SOFTCORE UNIVERSITY

School of Electrical and Electronic Engineering

Regulations and Syllabus for the Degree

Of

Bachelor of Science

in

Electrical and Communication Engineering

1.0 INTRODUCTION

This curriculum provides systematic university-level education and training towards the attainment of pre-defined exit level learning outcomes of the Softcore University and recognized by professional bodies in engineering for the attainment of the degree of Bachelor of Science in Electrical and Communication Engineering. Students are prepared for professional practice at entry-level electrical engineering positions, or to pursue graduate study in engineering and other professional degree programmes through rigorous lectures, seminars and practical sessions.

The graduates of the programme will be qualified to work in many industrial and public organizations in the fields of electrical machinery, electrical power generation, electrical power distribution, telecommunications, computer engineering, and information technology. These industries continue to enjoy phenomenal growth and are generally recognized to be in forefront of the next wave of economic expansion at the global level and form an integral part of the Kenya Vision 2030.

2.0 OBJECTIVES

Graduates of this programme will have been exposed to or will have gained:

(i) An ability to apply knowledge of mathematics, science, and engineering to electrical engineering problems;
(ii) An ability to design and conduct experiments, as well as to analyze and interpret data;
(iii) An ability to design a system, component, or process to meet desired needs;
(iv) An ability to function on multi-disciplinary teams;
(v) An ability to identify, formulate and solve engineering problems;
(vi) An understanding of professional and ethical responsibility;
(vii) An ability to communicate effectively orally and in writing;
(viii) The broad education necessary to understand the impact of engineering solutions in a global and societal context;
(ix) Recognition of the need for and an ability to engage in life-long learning and knowledge of contemporary issues;
(x) An ability to use the techniques, skills, and modern engineering and computing tools necessary for engineering practice;
(xi) The capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems in engineering;
(xii) Ability to make measurements and interpret data from engineering systems

3.0 DESIGN OF THE DEGREE PROGRAMME

The degree programme is designed to offer sound training in the following core areas:-

(i) Electronics
(ii) Electrical Machines
(iii) Electrical Power
(iv) Control and Instrumentation
(v) Microprocessor Systems and Applications
(vi) Telecommunications

Engineering mathematics, computer-based analyses, fundamentals of mechanical engineering and other courses are also offered as compulsory supportive courses in the programme. Selected courses from Social Sciences are built into the programme during the first two years of study to enable students develop a broad education outlook in their training.

4.0 DURATION

The Bachelor of Science in Electrical and Communications Engineering degree shall normally be covered in five academic years, each of which is divided in to two semesters. A semester is comprised of sixteen weeks; fourteen weeks for learning and two weeks for examinations. The students shall also undergo eight weeks of Fieldwork and Workshop Practice and two Industrial Attachments of eight weeks each.

5.0 ADMISSION REQUIREMENTS

(a) All candidates admitted to the degree programme of Bachelor of Science in Electrical and Communication Engineering must satisfy the minimum entry requirements stipulated in the common university admission regulations.

(b) In addition, candidates must obtain at least the minimum cut-off points for the year as determined by Kenya Universities and Colleges Placement Service, from any one of the following four subject clusters from the K.C.S.E. structure.

ALTERNATIVE A	**ALTERNATIVE B**
Mathematics	Mathematics
Physics	Physical Sciences
Chemistