, capacitive, inductive, optical, thermal and piezoelectric, photovoltaic display devices. Measurement of mass, volume and area. Measurement of time, displacement, speed, ecceleration and frequency; strain, force, torque, power and pressure; vibration; temperature and fluid flow.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Electronics Lab
2. LCD projector

Course Textbooks

1. Robert B. Northrop, (2014) *Introduction to Instrumentation and Measurements*, CRC Press.
2. Francis S. Tse, Ivan E. Morse (1989), *Measurement and instrumentation in engineering: principles and basic laboratory experiments*,CRC Press, illustrated Ed.
3. Alan S. Morris (2015), *Measurement and instrumentation principles*, Elsevier.

Course Journals

Reference Textbooks

1. Robert B. Northrop (2014), *Introduction to instrumentation and measurements*, CRC Press.
2. Rohit Khurana (2016), *Electronic instrumentation and measurements*, Vikas.

Reference Journals

1. IEEE Transactions on Industrial Electronics and Control Instrumentation
2. Acta Electrotechnica
3. IEE Proceedings - Part A: Physical Science, Measurements and Instrumentation, Management and Education, Reviews
4. Sensors and Actuators A: Physical
5. Remote Sensing of Environment

EEEI 339 Electromagnetic Fields and Waves **48 hrs, 1.0 units**

Prerequisites: Electrical Circuits and Networks, Mathematics 1A

Purpose

The aim of this course is to enable the student to;

1. Appreciate the role of Maxwell’s equations as the foundation of electromagnetic theory
2. the fundamentals and properties of guided waves
3. understand mechanisms of interaction of electromagnetic waves with different media

Learning Outcomes

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

1. Solve simple problems involving electromagnetic fields penetrating boundaries of different media and how to calculate energy in magnetic fields..
2. Solve Maxwell’s equations for simple problems involving guided wave systems.
3. Analyze uniform plane waves in vacuum, conducting and non-conduction media using Maxwell’s equations.

Course Description

Vector operators; vector algebra; the gradient; invariance of the operator; flux; the divergence; the Laplacian’s operator; orthogonal curvilinear coordinates; the curl; phasors; solving a second-order differential equation with phasors. Electric fields: static and steady electric fields. Coulomb's law, the principle of superposition, Gauss' law, Divergence theorem relating volume function to surface function; Stokes' theorem.Time varying electric fields, static magnetic fields. Laplace and Poisson equations for time-dependent electric fields; The law of conservation of electric charge; Conduction in an alternating electric field, electric dipoles. Magnetic circuits. Lorentz’s force law; Hall effect. Biot-Savart law and Ampere circuital law. The magnetic force between two closed circuits. Time dependent electromagnetic fields.Boundary conditions in electromagnetic fields. Energy considerations in magnetic circuits.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Course Journals

1. Journal of Instrumentation

Instruction materials/equipment

1. Control Engineering Laboratory

2. Electronics Laboratory

3. Projector

Prescribed text books

1. Norman Violette, (2014), *Electromagnetic Compatibility*, Springer.
2. Fawwaz T. Ulaby, Umberto Ravaioli, (2014) *Fundamentals of Applied Electromagnetics*, Pearson.
3. Sadiku, Matthew (2014), *Elements of Electromagnetics*, New York: Saunders.

References

1. Alan S. Morris (2005), Measurement & Instrumentation Principles, Elsevier India Pri-
2. vate Limited, ISBN: 8131202666
3. J. B. Gupta (2006), A Course in Electronics and Electrical Measurements and Instru-
4. mentation, S. K. Kataria & Sons, ISBN: 8188458937
5. Dipak L. Sengupta, Valdis V. Liepa (2006), *Applied Electromagnetics and Electromagnetic Compatibility*, John Wiley &Sons.
6. Sadiku, Matthew (1994), *Elements of Electromagnetics*, New York: Saunders, 2nd Ed.
7. Markus Zahn (2003), *Electromagnetic Field Theory: A Problem Solving Approach*, Krieger Publishing Company, reprint Ed.

EEEI 391 Electrical Engineering Laboratory IIA **96 hrs, 2.0 units**

Laboratory exercises in DC Machines and Transformers, Electronic Circuit Design, Electromagnetic Fields and Waves, Analogue and Digital Control Systems, Instrumentation and Measurement.

3.3.3 Semester III

EEEI 302 Numerical Methods **48 hrs, 1.0 units**

Prerequisites

Mathematics 1B

Purpose

The aim of this course is to enable the student to;

1. understand interpolation and numerical integration
2. understand numerical solution of ordinary differential equations

Learning Outcomes

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

1. do numerical differentiation and integration
2. use numerical solution of ordinary differential equations in telecommunication systems

Course description

Principles and importance of numerical solution to engineering problems. Introduction to errors and error analysis, absolute and relative errors. Solution of systems of linear equation. Solution of non-linear equations. Simple iteration methods for finding roots of polynomial and transcendental equations. Newton-Raphson method. Convergence and convergence rates. Finite differences and interpolation techniques. Numerical differentiation and numerical integration. Forward and backward differences. Numerical solutions of ordinary differential equations including wave and heat equations. Introduction to finite element method.

Teaching Methodology

3 hour lectures and 1 hour tutorial per week

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Textbooks

1. C. A. Faul, (2016), *A Concise Introduction to Numerical Analysis*, Chapman and Hall/CRC.
2. Richard L. Burden, J. Douglas Faires (2015), *Numerical Analysis*, Thomson Brooks/Cole.

Course Journals

Reference Textbooks

1. Kendall Atkinson (2016), Elementary Numerical Analysis, Wiley.
2. Chapra Canale, (2016), Numerical Methods for Engineers, Mc Graw Hill India.

Reference Journals

EEEI 332 Electrical Installation Technology **48 hrs, 1.0 units**

Prerequisites:

Material Science

Purpose

The aim of this course is to enable the student to:

1. understand the basic principles of designing electrical installation works
2. understand the principle functions of various types of lighting systems
3. appreciate the typical materials used for the construction/fabrication/manufacturing oftypical common lamps.

Learning Outcomes

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

1. design electrical installation works
2. identify and have information related to various common features of luminares
3. select the constructional materials used for electrical works
4. prepare Bill of Quantities and tender documents.

Course Description:

Types of Conductors and cables: construction of cables, types of cables, sizes and ratings.Domestic lighting and power circuits: sequence of control at the intake point, lighting circuit, socket outlets, cooker and water heater. Wiring system: types of wiring system, factors affecting choice, applications of given systems. Wiring accessories: types of accessories.Earthing and protection: terms in earthing, purpose in earthing, earthing methods, earth resistance area, protective devices, excess current protection. Tests and inspections: tests on completed installations and major extensions and alterations. Structured cabling: terms used, designing, installation. Building services: building structure, accommodating electrical services in building, utility services.

Teaching Methodology:

2 hour lecture and 1 hour tutorial per week and at least three

3-hour laboratory sessions per semester organized on a rotational basis

Instruction materials/equipment

1. Electrical Installation Workshop
2. Illumination Laboratory
3. Computer laboratory

4. Software: ArchCAD, AutoCAD

5. Projector

Prescribed text books

1. J. R. Coaton, A. M. Marsden (1996), Lamps and Lighting, Architectural Press, ISBN: 0340646187

2. Chartered Institution of Building Services (CIBSE) (2002), Code for Lighting, Butterworth-Heinemann, ISBN: 0750656379

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References

1. IEE Wiring Regulations: BS7671, 2001 Incorporating Amendments No. 1 & 2, 2004, Institution of Engineering and Technology, ISBN: 0863413730

2. IEE on Site Guide (BS 7671: 2001 16th Edition Wiring Regulations Including Amendment 2: 2002), Institution of Engineering and Technology, ISBN: 0863413749

3. Manufacturers Catalogues IEE (KEBS) regulations ERC IES codes

EEE 2412: Electronic Circuit

EEEI 334 Signals and Systems **48 hrs, 1.0 units**

Prerequisites

Analogue B

Purpose

The aim of this course is to enable the student to;

1. Understand the characteristics of elementary signals used in telecommunications
2. Understand the characteristics of modulation techniques used in telecommunications
3. Understand the operation mechanisms of radio transmitters and receivers

Learning Outcomes

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

1. Perform convolution and correlation of signals
2. Evaluate Fourier series of periodic signals and calculate the harmonic power content
3. Perform Fourier Transform of signals
4. Describe the sampling theorem and its application in digital communications
5. Select a suitable signal modulation technique for pass-band transmission
6. Describe how simple transmitter and receiver equipment work

Course Description

Representation and analysis of continuous and discrete time signals, time and frequency analysis of linear time-invariant systems, convolution, differential and difference equations. Fourier series and Transform. Z-transform:characteristics - noise and its effect on communication, sources and types of noise. Noise performance of various modulation schemes. Frequency Modulation (FM) threshold. Radio transmitters: classification of transmitters according to type of modulation and services. Block diagrams of AM and FM transmitters. Transmitter circuits: master oscillators, harmonic generators, limiters and modulating circuits, privacy devices in radio telephony; neutralization methods. Radio receivers: classification and types of radio receivers. Block diagram of tuned frequency and super-hEEEIrodyne receivers. RF amplifier and selector circuits, mixers and frequency converter circuits, IF circuits, AM and FM dEEEIctor circuits including AGC, noise limiter and AFC; tracking and alignment of receivers. Computer communication systems: Internet. Electronic mail (E-mail). Teledata systems: TelEEEIxt; view data (Prestel); transmission over telephone network for TV reception, application of Frequency shift Keying (FSK), Amplitude shift Keying (ASK) and asynchronous transmission. The design and planning consideration of each of the above systems.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week and at least three 3- hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Telecommunications laboratories
2. LCD projector

Course Textbooks

1. Jeffrey S. Beasley, Jonathan D. Hymer, Gary M. Miller (2013), *Electronic Communications,* Pearson India.
2. Louis Frenzel (2015), *Principles of Electronic Communication System,* Tata McGraw-Hill, India.

Course Journals

Reference Textbooks

1. Ziemer and Tranter (2014*), Principles of Communication,* Mifflin Company, USA

2. R. A. Gabel and R.A. Roberts (1973*), Signals and Linear Systems*, John Wiley and Sons, New York.
1. Papoulis (1981*), Circuits and Systems*, Holt-Saunders Int, Japan

Reference Journals

1. Radio Electronics and Communication systems
2. IEICE – Transactions on Info and Systems
3. Telecommunications (International Edition)

EEEI 336 Digital Circuit Design **48 hrs, 1.0 units**

Prerequisites

EEEI 331 Digital Electronics

Purpose

The aim of this course is to enable the student to;

1. understand logic design techniques, combinational logic using Small Scale Integration (SSI) and Medium Scale Integration (MSI), sequential logic design and analysis using MSI, Large scale integration and their applications

Learning Outcomes

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

1. Analyze various components found in a digital system.
2. Design a basic computer

Course Description

Design and synthesis of digital systems using both combinational and sequential circuits. Includes laboratory projects implemented with standard ICs.Apply concepts of number systems to perform binary arithmetic and conversions between bases. Apply Boolean algebra and K-Map to simplification of Boolean expressions, and analysis and synthesis of digital circuits.

Design combinational circuits, such as binary adders, code converters, etc., by using logic gates. Design sequential circuits, such as counters, registers, etc., by using flip-flops and logic gates. Design and test digital circuits using MSIs, EPROMs and simple CAD tools.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Digital Electronics Lab
2. LCD projector

Course Textbooks

1. Mark Balch (2003), *Complete Digital Design*, McGraw-Hill Professional, illustrated Ed.
2. Morris Mano (1979), *Digital Logic and Computer Design*, Prentice Hall, illustrated Ed.

Course Journals

Reference Textbooks

1. Morris Mano and Charles Kime (2015), *Logic and Computer Design Fundamentals*, Prentice Hall, 4^{th} Ed.
2. Alan B. Marcovitz,(2009), *Introduction to Logic Design*, McGraw-Hill.

Reference Journals

1. Journal of Computational Electronics

EEEI 342 DC Machines and Transformers **48 hrs, 1.0 units**

Prerequisites

Electrical Circuits and Networks, Physics B

Purpose

The aim of this course is to enable the student to;

1. understand working principle of DC machines
2. understand operation of transformers

Learning Outcomes

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

1. analyze DC machines and transformers

Principle of energy conversion: Faraday's law of electromagnetic induction, singly and doubly excited magnetic field systems, torque production in rotating machines, general analysis of electro mechanical systems.D.C machines:motor, torque/ speed characteristics, motor equations, generator characteristics, applications. D.C motors: load test, speed control, calculations, applications.DC machine control: basic machine equations, variable speed drives, control feedback loops.Single phase transformers: construction and windings, equivalent circuits, phasor diagram. Analysis of operation, rating, heating, cooling, losses, temperature rise, efficiency, parallel operation. Parameterdetermination. Three phase transformer: construction and windings, equivalent circuit. Phasor diagrams, methods of connection. Analysis of operation, parallel operation, Scott connection, operation on infinite bus bars. Load sharing on infinite bus bars, rating, heating, temperature rise, cooling, losses and efficiency.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Machines Lab
2. LCD projector

Course Textbooks

1. Charles I. Hubert, (2016), Electric Machines, Pearson International.
2. Alexander Gray (2015), Electrical Machine Design - The Design and Specification of Direct and Alternating Current Machinery, Scholar's Choice.
3. K. R. Sidhdhapura, D. B. Raval, (2016) DC Machines and Transformers, Vikas.

Course Journals

Reference Textbooks

1. K. R. Sidhdhapura, D. B. Raval, (2016), A Textbook of Electrical Machines, Vikas.
2. Ryan Godsell, (2014), Electrical Machine Principles, RG Kindle Publishing.

3. Mohamed Abdus Salam (2013), Fundamentals of Electrical Machines, Alpha Science, illustrated Ed.

Reference journals

1. Electrical Machines and Power Systems
2. Journal of Electrical and Electronics Engineering
3. Journal of Electrical Systems
4. Acta Electrotechnica

EEEI372 Microprocessor Architecture and Interfacing **48 hrs, 1.0 units**

Prerequisite

EEEI 331 Digital Electronics

Purpose

The aim of this course is to introduce the student to microprocessor systems architecture and programming of microprocessors using assembly language

Learning Outcomes

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

1. describe the architecture of Z80 microprocessors
2. write Assembly language code for microprocessors
3. explain the working of multiprocessor systems
4. explain how microprocessors are interfaced with other system hardware
5. Describe the working of registers at various levels in microprocessors

Course Description

General architecture of a microprocessor, hardware architecture of the Z80, addressing modes, instruction set, instruction templates, instruction execution timing. Assembly language programming, programming examples. Modular programmimg: Assembler instruction format. Different programming models, Assembler directives and operators, assembly process, Linking and relocation, stacks, procedures, interrupt routines, macros. 80 hardware design – Bus structure, bus buffering and latching, system bus timing with diagram, memory (RAM and ROM) interfacing, memory address decoding. I/O interfacing : serial and parallel I/O, Programmed I/O. Interrupts and their processing, interrupt driven I/O. Minimum and maximum mode configurations of 8086, 8087 co-processor architecture and configuration..

Teaching Methodology

1. 2 hours of lectures per week will be used to introduce material on the formal aspects of the unit
2. 1 hour tutorial per week
3. at least five 3-hour laboratory sessions per semester organized on rotational basis
4. students will research and present their findings on various topics
5. discussions and working out problems

Mode of Course Assessment: Continuous assessment and written University examinations shall contribute 30% and 70% respectively of the total marks

Instructional Materials/Equipment

1. microprocessor system development toolkit
2. assembly language programming environment (assembler)

Course Textbooks

1. Ramesh S. Gaonkar, The Z80 Microprocessor: Architecture, Interfacing, Programming and Design,Merrill Pub Co, 2nd edition, 1992, ISBN-10: 0023404841, ISBN-13: 978-0023404849
2. Walter A. Triebel and Avtar Singh, The 8086 Microprocessor: Architecture, Software and Interfacing Techniques, Prentice Hall, 1984, ISBN-13: 978-0132466950 ISBN-10: 0132466953
3. David A. Patterson and John L. Hennessy, Computer Organization and Design, Fourth Edition: The Hardware/Software Interface (The Morgan Kaufmann Series in Computer Architecture and Design), Morgan Kaufmann , 5th Edition, 2013, ISBN-13: 978-0124077263 ISBN-10: 0124077269

Course Reference Textbooks

1. Jean-Loup Baer, Microprocessor Architecture: From Simple Pipelines to Chip Multiprocessors, Cambridge University Press; 1st edition, 2009, ISBN-10: 0521769922, ISBN-13: 978-0521769921
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, Computer Organization and Embedded Systems, 2011
3. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach (The Morgan Kaufmann Series in Computer Architecture and Design), Morgan Kaufmann, 5th edition, 2011, ISBN-13: 978-0123838728, ISBN-10: 012383872X
4. John Paul Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, 1st Edition, 2013, ISBN-10: 1478607831, ISBN-13: 978-1478607830

Course Journals

1. General addressing mechanisms for microprocessors, Microprocessors and Microsystems, Volume 12, Issue 2, March 1988, Pages 67-75
2. Methodology for the evaluation and selection of microprocessors for specific applications, Microprocessors and Microsystems, Volume 7, Issue 9, November 1983, Pages 439-443
3. Programming microprocessors with a high level language-the case of PASCAL/64000, Microprocessors and Microsystems, Volume 7, Issue 4, May 1983, Pages 169-172

Reference Journals

1. IEEE Journal of Solid-State Circuits
2. The international Journal of Microprocessors and Microsystems
3. *Embedded Hardware Design (MICPRO)*

EEEI 392 Electrical Engineering Laboratory IIB **96 hrs, 2.0 units**

Laboratory exercises in Microprocessor Architecture and Interfacing, Digital Circuits Design, Signals and Systems, Electrical Installation Technology.

3.4 Year IV

3.4.1 Semester I

EEEI 490 Industrial Attachment **432 hrs (12 Weeks), 4.5 units**

This is session to be taken during practical attachment in industry. The student shall be required to perform all the duties of an engineeringtrainee. This course shall be examined by field assessment and a report.

3.4.2 Semester II

3.4.2.1 Core Courses

EEEI 471 Microprocessor Systems and Applications **48 hrs, 1.0 units**

Prerequisites

Microprocessor Architecture and Interfacing

Purpose

The aim of this course is to enable the student to:

1. learn the basics of designing, interfacing and configuring microprocessors
2. learn the basics of microprocessor programming

Learning Outcomes

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

1. describe the architecture of an ideal microprocessor
2. write assembly language code for microprocessors
3. explain the READ and WRITE machine cycles
4. explain how microprocessors are interfaced with other system hardware
5. describe the working of registers at various levels in microprocessors
6. use of development tools in the design and implementation of microprocessor-based systems

Course Description

Microprocessor Architecture: the ideal microprocessor, practical limitations, the data bus address bus, control bus, central processing unit architecture. Internal registers. The Arithmetic Logic Unit. Instruction word flow. Data word flow. State transmission diagram. Microprocessor instruction set. Addressing modes. Status registers. The binary code. Hexadecimal code. Flow charts. Opcodes, Fetch machine cycle. WRITE and READ machine cycle. Interrupt, Acknowledge. Timing diagrams. Address allocation techniques. Address decoding techniques. Memory organization and memory management. Assembler, complier, loader, monitor, and other software aids. Assembly language. Programming with a typical microprocessor.Interfacing techniques: Interfacing the decoder, static RAM with programmable Input/Output ports, ROM, ERROM with Input/Output transfers. Device-initiated interrupt Input/Output transfer. Direct memory access. Applications: Microprocessor selection. Design methodology. Simple examples of applications. Use of development tools in the design and implementation of microprocessor-based systems. Design assembly language programs involving I/O devices. Understand bus structure, and timing and activities of bus cycles of 8086 microprocessor. Apply concept and principle of system bus to the design of bus control logic and I/O interfaces using LSI supporting devices. Design memory modules using ROM and RAM devices. Understand major architectural features of advanced microprocessors in the 8086 family.

Teaching Methodology

1. 2 hours of lectures per week will be used to introduce material on the formal aspects of the unit
2. 1 hour tutorial per week
3. at least five 3-hour laboratory sessions per semester organized on rotational basis

4. students will research and present their findings on various topics
5. discussions and working out problems

Mode of Course Assessment: Continuous assessment and written University examinations shall contribute 30% and 70% respectively of the total marks

Instructional Materials/Equipment

1. microprocessor system development toolkit
2. assembly language programming environment (assembler)

Course Textbooks

1. David A. Patterson and John L. Hennessy, (2017) Computer Organization and Design, Fourth Edition: The Hardware/Software Interface (The Morgan Kaufmann Series in Computer Architecture and Design), Morgan Kaufmann.
2. Carl Hamacher, ZvonkoVranesic, SafwatJean-Loup Baer, (2010) Microprocessor Architecture: From Simple Pipelines to Chip Multiprocessors, Cambridge University Press
3. Zaky and NaraigManjikian, (2011) Computer Organization and Embedded Systems, McGraw-Hill Education.

Reference Textbooks

1. John Paul Shen and Mikko H. Lipasti, (2013) Modern Processor Design: Fundamentals of Superscalar Processors.
2. A.P.Godse and D.A.Godse Microprocessor and Interfaces, Technical Publications.
3. Saifullah Khalid and Dr.NeetuAgrawal, Microprocessor System, Laxmi Publications, 2009, ISBN 8131807525, 9788131807521
4. D.A.GodseA.P.Godse, Microprocessors and its Applications, Technical Publications, 2006, ISBN 8184310544, 9788184310542

Reference Journals

1. Methodology for the evaluation and selection of microprocessors for specific applications, Microprocessors and Microsystems, Volume 7, Issue 9, November 1983, Pages 439-443
2. Programming microprocessors with a high level language-the case of PASCAL/64000, Microprocessors and Microsystems, Volume 7, Issue 4, May 1983, Pages 169-172
3. General addressing mechanisms for microprocessors, Microprocessors and Microsystems, Volume 12, Issue 2, March 1988, Pages 67-75

Reference Journals

1) IEEE Journal of Solid-State Circuits
2) The international Journal of Microprocessors and Microsystems
3) *Embedded Hardware Design (MICPRO)*

EEEI 473 Computer Hardware and Maintenance **48 hrs, 1.0 units**

Prerequisites

Digital Electronics

Purpose

The aim of this course is to:

1. equip the student with the basic theory of personal Computer Systems fault finding
2. equip the student with knowledge to repair personal computers and power supplies
3. prepare the student for more advanced analytical work in simulation of computer faults at higher levels in this field

Learning Outcomes

By the end of this course, the student will be able to:

1. Install a personal computer system and peripheral devices
2. Trouble shoot the personal computer system and the associated power systems
3. Replace faulty parts on personal computer and power supplies

Course Description

The visible PC: PC components, switches and jumpers, documentation. Microprocessors: external data bus, registers, clock, memory, address bus, 8086 CPU family up to Pentium 4, typical CPU problems. RAM-DRAM, SRAM, SIMMS, DIMMS, SDDRAM, DDR, DRAM, RD DRAM, working with RAM, typical RAM problems. Motherboard and BIOS: BIOS, Power-on Self Test (POST), CMOS, Motherboard layouts, Form factor, Motherboard installation and replacement, Typical BIOS problems. Expansion bus: System bus, I/O buses, The big three, I/O addresses, interrupt request numbers, DMA, AGP, PC cards, plug and play, the process of device installation , problems of expansion buses and device installation. Power supplies: the power supply, power connections, motherboard power, power switch, connections to peripherals, power supply fan, Electrostatic Discharge (ESD), surge suppressors, uninterruptible power supplies, power supply problems. Floppy drives:understanding floppy drives, floppy drive installation, care and feeding of floppy drives, floppy drive problems. Hard drives:inside the drive, hard drive interface to the PC, partitioning and formatting, hard drive capacity, hard drive types, hard drive problems. CD Media: CD-ROM, CD-ROM speeds, CD-R, CD-RW, DVD, installing CD media devices, troubleshooting CD drives. Sound: types of sound cards, 3-D sound cards on the PC, sound card problems. Printers: various types of printers impact printers. Modems: communications standards, modem commands, telephone lines, installation and troubleshooting of modems, modem problems. Portable PCs and Laptops. I/O controllers: keyboard and display interfaces, hexadecimal encoder, DMA controller. Printer interface, CRT controller, graphic controller, floppy disk interface, co-processors. Fault finding on microprocessor-based systems:conventional tools/ equipment, specialized tools/equipment, fault finding on digital ICs, automatic test equipment, signature analyzers, logic analyzers. Maintenance of microcomputer systems: common faults replacement, motherboard, power supplies, monitor(screens), memory devices, printers, scanners. Installation:stand alone, intranets, internet.

Teaching Methodology

2 hour lectures, 1 hour tutorial and 2 hour laboratory and workshop per week for the whole semester.

Mode of course assessment

Written class tests, laboratory assignments constitute 40%: written university examinations constitute 60%.

Instructional material/Equipment

Data communication laboratory

Computer and projector

Course Textbook

1. Craig Zacker and John Rourke (2001), *PC Hardware*: *The complete reference, McGraw-Hill*

Reference Textbooks

1. Mark Minasi, *Hard Disk survival guide, BPB puplications*

EEEI 491 Electrical Engineering Laboratory IIIA **48 hrs, 1.0 units**

Laboratory exercises in electronic circuit design, signals and system, micro design, processor and digital, data communication networks, digital transmission, power electronics and power system protection.

EEEI 493 Technical Project A **96 hrs, 2.0 units**

Purpose

The aim of this course is to enable the student to:

1. appreciate the applications of the theory learnt in class in addressing real world problems
2. develop the ability to identify and dene real world engineering problems
3. develop the ability to design an engineering system, component or process that meetsa desired need
4. develop the ability to design, implement and test the product, using appropriate toolsand techniques
5. develop the ability to analyze, demonstrate and orally present experimental results/research ndings.

Learning Outcomes

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

1. develop an electrical/electronic engineering project, manage and execute it
2. use relevant tools and demonstrate practical skills in implementing the project objectives
3. test and commission the designed product
4. produce a project report
5. present the project work to the departmental examination board

Course Description

Each student is expected to prepare a report on a practical project work done by him/her and present a paper highlighting the work in a seminar. The student is expected to complete the project work assigned to him/her and submit the project report by the end of the fourth year final semester.

Teaching Methodology:

The student will be allowed 8 hours per week to research, consult, design, fabricate, test, and analyze obtained results. Every student will make an oral presentation once every four weeks and hand in a progress report.

Instruction materials/equipment

1. Electrical and Electronics Engineering Laboratories and Workshops
2. Computer Laboratories
3. Design and Simulation Softwares
4. Internet

3.4.2.2 Power Systems Engineering

EEEI 444 Power System Engineering A **48 hrs, 1.0 units**

Prerequisites: DC Machines and Transformers

Purpose

The aim of this course is to enable the student to:

1. understand the fundamentals of power systems
2. understand the mechanical and electrical design of transmission lines
3. understand HVDC transmission
4. understand the construction and various properties of underground cables
5. understand dierent types of distribution systems.

Learning Outcomes

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

1. analyze the performance of single and three phase AC transmission systems
2. design mechanical and electrical aspects of transmission lines
3. explain HVDC transmission operation and applications
4. analyze the performance of underground cables
5. explain the various types of power distribution systems.

Course Description

Mechanical design of transmission lines- electrical conductors, supports, insulators, sag and tension calculations, vibrations, corona and its interference with communication systems. Electrical design of transmission lines- electrical parameters, inductance and capacitance of single phase and three phase, symmetrical spacing, unsymmetrical spacing and transposition. Classification of the transmission lines- short, medium and long transmission lines, t and π circuits, Ferranti effect. Per unit quantities, symmetrical components, unsymmetrical faults. Relays- principle of operation, types, characteristics, torque equation, electromagnetic and solid state relays, relaying schemes. Apparatus and line protection- feeder protection, ring main protection, bus bar protection, carrier current protection of transmission lines, generator and transformer protection.

Teaching Methodology:

2 hour lecture and 1 hour tutorial per week and at least three3-hour laboratory sessions per semester organized on a rotational basis

Instruction materials/equipment

1. High Voltage Laboratory

2. Computer Laboratory

3. Simulation Software e.g. PST (MATLAB based), PowerFactory, PowerWorld

4. Projector

Prescribed text books

1. J. Duncan Glover, Thomas Overbye, Mulukutla S. Sarma (2016), Power System Analysis and Design, CL Engineering.
2. V.K. Mehta (2005), Principles of Power Systems, S.Chand & Company Ltd.

References

1. Turan Gonen, (2016), Modern Power System Analysis, CRC Press.
2. R.K. Rajput (2006), Power Systems Engineering, LAXMI Publications.

EEEI 443 Control Systems Engineering **48 hrs, 1.0 units**

Purpose

The aim of this course is to enable the student to:

1. Understand the difference between open and closed loop systems
2. Understand the principles of system modelling and feedback
3. 3. Un perform block diagram analysis of feedback control systems
4. understand design of controllers using the root locus
5. understand the design of controllers using Nyquist frequency techniques
6. understand the determination of system parameters and stability.

Learning Outcomes

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

1) explain the difference between open and closed loop systems
2) model physical systems with feedback
3) use dierent methods to determine system stability.
4) differentiate between the various control actions and their application
5) select an appropriate control action for a specific design
6) Design PI,PD and PID controllers

Course Description

Mathematical Foundation: Complex-Variable theory; Differential and Difference Equations; Laplace transformation and Z-transformation.Introduction: definition of a control system, importance of control systems, basic components, use of feedback in most control systems and types of control systems- examples in engineering and non-engineering fields.Transfer function: impulse response of linear systems,poles and zeros,response to excitations,relationship to frequency response,transfer function of electrical networks,electronic network,mechanical systems,analogue systems,electro-mechanical systems,transfer function matrices. Design specifications, controller configurations, fundamental principles of design, stability improvement using compensation networks. Design with proportional plus integral (PI controller), proportional plus derivative (PD controller), and proportional plus integral plus derivative (PID controller). Block diagrams and signal flow graphs. Error deductors and transducers,servo amplifiers,servo motors,other related Components- demodulators and modulators and types. Differentiators, integrators, attenuators, compensators-phase lead, phase lag and lag lead. Resolver:hydraulic elements,pneumatic elements,and pneumatic power servo-mechanism. System specification:system stability, Nyquist stability method, Bode plot method,root locus technique,design techniques,state variable characterization,non linear control systems,discreteltime systems,optimal control theory,stochastic control systems,self-adaptive control systems.

Teaching Methodology

2 hour lecture and 1 hour tutorial per week and at least three 3-hour laboratory session per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Control Engineering laboratory
2. LCD projector

Course Textbooks

1. Norman S. Nise, (2015) Control Systems Engineering, Wiley.
2. Distefano J. J, Stubberud A.R.,& Williams I.J (2013), Feedback and Control Systems; Theory and Problems (Schaum’s Outline Seties), McGraw-Hill.
3. Ogata K. (2016), Modern Control Engineering, Prentice Hall.

Course Journals

Reference Textbooks

1. Kuo, B.C, &Farid G. (2017), Automatic Control Systems, Wiley.
2. Gene F., (2014), Feedback Control of Dynamic Systems, Prentice Hall.

Reference Journals

1. Automatic control and computer science
2. Electrika: Journal of Electrical Engineering
3. Russian Electrical Engineering
4. Computing and Control Engineering
5. Acta Electrotechnica

EEEI 442 AC and Special Machines **48 hrs, 1.0 units**

Prerequisites:

DC Machines and Transformers

Purpose

The aim of this course is to enable the student to:

1. Understand the principle of operation of DC and AC machine drives
2. Understand the applications of DC, AC and special purpose machine drives.

Learning Outcomes

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

1. Explain the performance and electronic control of DC machine drives
2. Explain the performance and electronic control of AC machine drives
3. Explain the applications of DC, AC and special purpose machine drives.

Course Description

Polyphase induction motors: types and construction features, equivalent circuit, starting and speed control, induction generators. Single phase induction motors: types and construction features, principle of operation, equivalent circuit, based on double rotating field theory. Special machines: stepper, servo motors, linear, hysteresis, reluctance, applications, alternators: types and construction features, emf equation, rotating magnetic field, armature reaction, load characteristics, predetermination of regulation, basic ideas of two reaction theory.

Synchronous motors: synchronous machines on infinite bus bars, phasor diagram, V and inverted V curves current, hunting and suppression, starting methods. Brushless synchronous machine, Inverter-fed synchronous motor drives, reluctance and stepper motor drives.

Teaching Methodology:

2 hour lecture and 1 hour tutorial per week and at least three 3-hour laboratory sessions per semester organized on a rotational basis

Instruction materials/equipment

1. Electrical Machines Laboratory
2. Projector

Prescribed text books

1. Andre Veltman, Duco W.J. Pulle, Rik W. De Doncker (2014), Fundamentals of Electric Drives, Springer.

2. Muhammad H. Rashid (2014), Power Electronics: Circuits, Devices and Applications, Prentice Hall.

References

1. Vedam Subrahmanyam (2004), Electric Drives: Concepts and Applications, Tata Mc-Graw Hill, ISBN: 0074603701

2. Austin Hughes (2016), Electric Motors and Drives, 3rd Ed., Elsevier India.

JOURNALS

IEEE Transactions on Power Electronics

3.4.2.3 Telecommunication Systems Engineering

EEEI 452 Data Communication Networks **48 hrs, 1.0 units**

Prerequisites: Introduction to Computer Science

Purpose

The aim of this course is to enable the student to:

1. understand computer networks hardware and software
2. understand the different layers of the ISO/OSI Reference model and their functions
3. understand computer networks applications and standards.

Learning Outcomes

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

1. set-up a computer network

2. explain the propagation path of a digital signal in a computer network

3. explain the different layers of the ISO/OSI Reference model and their functions

4. explain computer networks applications and standards.

Layered network architecture;link layer protocols. High speed packet switching;queuing theory; Local Area Network (LAN) and Wide Area Networks (WAN); routing and flow control. WAN encapsulation methods;asynchronous connection. Point-to-point protocol,leased line,and Integrated Services Data Networks (ISDN). Virtual private networks;frame relay. Automatic teller machines (ATM), Synchronous Optical Network (SONE),and compression. Network address translation;network service providers.The Internet;network management;delay and loss management.

Teaching Methodology:

2 hour lectures and 1 hour tutorial per week and 3 hour laboratory

sessions per week organized on a rotational basis

Mode of Examination: Continuous Assessment and Written University Examination shall

contribute 30% and 70% respectively of the total marks.

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Instruction materials/equipment

1. Computer Laboratory
2. Projector

Prescribed text books

1. Brijendra Singh (2014), Data Communications and Computer Networks, Prentice Hall.
2. Thomas G. Robertazzi (2017), Introduction to ComputerNetworking, Springer

References

1. Douglas E. Comer & David L. Stevens (2013), Internetworking with TCP/IP, Prentice Hall.
2. William Stallings (2009), Computer Networking with Internet Protocols, Dorling Kindersley.

Journals

International Journal of Computer Networks & Communications

EEEI 454 Microwave Engineering **48 hrs, 1.0 units**

Prerequisites

Electromagnetic Fields and Waves

Purpose

The aim of this course is to enable the student to;

1. understand microwave devices and systems and their applications in modern science and technology
2. understand RF, ultra-fast integrated circuits and optics

Learning Outcomes

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

1. select suitable microwave devices for different tasks
2. apply the acquired knowledge and skills gained through laboratory practices and industrial attachment to design and construct and simple microwave components

Course Description

Introduction: Microwave frequencies, standard frequency bands, behaviour of circuits at conventional and microwave frequencies, microwave application, review of Maxwell’s equations. Waveguide:overview of guided waves; TE, TM and TEM modes, circular wave guide, Choice of the type of waveguide dimensions, waveguide problems. Microwave Components & Devices : Scattering matrix and its Properties, coupling probes, coupling loops, windows, Waveguide tuners, Termination, E-plane Tee, H-plane Tee, Magic Tee, Phase-Shifter, attenuators, Directional coupler, Gunn diode, Microwave transistor MASER, Resonator and circulators. Microwave generators: transit-time effect, limitations of conventional tubes, two-cavity and multi-cavity Klystrons, Reflex Klystron, TWT and magnetrons. Microwave antennae: Directional characteristics of antennas. Dipole, folded dipole and Yagi antenna, Broadband, Antenna arrays, Horn antennas. Parabolic and lens antennae. Microwave measurements: power measurement; calorimEEEIr method, BolomEEEIr bridge method, thermocouples, impedance measurement, measurement of frequency and wavelength, measurement of unknown loads, measurement of reflection coefficient, VSWR and noise, microwave test bench.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Telecommunication Lab
2. LCD projector

Course Textbooks

1. Mackintosh Consultants Company (1975), *Microwave Devices and Applications*,Mackintosh.
2. Simon Ramo, John R. Whinnery & Theodore Van Duzer (1984), *Fields and Waves in Communication Electronics*, John Wiley & Sons, 2nd Edition.

Course Journals

Reference Textbooks

1. Ahmad Shahid Khan,(2014) Microwave Engineering: Concepts and Fundamentals, CRC Press.
2. Bradford L. Smith, Michel H. Carpentier (1993), *Microwave Engineering Handbook: Microwave circuits, antennas, and propagation*, Van Nostrand Reinhold, illustrated Ed.
3. David M. Pozar (2011), *Microwave Engineering*, Wiley International, 3rd Edition.
4. Annapurna Das (2010), *Microwave Engineering*, Tata McGraw-Hill.

Reference Journals

1. Radio Engineering
2. International Journal of Microwave Science and Technology
3. IEEE Microwave and Wireless Components Letters

EEEI 456 Digital Signal Processing **48 hrs, 1.0 units**

Prerequisites

Digital Electronics

Purpose

The aim of this course is to enable the student to;

1. understand discrete systems and Fourier transforms
2. understand Z-transforms
3. understand design of IIR and FIR filters

Learning Outcomes

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

1. use Fourier and Z-transforms in the design of FIR and IIR filters
2. design IIR and FIR filters

Course Description

Discrete-time signals and systems: Discrete–time sequences, Linear Time Invariant (LTI) systems, linearity, time invariance, causality, stability, unit-sample response. Linear constant-coefficient difference equations; recursive and non-recursive.

Digital signal processing (DSP): key DSP operations;applications in audio, telecommunications and biomedical engneering. Sampling continuous time signals. Anti-aliasing filters. Quantization effects in the in the computation of DFT. Digital filter structures. Block diagram and signal flow graph representation. Basic FIR and IIR structures. State-space structures. Digital filter design. FIR filter design based on window methods (Truncated Fourier series, BartlEEEl, Blackman, Hamming, Hanning, Kaiser) and frequency sampling approach. Adaptive digital filter - basic concepts and applications. Quantization and round off effects in digital filters. Multirate DSP. Design of decimator and interpolator. Digital signal processors: architecture for signal processing. General purpose processorsand special DSP hardwares.Application and design studies. Evaluation boards for real time signal processing. Detection of foetal heart beats. Equalization of digital audio signals. Spectral analysis of audio signals. Transmultiplexers, Multitone transmission of digital data.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector
3. Laboratory work

Course Textbooks

1. John G. Proakis and Vinay K. lngle (2016), *Digital Signal Processing using Matlab*,International Thomson.
2. Jose Maria Giron-Sierra (2016) Digital Signal Processing with Matlab Examples, Springer.**Course Journals**

Reference Textbooks

1. K. Raja Rajeswari, (2014) Digital Signal Processing, I K International Publishing House.
2. Edmund Lai (2003), *Practical Digital Signal Processing for Engineers and Technicians*, Newnes, 1st Ed.
3. Andreas Antoniou (2006), *Digital Signal Processing Signals Systems and Filters*, McGraw.

Reference Journals

1. IEEE Transactions on Acoustics, Speech & Signal Processing
2. Eurasip Journal on Applied Signal Processing

3. **IEEE Transactions on Circuits and Systems Part II: Analog and Digital Signal Processing**
4. **EURASIP Journal on Advances in Signal Processing**
5. International Journal of Signal Processing

3.4.2.4 Instrumentation and Control Engineering

EEEI 461 Optical Instrumentation **48 hrs, 1.0 units**

Prerequisites

All Units from year I to III

Purpose

The aim of this course is to enable the student to:

1. Know the basic principles of optical instruments
2. Design various optical tools and equipment

Learning outcomes

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

1. Describe light principles behind the operation of optical instruments
2. Design the common optical instruments
3. Predict the future trends in optics

Course description

Semiconductor devices: PN junctions, Solar cell, LEDs , gain conditions, rate equations, spectra, lasers, Masers , waveguides and VCSELs, semiconductor optical amplifiers, optical modulators, all-optical switches, dEEEIctors, optical links. Optical instrumentation and sensors: Optical metrology, interferometry, fundamental length metrology, transfer of the length standard, gyroscopes, hydrophones, strain and temperature sensing, grating and distributed sensors, vibrometry, and velocimetry, speckle interferometry , optical telemetry, design of optical equipment e.g. reflective and refractive systems. photonic guiding: waveguide fundamental properties, dispersion, integrated optics, optical coating design and application, photonic crystals, Wave propagation, application to high efficiency emitters, miniaturized photonic circuits and dispersion engineering. Nonlinear optics and modulators: phenomenological theory of nonlinearities, optics of anisotropic media, harmonic generation, mixing and parametric effects. Two-photon absorption, saturated absorption and nonlinear refraction, Rayleigh, Brillouin and

Raman scattering, self-focusing and self-phase-modulation, self-induced transparency -solutions, optical switching, electro-optic effect and acousto-optic effects. EO and AO modulators. Optical informatics: optoelectronic interconnections, opto-electronic switching fabrics, quantum computing and quantum cryptography. Optical storage systems, e.g. CD, MD, CD-RW and DVD, tracking and focusing servo-systems, display and spatial light modulators, printers and scanners, image forming systems, coherent and incoherent imaging. Applications:laser safety, optical techniques in the automotive industry, aerospace applications of photonics, engineering management, pulsed laser material processing

Teaching methodology

3 hour lecture and 1 hour tutorial per week, and at least three 3-hour laboratory sessions per semester organised on a rotational basis

Mode of course assessment

Continuous assessment and written University examinations shall contribute 30% and 70% respectively of the total marks

Instructional materials/Equipment

1. Optical instrumentation lab
2. LCD projector

Course textbooks

1. Grant R. Fowles (1975),*Introduction to Modern Optics* ,Dover Publications Inc, New York 2nd Edition
2. Bahaa E. A. Saleh, Malvin Carl Teich,(2012)*Fundamentals of Photonics,* John Wiley & Sons, Inc,4th Edition

EEEI 463 Control Systems Engineering **48 hrs, 1.0 units**

Prerequisites: All Units from year I to III

Purpose

The aim of this course is to enable the student to:

1. Understand the difference between open and closed loop systems
2. Understand the principles of system modelling and feedback
3. perform block diagram analysis of feedback control systems
4. understand design of controllers using the root locus

5. understand the design of controllers using Nyquist frequency techniques
6. understand the determination of system parameters and stability

Learning Outcomes

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

1) explain the difference between open and closed loop systems
2) model physical systems with feedback
3) use dierent methods to determine system stability
4) differentiate between the various control actions and their application
5) select an appropriate control action for a specific design
6) Design PI,PD and PID controllers

Course Description

Mathematical Foundation: Complex-Variable theory; Differential and Difference Equations; Laplace transformation and Z-transformation. Introduction: definition of a control system, importance of control systems, basic components, use of feedback in most control systems and types of control systems - examples in engineering and non-engineering fields. Transfer function: impulse response of linear systems, poles and zeros, response to excitations, relationship to frequency response, transfer function of electrical networks, electronic network, mechanical systems, analogue systems, electro-mechanical systems, transfer function matrices. Design specifications, controller configurations, fundamental principles of design, stability improvement using compensation networks. Design with proportional plus integral (PI controller), proportional plus derivative (PD controller), and proportional plus integral plus derivative (PID controller). Block diagrams and signal flow graphs. Error deductors and transducers, servo amplifiers, servo motors, other related Components - demodulators and modulators and types. Differentiators, integrators, attenuators, compensators-phase lead, phase lag and lag lead. Resolver: hydraulic elements, pneumatic elements, and pneumatic power servo-mechanism. System specification: system stability, Nyquist stability method, Bode plot method, root locus technique, design techniques, state variable characterization, non-linear control systems, discrete time systems, optimal control theory, stochastic control systems, and self-adaptive control systems.

Teaching Methodology

2 hour lecture and 1 hour tutorial per week and at least three 3-hour laboratory session per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Control Engineering laboratory
2. LCD projector

Course Textbooks

1. Norman S. Nise, (2015) Control Systems Engineering, Wiley.
2. Distefano J. J, Stubberud A.R.,& Williams I.J (2013), Feedback and Control Systems; Theory and Problems (Schaum's Outline Seties), McGraw-Hill.
3. Ogata K. (2016), Modern Control Engineering, Prentice Hall.

Course Journals

Reference Textbooks

1. Kuo, B.C, &Farid G. (2017), Automatic Control Systems, Wiley.
2. Gene F., (2014), Feedback Control of Dynamic Systems, Prentice Hall.

Reference Journals

1. Automatic control and computer science
2. Electrika: Journal of Electrical Engineering
3. Russian Electrical Engineering
4. Computing and Control Engineering
5. Acta Electrotechnica

EEEI 465 Computer Vision **48 hrs, 1.0 units**

Digital Signal Processing

Learning Outcomes

1. Learning digital image fundamentals: visual perception, digital image pixels, image features.

2. Applying knowledge of Matlab in digital image representation, colour spaces, histogram, quantisation of image features.
3. Learning and applying knowledge in analysing image filtering, DFT, enhancement, and registration methods.
4. Learning and applying knowledge in analysing image decomposition and reconstruction with wavelets, image morphology, WFT.
5. Learning and applying knowledge in analysing image segmentation, representation, description, and recognition techniques.

Course Description

Introduction: estimating image motion field, pin-hole camera model, Lambertian surfaces. Image motion in 2-D. Brightness equation: binocular, stereo, reflection, surface orientation. Photometric stereo: brightness distribution (BDF), shapes from shading and gradient, Binary image processing,Euler equation and application, optical flow, motion vision, motion field, extended Gaussian images, geometry of translation. Basic principles of photogrammetry: image control and orientation, measurement from images, and image manipulation. Block schematic diagram of computer vision elements. Computer vision systems: Binary image processing, Euler equation and application, Image acquisition, pre-processing, features extraction,detectiondetection, and segmentation. High level processing: estimation of application specific parameterparameters, classifying detecteddetected objects. Computer vision tasks: recognition, detectiondetection. Content base image retrieval, pose estimation, optical character recognition. Ego-motion and tracking.

Textbook

J.F. Peters, (2014) Fundamentals for the Design of Vision Systems.

R.C. Gonzales, and Richard E. Wood, (2016) Digital Image Processing, Addison-Wesley.

Evaluation Details

The final course grade will be determined from a student's performance in laboratories (value 10%), and on 2 mid-terms (value 40%) and on final examinations (value 50%). Students must complete all the laboratories in order to be eligible to receive a passing grade

3.4.2.5 Electronic and computer engineering

EEEI 452 Data Communication Networks **48 hrs, 1.0 units**

Prerequisites

Data communications

Purpose

The aim of this course is to enable the student to;

1. understand data communication protocols work
2. understand the operation of high speed data networks
3. know how different data networks can be inter-connected

Learning Outcomes

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

1. Describe the operation of the TCP/IP protocol
2. Describe how high speed data networks are obtained by multiplexing lower data speeds
3. Choose an appropriate routing protocol for data communication

Layered network architecture; link layer protocols. High speed packet switching; queuing theory; Local Area Network (LAN) and Wide Area Networks (WAN); routing and flow control. WAN encapsulation methods; asynchronous connection. Point-to-point protocol, leased line, and Integrated Services Data Networks (ISDN). Virtual private networks; frame relay. Automatic teller machines (ATM), Synchronous Optical Network (SONE), and compression. Network address translation; network service providers. The Internet; network management; delay and loss management.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week and at least three 3- hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Telecommunications laboratory
2. Computer Laboratory
3. LCD projector

Course Textbooks

1. Joe Casad,(2017), *TCP/IP in 24 Hours, Sams Teach Yourself*, Sams Publishing.
2. Handel R., Huber M.N., Schoder S., (1995), *ATM Networks*, Addison-Wesley Publishing Co.

Course Journals

Reference Textbooks

1. Tanenbaum A.S. (2010), *Computer Networks*, Prentice Hall
2. Helgert H., (1991), *Integrated Services Digital Networks*, Addison-Wesley Publishing Co.

Reference Journals

EEEI 414 Computer Networks **48 hrs, 1.0 units**

Prerequisites

None

Purpose

The aim of this course is to enable the student to;

1. understand working principle of OSI and TCP/IP reference models
2. understand different protocols and access methods
3. understand operation of different devices in different layers of OSI and TCP/IP models

Learning Outcomes

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

1. design and implement a basic network
2. configure network devices

Course Description

Local Area Networks: wired LANs,topology, transmission media, medium access control methods, CSMA/CD, Control token, slotted ring, demand priority, CSMA/CA,wireless LANs. Transmission schemes: radio, infrared, medium access control methods, standards, and protocols. High speed and bridged LANs: Ethernet switching, fast Ethernet, IEEE 802.12, FDDI, bridges, topology, port status, state transitions, frame format, bit rate, frame size. Wide Area Networks: characteristics of public data networks, packets switched data networks, circuit switched data networks. Integrated services, digital networks, private networks. Internetworking: Internet work architectures, router/gateway. Protocol converter: Internetworking issues, network service, addressing, routing, quality of service, maximum packet size, flow and congestion control, error reporting. Network layer structure:Subnetwork Independent Convergence Protocol (SNIP), Subnetwork Dependent Convergence Protocol

(SNDCP), Subnetwork Dependent Access Protocol (SDAP); Internet protocol standards. Internet IP,address structure, datagrams, protocol functions, fragmentation and reassembly, routing - autonomous systems, address resolution protocol, interior and exterior gateway protocols, Internet control message protocol, IPV6. The ISO internet and routing protocols. Broadband multi-service networks: networking requirements, FDDI II,cycle structure, initialization process, bandwidth allocation. Cell based networks; ATM LANs; cell format and switching principles, switch architecture, protocol architecture, ATM adaptation layer, ATM layer, call processing, DQDB, ATMR , CRMA II, access control mechanism

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Textbooks

1. Andrew S. Tanenbaum (2002), *Computer networks*,Prentice Hall, 4th ed.
2. Larry L. Peterson, Bruce S. Davie (2007), *Computer Networks: A Systems Approach*, Morgan Kaufmann, 4th ed.

Course Journals

Reference Textbooks

1. John Y. Hsu (1996), *Computer networks: architecture, protocols, and software*, Artech House, illustrated Ed.
2. Raghavan, Gregor von Bochmann, G. Pujolle (1993), *Computer Networks, Architecture and Applications*, North-Holland, illustrated Ed.

Reference Journals

1. Computer Communications
2. Computer World

3. Journal of Computer Science

EEEI 465 Computer Vision 48 hrs, 1.0 units

Prerequisite

EEEI 456 Digital signal Processing

Learning Outcomes

1. Learning digital image fundamentals: visual perception, digital image pixels, image features.
2. Applying knowledge of Matlab in digital image representation, colour spaces, histogram, quantisation of image features.
3. Learning and applying knowledge in analysing image filtering, DFT, enhancement, and registration methods.
4. Learning and applying knowledge in analysing image decomposition and reconstruction with wavelets, image morphology, WFT.
5. Learning and applying knowledge in analysing image segmentation, representation, description, and recognition techniques.

Course Description

Introduction: estimating image motion field, pin-hole camera model, Lambertian surfaces. Image motion in 2-D. Brightness equation: binocular, stereo, reflection, surface orientation. Photometric stereo: brightness distribution (BDF), shapes from shading and gradient, Binary image processing, Eurler equation and application, optical flow, motion vision, motion field, extended Gaussian images, geometry of translation. Basic principles of photogrammetry: image control and orientation, measurement from images, and image manipulation. Block schematic diagram of computer vision elements. Computer vision systems: Binary image processing, Euler equation and application, Image acquisition, pre-processing, features extraction, detection, and segmentation. High level processing: estimation of application specific parameterparameters, classifying detected objects. Computer vision tasks: recognition, detection. Content base image retrieval, pose estimation, optical character recognition. Ego-motion and tracking.

Textbook

1. J.F. Peters, Fundamentals for the Design of Vision Systems, 2014 (distributed during course).
2. R.C. Gonzales, and Richard E. Wood, Digital Image Processing, 3rd Ed, Addison-Wesley, 2008.

Evaluation Details

The final course grade will be determined from a student's performance in laboratories (value 10%), and on 2 mid-terms (value 40%) and on final examinations (value 50%). Students must complete all the laboratories in order to be eligible to receive a passing grade

3.4.3 Semester III

3.4.3.1 Core Courses

EEEI 421 Systems Reliability and Maintainability **48 hrs, 1.0 units**

Prerequisites

- All units from year I to III

Purpose

The aim of this unit is to enable the learner to:

i. Apply engineering knowledge and specialist techniques to prevent or reduce likelihood of frequency failure
ii. Identify and correct the causes of failures that do occur, despite the efforts to prevent them
iii. Determine ways of coping with failures that occur if their causes have not been corrected
iv. Apply methods for estimating the reliability of new designs and analyse reliability data

Learning outcomes

At the end of this unit learner should be able to:

i. understand systems reliability and its limitations.
ii. develop an intuitive feel maintainability.
iii. systems analysis to determine reliability.
iv. analyse and understand maintenance procedure

Course description

Reliability: failure probability and density functions, component reliability, measures of reliability, reliability in the systems life cycle, reliability analysis methods, design review and evaluation or reliability, reliability test and evaluation. Maintainability: Maintenance management organization and scheduling, measures of maintainability, maintainability in the system life cycle, maintainability analysis methods. Design review and evaluation of maintainability.

Teaching Methodology

Three hours lectures with an hour group discussion per week

Modes of course assessment

Coursework for the unit shall be by continuous assessment and shall be defined as comprising assignments and continuous assessment tests and University examination to contribute 40% and 60% respectively for the total marks.

Instructional materials/Equipment

1. Overhead projector
2. Lecture room

Reference Textbooks

1. Rausand, M. 2004. System Reliability theory 2nd edition models. Statistical Methods and applications. John Wiley & Sons
2. Ross, S.M. 2014. Introduction to Probability Models. Academic Press
3. Lewis, E. E. 1996. Introduction to Reliability Engineering, John Wiley & sons New York.
4. Pecht, M. 1994. Integrated circuit, Hybrid and multichip module package design guidelines, A focus on reliability, John Wiley & sons, New York.
5. Practical tool for reliability engineer. 1999. Reliability analysis centre, NY
6. Dhillon B.S. 2002. Engineering maintenance: a modern approach. CRC PRESS

EEEI 481 Management and Entrepreneurship 48 hrs, 1.0 units

Prerequisites

None

Purpose

The aim of this course is to enable the students to;

1. understand the concepts and development of management
2. understand motivation and role of a manager
3. set up and manage small scale enterprises
4. perform financial accounting, budgeting, management and financial analysis
5. be well versed about sound leadership of business setups

Learning Outcomes

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

1. use concepts of management in leadership, delegation, budgets and personnel management
2. communicate, do performance appraisal and motivate in management
3. prepare and understand a profit and loss account and a balance sheet

4. demonstrate the ability to prepare a budget for an engineering/production firm, and identify the various sources of financing such a budget
5. demonstrate the ability to evaluate the performance of a business, using the various analysis ratios

Course description

Economics: basic concepts of micro and macro economics. International trade, World Bank and IMF. Management principles: basic concepts of management with examples of practical application. Project planning and management: project planning, CPA, costing, loading and scheduling, progress reporting, commissioning. Office administration: the office, functions, office equipment, organization andadministration. Production management: production planning activities, product development, quality of product control, statistical quality control, material procurement and stores, work study. Production Plant:plant location, types of production, plant layout,plant maintenance. Human resource management: organization structure, recruitment and selection, rewarding, industrial relations. Finance and budgeting: financial control, elements of costs, budgeting control, basic accounting procedures. Result oriented management (ROM): ROA and SMART, Steps in ROM, Comparison with RBM and RBI, performance contracts. Marketing linkages between entrepreneurship and engineering: problem solving, planning, systems analysis, and can-do attitude. Effecting projects through sales, marketing, planning, staffing, implementation, financing and growth. Survival and success through cash flow management. Human issues in new enterprises. Alignment of interests between providers of value and providers of capital. Transformation of enterprises along growth path.

Teaching Methodology

3 hour lecture and 1 hour tutorial per week.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Presentation software
2. LCD projector

Course Textbooks

1. Hisrich R. D., Michael P. & Dean A. (2016), Entrepreneurship, Boston, McGraw-Hill.
2. Charles Bamford, Garry Bruton (2015), Entrepreneurship, McGraw-Hill Education.

Reference Textbooks

1. H. James Harrington, Richard Harrington Jr., Ron Skeddle (2017), Creativity, Innovation, and Entrepreneurship, Productivity Press.
2. Dollinger, Marc J. (2007), Entrepreneurship: Strategies and Resources, New Jersey, Prentice Hall.

Reference Journals

EEEI 492 Electrical Engineering Laboratory IIIB **48 hrs, 1.0 units**

Laboratory exercises in Microprocessor systems, Computer Communications, Computer Vision, Multi media, Electrical Machines Drives and Robotics.

EEEI 494 Technical Project B **96 hrs, 2.0 units**

Prerequisites

Successful completion of all units from first year to fourth year of study.

Purpose

The objective is to confront the student with a real world engineering problem in order to consolidate skills in problem definition, analysis, design, construction, measurement, evaluation and communication. The project work will be selected so as to reflect the requirements for specially creative and analytical approaches. Students are expected to work largely on their own initiative.

Learning outcomes

At the end of this course the students will come up with a project and a report that must have the following components;

1. design
2. fabrication
3. testing

Course Description

The student is expected to produce a practical construction of a project as based on own designs. The project shall be submitted at the end of the third semester and shall be accessed through seminars, oral presentation, and examination of the written project report.

Course regulation

The project unit will have the following components for regulating it implementation:

(i) Project proposal and examination. Examinable components include proposal write up and oral presentation.

(ii) Project implementation in consultation with the supervisor

(iii) Project final examination. The examinable components include dissertation write up, oral presentation and project demonstration.

Teaching methodology:

The students will be allowed a day (8 hours) per week to research, design and fabricate, and consult with the supervisors. Another 2 hours are allowed every week for the students to present their progress reports on rotational basis. Academic staff members will usually attend.

Mode of course assessment: 100% based on presentations, reports and demonstrations.

Instruction materials/equipment

1. Electrical Engineering laboratories and workshops;
2. Computer laboratory;
3. LCD projector;

Course texts:

No predefined texts. The student will do literature review and identify suitable reference materials for the project.

3.4.3.2 Power Systems Engineering

EEEI 433 Power Electronics **48 hrs, 1.0 units**

Prerequisites

- Analogue electronic A
- Analogue electronic B
- Digital electronics
- Electric Circuits and Networks

Purpose

The aim of this unit is to enable the learner to:

i. have knowledge of discrete electronic devices, design, analysis and applications of discrete electronic circuits.
ii. Understand the basics of power converter circuit design and its limitations.
iii. Developed an intuitive feel power converter circuits analysis and design.
iv. Analysis of various converter circuits to determine frequency response, stability and feedback topologies.

v. Analyse and understand the behaviour of inverters.

Learning outcomes

At the end of this unit learner should be able to:

i. Understand the fundamentals of electronic devices and its limitations.
ii. Developed an intuitive feel for electronic circuits working and analysis
iii. Design and Applications of discrete electronic circuits.
iv. Pre requisites for other electronics subjects.
v. Analysis of analogue circuits to determine frequency response, stability and feedback topologies.

Course Description

Power devices: SCR, Triac, BJT, MOSFET, IGBT, and GTOs. Review of line commutated converters. Principle of phase control. Half-wave converters with R and RL loads. Full converters. Single phase half controlled and fully controlled bridge converters. Overlap angle. Three phase half- controlled and fully-controlled bridge converters. Dual converters, cyclo converters. Inverters: voltage source inverters- single-phase and six step inverters. Operation of single phase and polyphase half-controlled bridge circuits. Fully controlled bridge circuits. Free-wheeling diode. AC voltage control, RF interference. Forced-commutation Thyristor applications- Definition of forced commutation and additional stresses imposed on the thyristor. Methods of forced commutation. DC-DC conversion.

Teaching Methodology

- Overhead projector
- Lecture room
- Four Lab per semester

Modes of course assessment

Coursework for the unit shall be by continuous assessment and shall be defined as comprising assignments and continuous assessment tests and University examination to contribute 30% and 70% respectively for the total marks.

Instructional materials/Equipment

- Power Electronic Lab
- Overhead projector
- Lecture room

Reference Textbooks

1. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuits,Pearson India.
2. Malvino Albert Paul(2015) Electronic Principles, Tata McGraw-Hill Publishing Company Limited.
3. Bell David A, Electronic Devices And Circuits, (4th) New Delhi, Prentice Hall Of India, 2004.
4. Horowitz P & Hill W, (2015)The Art of Electronics. UK. Cambridge University Press.
5. Aldo Karlmann, (2016) Electronic Devices and Circuits, CreateSpace Independent Publishing Platform.

EEEI 441 Electrical Machine drives **48 hrs, 1.0 units**

Circuit & Network Theory; Physics

Purpose

The aim of this course is to enable the student to:

1. understand the constructional features and operational characteristics of DC machines
2. understand the constructional features and operational characteristics of transformers.

Learning Outcomes

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

1. Describe the constructional features of DC machines and transformers
2. Analyze the characteristics and operation of DC machines and transformers
3. Explain starting, speed control and braking methods used for DC motors.

Course Description

DC Machines Drives – dynamics, performance equations, and systems. Electronic control of DC drives using rectifier and choppers. Transfer function of DC machine drive systems. Speed and current feedback control systems for DC machines drives. Microprocessor control systems for DC machine drives. Application of DC machine variable speed drives in traction including railway traction, lifts etc. AC Machine Drives- AC Machine drive dynamics and performance equation. AC machine drive systems, induction motor drives. Synchronous motor drives. Electronic control of AC drives using inverters. Harmonic distortion and losses. Control of frequency, voltage and power. Transfer functions of AC machine drive systems with speed, current, flux feedback. Microprocessor control of AC machine drives. Applications of AC machine variable speed drives.

Teaching Methodology: 2 hour lecture and 1 hour tutorial per week and at least three

3-hour laboratory sessions per semester organized on a rotational basis

Instruction materials/equipment

1. Electrical Machines Laboratory

2. Projector

Prescribed text books

1. Andre Veltman, Duco W.J. Pulle, R.W. de Doncker, (2016) Fundamentals of Electrical Drives (Power Systems), Springer

2. El-Sharkawi (2016), Fundamentals of Electric Drives, Cengage Learning (Thompson),
ISBN: 8131510042

2. Muhammad H. Rashid (2014), Power Electronics: Circuits, Devices and Applications, Prentice Hall, ISBN: 0131011405

References

1. Ion Boldea, Syed A. Nasar (2016), Electric Drives,CRC Press.

2. Austin Hughes (2016), Electric Motors and Drives, Elsevier India Private Limited, ISBN: 8131206688

3. IEEE Transactions on Power Electronics

EEEI 443 Power Systems Engineering B **48 hrs, 1.0 units**

Prerequisites :Power Systems A

Purpose

The aim of this course is to enable the student to:

1. understand the significance and applications of symmetrical components in power system modeling
2. understand symmetrical and unsymmetrical fault calculations
3. understand underground cables fault detection and location
4. understand the various power systems protection schemes.

Learning Outcomes

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

1. model simple power systems using symmetrical components
2. analyze symmetrical and unsymmetrical power system faults
3. explain the operation of various relays and circuit breakers, their functions and applications
4. determine relay coordination in power systems protection
5. select rationally and design the best protection system for any electrical equipment.

Course description

Protection against over voltages- ground wires, surge absorbers and diverters. Earthing- neutral earthing, insulation coordination. Circuit breakers- theory of arc quenching and circuit breakers, rating of CB, and types of circuit breakers. Power system economics- load curves and maximum demand, station operating schedule. Plant capacity and plant use factors. Economics of power generation, cost of electrical energy, methods of determining depreciation, importance of high load factor. Forecast of load growth co-ordination of different types of plant. Introduction to optimum economic dispatch solutions using digital computers. Power systems stability- power transfer and steady state stability. Transient stability, the swing equation and the equal area criterion for stability. Methods of improving power system stability.

Teaching Methodology:

2 hour lecture and 1 hour tutorial per week and at least three3-hour laboratory sessions per semester organized on a rotational basis

Instruction materials/equipment

1. High Voltage Laboratory
2. Computer Laboratory
3. Power system simulation software e.g. Power System Toolbox (MATLAB based), PowerFactory
4. Projector

Prescribed text books

1. J. Duncan Glover, Thomas Overbye, Mulukutla S. Sarma (2016), *Power System Analysis and Design*, CL Engineering.
2. V.K. Mehta (2005), Principles of Power Systems, S.Chand & Company Ltd.

References

1. Turan Gonen, (2016), Modern Power System Analysis, CRC Press.
2. R.K. Rajput (2006), Power Systems Engineering, LAXMI Publications.

3.4.3.3 Telecommunication Systems Engineering

EEEI 455 Telecommunications and Internet **48 hrs, 1.0 units**

Teaching Methodology

2 hour lectures and 2 hour tutorial per week, and at least three 2-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Communication Lab
2. LCD projector
3. White boards and Marker pens

Course Description

Fundamentals of antennas: characteristics of the electromagnetic waves. The electromagnetic spectrum: the Hertzian dipole, half wave dipole and their radiation patterns. Propagation of electromagnetic waves: free space propagation,absorption, reflection, and diffraction. Various modes of propagation: sky wave propagation and tropospheric propagation. Communications systems: basic elements, communications signals, time and frequency domains, bandwidth, the electromagnetic spectrum, physical media (copper, fibre, and radio propagation), signal degradation, noise and signal to noise ratio, networks and architectures, protocols and layering, standards. Modulation and multiplexing: principles of sinusoidal carrier modulation, amplitude modulation and demodulation, frequency division multiplexing, pulse amplitude modulation, sampling, aliasing, pulse code modulation, quantisation, compacting, time division multiplexing. Digital communications and networks: bit-rate and channel bandwidth, digital modulation schemes, modems, data transmission, throughput, telecommunications networks and resource sharing, basic call set-up. Internet protocols and applications: internetworking, introduction to layer 3 (IP) and layer 4 (TCP/UDP) protocols, applications protocols: email, ftp, world-wide web, packet voice.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least 2 2-hour laboratory sessions per semester.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1) Communication Lab.
2) LCD projectors.
3) White boards and marker pens.

Course Textbooks

1) Walter Fischer, (2013) Digital Video and Audio Broadcasting Technology, signals and communication technology, Verlag Berlin Heidelberg.
2) J. D. Kraus and R.J. Marhefka (2006), Antennas (for all applications), McGraw-Hill.
3) Wireless Communications and Networking, J. W. Mark & W. Zhuang, Prentice Hall India, 2006.
4) Electronic Communications Systems, Fundamentals through Advanced (5th Ed.), W. Tomasi, Prentice Hall, 2004.
5) WCDMA for UMTS, Radio Access for Third Generation Mobile Communications (3rd Ed.),
6) John G. Proakis, “Digital Communications", 4th Edition, Prentice Hall, NewJersey, 2000

Reference Textbooks

1. M.Richharia (2014), “Mobile Satellite Communications, Principles and Trends,” Pearson Education.
2. Walter Fischer, Digital Television. Verlag Berlin Heidelberg 2010.
3. K. Fazel, S. Kaiser (2003) Multi-Carrier and Spread Spectrum Systems,John Willey and Sons

EEEI 453 Digital Broadcasting

Prerequisite **48 hrs, 1.0 units**

Electromagnetic I and II, Digital Signal Processing, Electromagnetic Fields and Waves, Antennae Theory and Design, Microwave Engineering.

Purpose

The aim of this course is to enable the student to;

1. to gain understanding of satellite transmitting and receiving antennae.
2. to gain knowledge on frequency planning and optimization.
3. prepare for more advanced work in RF and satellite communication.
4. to understand satellite communication configuration design of receivers.
5. to analyze the challenges affecting digital broadcasting and how to mitigate these challenges.

Learning Outcomes

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

1. to Compare Digital Video Standards.
2. to improve performance of digital broadcasting systems.
3. to select the best modulation and compression techniques for television and radio broadcasting.
4. to understand terrestrial transmission of digital television signals.
5. to select the best topology for satellite broadcasting

Course Description

Digital radio and television broadcasting technology. Development of digital broadcasting. Compression Techniques: audio compression techniques, video compression techniques. Modulation techniques used in digital broadcasting. Conditional access techniques for digital broadcasting. Standards currently used for satellite, cable, terrestrial and audio digital broadcasting. Likely future developments in digital broadcasting

Teaching Methodology

2 hour lectures and 2 hour tutorial per week, and at least three 2-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Communication Lab
2. LCD projector
3. White boards and Marker pens

Course Textbooks

1. Walter Fischer, (2013) Digital Video and Audio Broadcasting Technology, signals and communication technology, Verlag Berlin Heidelberg.
2. J. D. Kraus and R.J. Marhefka (2006), Antennas (for all applications), McGraw-Hill.

Reference Textbooks

1. M.Richharia (2014), "Mobile Satellite Communications, Principles and Trends," Pearson Education.
2. Walter Fischer, Digital Television. Verlag Berlin Heidelberg 2010.

EEEI 451 Multimedia Information Networking **48 hrs, 1.0 units**

Prerequisite: Data Communications

Course Objective

At the end of the course the learner should be able to:

to:

1. have an excellent understanding of multimedia enabling
   - technologies
   - services and
   - applications
2. master basic Networking concepts and protocols

3. Understand how Multimedia and Networking (Communications) play together

Learning outcomes

Upon the completion of this course the student should be able to:

1. Understand the overview of Multimedia Information Networking and enabling technologies. Classify and define information networks as well as multimedia systems.
2. Understand multimedia information representation
3. Explain Textual information codes and Multimedia file formats and digital video: video representation and transmission

4. Explain Audio coding, Still image code and Moving image coding
5. Explain data communication protocols and network topologies
6. Understand multimedia applications; Local Area Network, Wide Area Network and internetworking

Course Description

Overview of multimedia information networking: information universe -enabling technologies. Classification and definitions: need for classification and definition for information networks, multimedia systems. Multimedia information representation: digital versus analogue systems. Textual information Codes, e.g. Morse Code, ASCII Code and EBCDIC Code. Multimedia file formats. Audio coding; Still image Code. Moving image coding. Data communications principles – data transmission. Telephone networks. Signals for data communication -character and frame synchronization handshake techniques. The RS-232 standard. Data communication protocols. Networking fundamentals. Communication media. Network topologies -connection types. Communication casting modes - multimedia applications. Multi-user networked applications. Wide Area Networks: Circuit and packet switching networks. Local Area Networks. Internetworking and asynchronous transfer modes.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Computer Lab
2. LCD projector

Text Books

1. Z-N. Li, M.S. Drew, Fundamentals of Multimedia, Pearson Prentice Hall Upper Saddle River, NJ, 2004
2. R. Steinmettz and K. Nahrstedt, Multimedia: Computing, Communications and Applications, Prentice Hall, 1995.
3. R. Steinmettz and K. Nahrstedt, Multimedia Fundamentals: Media Coding and Content Processing, Prentice Hall, 2002.
4. K. R. Rao, Z. S. Bojkovic and D. A. Milanovic, Multimedia Communication

3.4.3.4 Instrumentation and Control Engineering

EEEI 431 Microprocessors and Digital Design **48 hrs, 1.0 units**

Prerequisites
Digital Electronics

Purpose
The aim of this course is to enable the students to;
1. understand the fundamentals of microprocessors
2. understand the concepts of interior elements of a microprocessor , including data transfer and storage
3. know how to design and implement software systems

Learning Outcomes
At the end of this course, the student should be able to;
1. Describe the internal structure of a microprocessor
2. know the difference between microprocessors and micro-controllers
3. Design systems requiring microprocessor controllers

Combinational logic: ROM and PLA as combinational logic elements, e.g code converters; the QUINE McLusky algorithms; multi-output minimization. Sequential logic:classification of state machine; Moore/Mealy diagrams and state diagram and tables, state reduction, design of clock driven and event driven sequential machine, race hazard conditions. Microprocessor architecture, instruction cycles and timing diagram, Instruction set, programming in assembly language, memories and I/O interfaces. Software development systems; assemblers, linkers, debuggers, compilers etc. Microcontroller systems; microcontroller architecture, instruction cycles and timing diagram, instruction set, programming in assembly language, memories and I/O interfaces, interrupts; prioritization by hardware, DMA operations. Diagnostics software; bus signals sequence predictions in free running. Troubleshooting of microprocessor-based systems; logic state analyzers.

Teaching Methodology

2 hour lecture and 1 hour tutorial per week and at least three 3-hour laboratory session per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Digital Electronics Laboratory
2. LCD projector

Course Textbooks

1. Khambata, Adi J, (1986), Microprocessors/Microcomputers: architecture, software and Systems, Wile, New York.
2. Crisp J. (2004), Introduction to Microprocessors and Microcontrollers, Amsterdam, Boston, Elsevier/Newnes, 2nd Ed.

Course Journals

Reference Textbooks

1. Tocci R.J, & Ambrosio F.J., (2002), Microprocessors and Microcomputers: hardware and software, Prentice Hall, 6th Ed.
2. Ramesh S.G.,(2002), Microprocessor Architecture, Programming, and Application with 8085, Prentice Hall, 5th Ed

EEEI 461 Robotics and Automation **48 hrs, 1.0 units**

Prerequisites

Programming in C/C++/Assembly Language

Purpose

The aim of this course is to enable the students to;

1. View robotics as application of control systems engineering
2. Comprehend the history of robotics
3. Comprehend the components of a robot and their roles
4. Design a robot for a given task and task environment
5. Program a robot

Learning Outcomes

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

1. View robotics as application of control systems engineering
2. Comprehend the history of robotics
3. Comprehend the components of a robot and their roles
4. Design a robot for a given task and task environment
5. Program a robot

Course Description

Automation androbotics - robot anatomy, work volume, drive systems, control system anddynamic performance precision of movement, End effectors, Sensors, Work cell control & Programming. Control system concept andmodels, controllers, control system analysis, activation andfeedback components, position sensor, velocity sensors. Manipulator, kinematics, transformations, robot arm kinematics anddynamics, sensors in robotics, tactile sensors, proximity andrange sensors, sensor based systems, uses of sensors in robotics. Introduction, sensing anddigitizing functions in machine vision. Image processing andanalysis, training and vision systems. Languages, arobot program as a path in science, motion interpolation, wait, signal anddelay commands, branching, and limitation. Goals, techniques, artificial intelligence (AI) androbotics, and machine. Implementation, safety, training, maintenance andquality control. Simulations.

Teaching Methodology

3 hours lectures and 1 hour tutorial per week, and at least five 3-hour lab sessions per semester organized on a rotational basis.

Mode of Course Assessment

Continuous assessment and written university examinations shall contribute 40% and 60% respectively of the total marks.

Instructional Materials/Equipment

1. Automation and Control Engineering Lab
2. LCD Projector

Course Textbooks

1. Kenneth F., Millian Q.(2016) *Robotics: The Beginner's Guide to Robotic Building, Technology, Mechanics, and Processes,* Kenneth Fraser.
2. Roland S., I. R. Nourbakhsh, Davide S. (2011) *Introduction to Autonomous Mobile Robots*, MIT Press.
3. David Cook, (2015) *Robot Building for Beginners*, Apress.

Course Journals

1. Journal of Intelligent & Robotic Systems
2. International Journal of Social Robotics

Reference Textbooks

John J. Craig, (2017) Introduction to Robotics: Mechanics and Control, Prentice Hall.

Reference Journals

IEEE Transactions on Robotics

EEEI 463 Digital Control Engineering **48 hrs, 1.0 units**

Prerequisites

Control System Engineering

Purpose

The aimof the course is to enable the student to:

i. Understand how discrete time signals are derived from continuous signals and vice versa
ii. Design and analyze digital control systems

Learning Outcomes

At the end of this course the student should be able to;

i. Carry out transform analysis of discrete time systems
ii. Analyze discrete time systems in terms input and output and stability
iii. Carry out design and analysis of digital control systems

Course Description

Sampling process, impulse modulation, z-transform mapping of j-plane to z-plane, pulse transfer function stability and analysis in z-plane. Discrete time signals and systems: SDC systems, sampling and data reconstruction, discrete time state (difference) equations and solution.Transform analysis of discrete systems: linear differential equations, pulse transfer function and pulse response, z-transform, equivalent of z-domain to s-domain. Design of digital controls: position servomechanism, digital PID controller, multivariable controllers, digital and logic gates. Functions: arithmetic functions skip and master control, data none system, digital bits, sequence functions, matrix functions, robot control, FIFO, LIFO and loop control. Process variables, mathematical modelling of liquid, gas, thermal, mechanical and chemical systems, linearizing techniques, liquid level control.On-off, proportional, integral, derivative modes: electronic pneumatic and hydraulic controllers, single and composite modes of controllers. Control valves:types, functions, electrical pneumatic, hydraulic actuators, solenoid E. P. converters. Simple loop, multi loop systems P/I, cascade ration feed forward, override split range, selective and auctioneering control system with multiple loops, dead time compensation, and adaptive, inferential control. Design of control systems for multivariable processes. Computer control systems in process control: DCS configuration, consul, DCS I/O hardware supervisory and data acquisition systems.Optical links: optical radiation sources, optical dEEEIctors, typical systems.

Teaching Methodology

3hour lecture and one tutorial per week and at least two3hr laboratory sessions per semester.

Modes of course assessment

i. Assignments – 5%
ii. At least one timed continuous assessment test 15%
iii. Laboratory Exercise – 10%
iv. End of Semester Examination 70%

Reference

1. Gopal M., (1997), *Digital Control and State Variable Methods*. Tata McGraw-Hill Publishing Company Limited, New Delhi
2. Fadali M.S. and Visioli A., (2012).*Digital Control Engineering*. Elsevier Publishers, Gurgaon – Haryana, India
3. Kuo B.C., (2007). Digital Control Systems. Oxford University Press Inc., New York

3.4.3.5 Electronic and computer engineering

EEEI 431 Microprocessors and Digital Design **48 hrs, 1.0 units**

EEEI 372 Microprocessor Architecture and Interfacing

Purpose

The aim of this course is to enable the student to design basic digital electronic systems and relate them to the internal architecture of microprocessors and microcontrollers

Learning Outcomes

At the end of this course you should be able to:

1. Distinguish between sequential and combinational logic
2. write assembly language code for microprocessors
3. describe the architecture of microprocessor and microcontroller systems
4. draw timing diagrams to illustrate microprocessor and microcontroller operations
5. troubleshoot microprocessor-based systems

Course Description

Combinational logic: ROM and PLA as combinational logic elements, e.g code converters; the QUINE McLusky algorithms; multi-output minimization. Sequential logic: classification of state machine; Moore/Mealy diagrams and state diagram and tables, state reduction, design of clock driven and event driven sequential machine, race hazard conditions. Microprocessor architecture, instruction cycles and timing diagram, Instruction set, programming in assembly language, memories and I/O interfaces. Software development systems; assemblers, linkers, debuggers, compilers etc. Microcontroller systems; microcontroller architecture, instruction cycles and timing diagram, instruction set, programming in assembly language, memories and I/O interfaces, interrupts; prioritization by hardware, DMA operations. Diagnostics software; bus signals sequence predictions in free running. Troubleshooting of microprocessor-based systems; logic state analyzers.

Teaching Methodology

1) 2 hours of lectures per week will be used to introduce material on the formal aspects of the unit
2) 1 hour tutorial per week
3) at least five 3-hour laboratory sessions per semester organized on rotational basis
4) students will research and present their findings on various topics
5) discussions and working out problems

Mode of Course Assessment: Continuous assessment and written University examinations shall contribute 30% and 70% respectively of the total marks

Instructional Materials/Equipment

1) microprocessor system development toolkit
2) assembly language programming environment (assembler)

Course Textbooks

1. Janice G Mazidi and Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems, 2nd Edition, 2005.
2. Michael D. Ciletti, Advanced Digital Design with the VERILOG (TM), HDL, 1/e, Prentice-Hall, ISBN: 0-13-089161-4.
3. Frank Vahid and Tony Givargis, Embedded System Design: A unified hardware/software introduction, John Wiley & Sons, ISBN: 0471386782.
4. Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, Computer Organization and Embedded Systems, 2011

Course Reference Textbooks

1. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach (The Morgan Kaufmann Series in Computer Architecture and Design), Morgan Kaufmann, 5th edition, 2011, ISBN-13: 978-0123838728, ISBN-10: 012383872X
2. David A. Patterson and John L. Hennessy, Computer Organization and Design, Fourth Edition: The Hardware/Software Interface (The Morgan Kaufmann Series in Computer Architecture and Design), Morgan Kaufmann , 5th Edition, 2013, ISBN-13: 978-0124077263 ISBN-10: 0124077269

Reference Journals

1. Programming microprocessors with a high level language-the case of PASCAL/64000, Microprocessors and Microsystems, Volume 7, Issue 4, May 1983, Pages 169-172
2. Methodology for the evaluation and selection of microprocessors for specific applications, Microprocessors and Microsystems, Volume 7, Issue 9, November 1983, Pages 439-443
3. General addressing mechanisms for microprocessors, Microprocessors and Microsystems, Volume 12, Issue 2, March 1988, Pages 67-75

Reference Journals

1. IEEE Journal of Solid-State Circuits
2. The international Journal of Microprocessors and Microsystems
3. *Embedded Hardware Design (MICPRO)*

EEEI 411 Database Management System **48 hrs, 1.0 units**

Prerequisites

EEE118 Computer Programming

Purpose

The aim of this course is to enable the student to;

1. differentiate between file system and database.
2. be familiarize with various database models
3. acquire the skills of how to manage databases.

Learning Outcomes

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

1. distinguish between the three database models.
2. query database using appropriate software.
3. create and maintain a simple database.

Course Description

Introduction: data base system concepts and architecture, data models schema and instances, data independence and data base language and interface, data definition languages, DML. Overall data base structure. Data modeling using Entity Relationship Model: ER model concept, notation for ER diagrams mapping constraints, keys - concept of super key, candidate key,primary key generalizations, aggregation, reducing ER diagrams to tables, extended ER model, relationships of higher degree. Relational data model and language: relational data model concepts, integrity constraints, keys domain constraints, referential integrity, assertions triggers, foreign key relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL. Example DBMS system:basic architecture data definition and data manipulation, ISQL,PL SQL, cursors, triggers, stored procedures etc. Database design: Functional dependencies, normal forms, first, second and third functional personal normal forms. BCNF, multi-valued dependencies fourth normal forms, join dependencies and fifth normal forms. Inclusion dependencies, loss less join decompositions, normalization using FD, MVD and JDs, alternatives approaches to database design. Transaction processing concepts: transaction processing system ,schedule and recoverability, testing of serializability, serializability of schedules, conflict & view serializable schedule ,transaction processing in distributed database fragmentation, locking, Protocols for distributed database recovery from transaction failures, deadlock handling, long durations transactions, SAGA concurrency control techniques: locking techniques for concurrency control ,time stamping protocols for concurrency control, concurrency control in distributed systems. Estimation of cost and optimization of tuple transfer for join in distributed styles, validation technique, multiple granularity, multiversion schemes.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Computer Lab
2. LCD projector

Course Textbooks

1. Carlos Coronel, Steven Morris,(2016) Database Systems: Design, Implementation, & Management, Course Technology.
2. C. J. Date (2003), *An Introduction to Database Systems*,Addison-Wesley.
3. Thomas M. Connolly, Carolyn E. Begg (2014), *Database systems: a practical approach to design, implementation, and management*, Addison-Wesley.

Course Journals

Reference Textbooks

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan (2015), *Database System Concepts*, McGraw-Hill.
2. Raghu Ramakrishnan, Johannes Gehrke (2003), *Database management systems*, McGraw.
3. Hector Garcia-Molina, Garcia-Molina, Jeffrey D (2014), *Database Systems: The Complete Book*, Prentice Hall.

Reference Journals

EEEI 451 Multimedia Information Networking **48 hrs, 1.0 units**

Prerequisite: Data Communications

Course Objective

At the end of the course the learner should be able to:
to:

1. have an excellent understanding of multimediaenabling
    - technologies
    - services and
    - applications
2. master basic Networking concepts andprotocols
3. Understand how Multimedia and Networking (Communications) play together

Learning outcomes

Upon the completion of this course the student should be able to:

1. Understand the overview of Multimedia Information Networking and enabling technologies. Classify and define information networks as well as multimedia systems.
2. Understand multimedia information representation
3. Explain Textual information codes and Multimedia file formats and digital video: video representation and transmission

4. Explain Audio coding, Still image code and Moving image coding
5. Explain data communication protocols and network topologies
6. Understand multimedia applications; Local Area Nertwork, Wide Area Network and internetworking

Course Description

Overview of multimedia information networking: information universe - enabling technologies. Classification and definitions: need for classification and definition for information networks, multimedia systems. Multimedia information representation: digital versus analogue systems. Textual information Codes, e.g. Morse Code, ASCII Code and EBCDIC Code. Multimedia file formats. Audio coding; Still image Code. Moving image coding. Data communications principles – data transmission. Telephone networks. Signals for data communication - character and frame synchronization handshake techniques. The RS-232 standard. Data communication protocols. Networking fundamentals. Communication media. Network topologies - connection types. Communication casting modes - multimedia applications. Multi-user networked applications. Wide Area Networks: Circuit and packet switching networks. Local Area Networks. Internetworking and asynchronous transfer modes.

Teaching Methodology

2 hour lectures and 1 hour tutorial per week, and at least five 3-hour laboratory sessions per semester organized on a rotational basis.

Mode of course assessment: Continuous assessment and written University examinations shall contribute 30% and 70%, respectively of the total marks.

Instructional Materials/Equipment

1. Computer Lab
2. LCD projector

Text Books

1. Z-N. Li, M.S. Drew, (2014) Fundamentals of Multimedia, Pearson Prentice Hall Upper Saddle River.
2. R. Steinmettz and K. Nahrstedt, Multimedia: Computing, Communications and Applications, Prentice Hall, 1995.
3. R. Steinmettz and K. Nahrstedt, (2008) Multimedia Fundamentals: Media Coding and Content Processing, Prentice Hall.
4. K. R. Rao, Z. S. Bojkovic and D. A. Milanovic, Multimedia Communication

4 Distribution of Examination Marks, Lectures and Practical's

BTech (Electrical and Electronic Engineering Technology) at KPUC

Course Code	Course	Course Hours	Cours e Unit	Examination Marks			Lectures and Practicals (Hours)		
				CW	Exam	Total	Lectur es	Practic als	Total

Year I

Semester I

EEEI 101	Mathematics IA	48	1	30	70	100	32	16	48
EEEI 111	Physics A	60	1.25	37.5	87.5	125	30	30	60
EEEI 113	Chemistry A	48	1	30	70	100	24	24	48
EEEI 115	Biological Science	48	1	30	70	100	24	24	48
EEEI 117	Introduction to Computing	60	1.25	37.5	87.5	125	30	30	60
EEEI 121	Introduction to Engineering Technology	36	0.75	30	45	75	18	18	36
EEEI 123	Engineering Graphics A	60	1.25	75	50	125	24	36	60
EEEI 181	Communication Skills	24	0.5	15	35	50	24	0	24
Total	**Semester I**	**384**	**8**	**285**	**515**	**800**	**206**	**178**	**384**
			0.0%	35.6%	64.4%	100%	53.6%	46.4%	100%

Semester II

EEEI 102	Mathematics IB	48	1	30	70	100	32	16	48
EEEI 112	Physics B	60	1.25	37.5	87.5	125	30	30	60
EEEI 114	Chemistry B	48	1	30	70	100	24	24	48
EEEI 116	Earth and Environmental Science	48	1	30	70	100	24	24	48
EEEI 118	Computer Programming	60	1.25	37.5	87.5	125	30	30	60
EEEI 122	Introduction to Electrical Engineering	36	0.75	30	45	75	18	18	36
EEEI 124	Engineering Graphics B	60	1.25	75	50	125	24	36	60
EEEI 182	Philosophy and Ethics	24	0.5	15	35	50	24	0	24
Total	**Semester II**	**384**	**8**	**285**	**515**	**800**	**206**	**178**	**384**
				35.6%	64.4%	100%	53.6%	46.4%	100%

Total	**Year I**	**768**	**16**	**570**	**1030**	**1600**	**412**	**356**	**768**
				35.6%	64.4%		53.6%	46.4%	100%

Year II

Semester I (Internal Attachment) (12 Weeks)

EEEI 290	Workshop Practice	432	4.5	450	0	450	0	216	216
Total	**Semester I**	**432**	**4.5**	**450**	**0**	**450**	**0**	**216**	**216**
				100.0 %	0.0%	100%	0.0%	100.0 %	100%

Semester II

EEEI 201	Mathematics IIA	48	1	30	70	100	32	16	48
EEEI 221	Fluid Mechanics	48	1	40	60	100	19.2	28.8	48
EEEI 223	Solid and Structural Mechanics	48	1	40	60	100	19.2	28.8	48
EEEI 225	Thermodynamics	48	1	40	60	100	19.2	28.8	48
EEEI 231	Electric Circuit Theory IA	60	1.25	50	75	125	24	36	60
EEEI 233	Analogue Electronics A	60	1.25	50	75	125	24	36	60
EEEI 291	Electrical Engineering Laboratory IA	96	2	200	0	200	0	96	96
Total	**Semester II**	**408**	**8.5**	**450**	**400**	**850**	**137.6**	**270.4**	**408**
				52.9%	47.1%	100%	33.7%	66.3%	100%

Semester III

EEEI 202	Mathematics IIB	48	1	30	70	100	32	16	48
EEEI 222	Energy Resources	48	1	40	60	100	19.2	28.8	48
EEEI 224	Mechanics of Machines	48	1	40	60	100	19.2	28.8	48
EEEI 226	Material Science	48	1	40	60	100	19.2	28.8	48
EEEI 232	Electrical Circuits and Networks	60	1.25	50	75	125	24	36	60
EEEI 234	Analogue Electronics B	60	1.25	50	75	125	24	36	60
EEEI 292	Electrical Engineering Laboratory IB	96	2	200	0	200	0	96	96
Total	**Semester III**	**408**	**8.5**	**450**	**400**	**850**	**137.6**	**270.4**	**408**
				52.9%	47.1%	100%	33.7%	66.3%	100%

Total	**Year II**	**1248**	**21.5**	**1350**	**800**	**2150**	**275.2**	**756.8**	**1032**
				62.8%	37.2%	100%	26.7%	73.3%	100%

Year III

Semester I (Internal Attachment) (12 Weeks)

EEEI 390	Project Design and Fabrication	432	4.5	450	0	450	0	216	216
Total	Semester I	**432**	**4.5**	**450**	**0**	**450**	**0**	**216**	**216**
				100.0 %	0.0%	100%	0.0%	100.0 %	100%

Semester II

EEEI 301	Probability and Statistics	48	1	30	70	100	32	16	48
EEEI 331	Digital Electronics	60	1.25	50	75	125	24	36	60
EEEI 333	Analogue and Digital Control Systems	60	1.25	50	75	125	24	36	60
EEEI 335	Computer Aided Design	60	1.25	50	75	125	24	36	60
EEEI 337	Instrumentation and Measurement	48	1	40	60	100	19.2	28.8	48

EEEI 339	Electromagnetic Fields and Waves	48	1	40	60	100	19.2	28.8	48
EEEI 391	Electrical Engineering Laboratory IIA	96	2	200	0	200	0	96	96
Total	**Semester II**	**420**	**8.75**	**460**	**415**	**875**	**142.4**	**277.6**	**420**
				52.6%	47.4%	100%	33.9%	66.1%	100%

Semester III

EEEI 302	Numerical Methods	48	1	30	70	100	32	16	48
EEEI 332	Electrical Installation Technology	48	1	40	60	100	19.2	28.8	48
EEEI 334	Signals and Systems	48	1	40	60	100	19.2	28.8	48
EEEI 336	Digital Circuit Design	60	1.25	50	75	125	24	36	60
EEEI 342	DC Machines and Transformers	60	1.25	50	75	125	24	36	60
EEEI 372	Microprocessor Architecture and Interfacing	60	1.25	50	75	125	24	36	60
EEEI 392	Electrical Engineering Laboratory IIB	96	2	200	0	200	0	96	96
Total	**Semester III**	**420**	**8.75**	**460**	**415**	**875**	**142.4**	**277.6**	**420**
				52.6%	47.4%	100%	33.9%	66.1%	100%

Total	**Year III**	**1272**	**22**	**1370**	**830**	**2200**	**284.8**	**771.2**	**1056**
				62.3%	37.7%	100%	27.0%	73.0%	100%

Year IV

Semester I (External Attachment) (12 Weeks)

EEEI 490	Industrial Attachment	432	4.5	450	0	450	0	216	216
Total	**Semester I**	**432**	**4.5**	**450**	**0**	**450**	**0**	**216**	**216**
				100.0 %	0.0%	100%	0.0%	100.0 %	100%

Semester II

Core

EEEI 471	Microprocessor Systems and Applications	48	1	30	70	100	32	16	48
EEEI 473	Computer Hardware and Maintenance	48	1	30	70	100	32	16	48
EEEI 491	Electrical Engineering Laboratory IIIA	48	1	100	0	100	0	48	48
EEEI 493	Technical Project A	96	2	40	160	200	12	84	96
		240	***5***	***200***	***300***	***500***	***76***	***164***	***240***
				40.0%	60.0%	100%	31.7%	68.3%	100%

Power Systems Engineering

EEEI 441	Power Systems Engineering A	48	1	30	70	100	24	24	48
EEEI 443	Control Systems Engineering	48	1	30	70	100	24	24	48
EEEI 445	AC and Special Machines	48	1	30	70	100	24	24	48
		144	***3***	***90***	***210***	***300***	***72***	***72***	***144***
				30.0%	70.0%	100%	50.0%	50.0%	100%

Telecommunication Systems Engineering

EEEI 451	Data Communication Networks	48	1	30	70	100	24	24	48
EEEI 453	Microwave Engineering	48	1	30	70	100	24	24	48
EEEI 455	Digital Signal Processing	48	1	30	70	100	24	24	48
		144	***3***	***90***	***210***	***300***	***72***	***72***	***144***
				30.0%	70.0%	100%	50.0%	50.0%	100%

Instrumentation and Control Engineering

EEEI 461	Optical Instrumentation	48	1	30	70	100	24	24	48
EEEI 463	Control Systems Engineering	48	1	30	70	100	24	24	48
EEEI 465	Computer Vision	48	1	30	70	100	24	24	48
		144	***3***	***90***	***210***	***300***	***72***	***72***	***144***
				30.0%	70.0%	100%	50.0%	50.0%	100%

Electronic and computer engineering

EEEI 471	Data Communication Networks	48	1	30	70	100	24	24	48
EEEI 475	Computer Networks	48	1	30	70	100	24	24	48
EEEI 473	Computer Vision	48	1	30	70	100	24	24	48
Total		***144***	***3***	***90***	***210***	***300***	***72***	***72***	***144***
				30.0%	70.0%	100%	50.0%	50.0%	100%

Total	**Semester II**	**384**	**8**	**290**	**510**	**800**	**148**	**236**	**384**
				36.3%	63.8%	100%	38.5%	61.5%	100%

Semester III

Core

EEEI 431	Systems Reliability and Maintainability	48	1	30	70	100	32	16	48
EEEI 482	Management and Entrepreneurship	48	1	30	70	100	32	16	48
EEEI 492	Electrical Engineering Laboratory IIIB	48	1	100	0	100	0	48	48
EEEI 492	Technical Project B	96	2	40	160	200	12	84	96
		240	***5***	***200***	***300***	***500***	***76***	***164***	***240***
				40.0%	60.0%	100%	31.7%	68.3%	100%

Power Systems Engineering

EEEI 442	Power Electronics	48	1	30	70	100	24	24	48
EEEI 444	Electrical Machine Drives	48	1	30	70	100	24	24	48
EEEI 446	Power Systems Engineering B	48	1	30	70	100	24	24	48
		144	***3***	***90***	***210***	***300***	***72***	***72***	***144***
				30.0%	70.0%	100%	50.0%	50.0%	100%

Telecommunications Systems Engineering

EEEI 452	Telecommunications and the Internet	48	1	30	70	100	24	24	48

EEEI 454	Digital Broadcasting	48	1	30	70	100	24	24	48
EEEI 456	Multimedia Information Networking	48	1	30	70	100	24	24	48
		144	***3***	***90***	***210***	***300***	***72***	***72***	***144***
				30.0%	70.0%	100%	50.0%	50.0%	100%

Instrumentation and Control Engineering

EEEI 462	Microprocessors and Digital Design	48	1	30	70	100	24	24	48
EEEI 464	Robotics and Automation	48	1	30	70	100	24	24	48
EEEI 466	Digital Control Engineering	48	1	30	70	100	24	24	48
		144	***3***	***90***	***210***	***300***	***72***	***72***	***144***
				30.0%	70.0%	100%	50.0%	50.0%	100%

Electronic and computer engineering

EEEI 472	Microprocessors and Digital Design	48	1	30	70	100	24	24	48
EEEI 474	Database Management System	48	1	30	70	100	24	24	48
EEEI 476	Multimedia Information Networking	48	1	30	70	100	24	24	48
		144	***3***	***90***	***210***	***300***	***72***	***72***	***144***
				30.0%	70.0%	100%	50.0%	50.0%	100%

Total	**Semester III**	**384**	**8**	**290**	**510**	**800**	**148**	**236**	**384**
				36.3%	63.8%	100%	38.5%	61.5%	100%

Total	**Year IV**	**1200**	**20.5**	**1030**	**1020**	**2050**	**296**	**688**	**984**
				50.2%	49.8%	100%	30.1%	69.9%	100%

Total	**Programme**	**4488**	**80**	**4320**	**3680**	**8000**	**1268**	**2572**	**3840**
				54.0%	46.0%	100%	33.0%	67.0%	100%

5 APPENDICES

5.1 APPENDIX I

LIST OF FACULTY ACCORDING TO QUALIFICATION AND DESIGNATION

S/NO	NAME	PROFFESIONAL QUALIFICATION	Designation
1	PROF. STEPHEN MUSYOKI	PhD, M.Eng, B.Eng	Associate Professor
2	PROF. DOMINIC B. O KONDITI	PhD, M.Sc, Hdip	Full Professor
3	DR. CHRISTOPHER M. MURIITHI	PhD, M.Sc, B.Sc	Senior Lecturer
4	PETER J. MIANO	Msc Hdip	Lecturer
5	JOSEPH M. KARANJA	Msc, Bsc(Elec)	Assistant Lecturer
6	JOSEPH ABOK	Msc, Bsc(Elec)	Assistant Lecturer
7	SAMUEL K. CHEGE	Msc,BPhil, Hdip	Technologist
8	ANTONE MUBINYA	Mtech, Btech, Hdip	Lecturer
9	WINSTONE O. OJENGE	Msc, Btech(education)	Lecturer
10	JACOB MUSEMBI	Msc, B Ed	Lecturer
11	BENARD MUTAI	Msc (Elec)	Lecturer
12	JOHN B. MWANZA	Mphil, Btech(Education)	Assistant Lecturer
13	ALFRED ORERO	Msc, Bsc (Elec)	Tutorial Fellow
14	RITA LAIBUTA	Msc, Bsc ((Elec))	Tutorial Fellow
15	BILL MAKAYOTO	Bsc (Elec)	Tutorial Fellow
16	LONAH SEGERA	Bsc (Elec)	Graduate Assistant

5.2 APPENDIX II

FACILITIES AND EQUIPMENT

Item	Number	Capacity	Usage	
			Specific to Department	Shared
Lecture Rooms	4	20	4	Yes
Seminar Room	1	20	1	Yes
Lecturer's Offices	3	6	3	Yes
Laboratories - Machines Lab. -Power Systems Lab - Control Lab -Power Electronics Lab	 1 1 1 1	 20-100 20-100 20-100 20-100	 1 1 1 1	 Yes Yes Yes Yes
Workshops	1	20-100	1	Yes
WiFi Router	4	20-100	1	Yes
Internet Access Points	10	20	10	No
Others- library sitting space	1	500 per seating	-	Yes

5.3 APPENDIX III

EQUIPMENT AND TEACHING MATERIALS (FOR THE DEPARTMENT)

Item	Type	Number	Capacity	Usage	
				Specific to Department	Shared
Computers (PCs)	Dell	10	20	10	Yes,
Lap Tops	HP/ Toshiba	4	20	4	Yes
LCD Projectors	Sony	4	20	4	0
Computer Software	PSAT OCTAVE	20 20	20 20	20 20	Yes Yes

5.4 APPENDIX IV

BACHELOR OF TECHNOLOGY (BTECH) PRELIMINARY SEMESTER CURRICULUM

Preliminary Semester I

EEEK201	Mathematics A	48	1
EEEK 222	Mechanics of Machines	48	1
EEEK 224	Thermo dynamics	48	1
EEEK 226	Fluid Mechanics	48	1
EEEK 211	Earth and Environmental Science	48	1
EEEK 213	Computer programming	48	1
UCCC1201	Health Education	48	1
		336	**7**

Preliminary Semester II

EEEK 202	Mathematics B	48	1
EEEK 212	Physics	60	1.25
EEEK 214	Chemistry	48	1
EEEK 216	Biological Science	48	1
EEEK 282	Elements Economics	48	1
EEEK 228	Introduction to Engineering Technology	36	0.75
UCCC1102	Creative and critical thinking	48	1
		336	7

		672	**14**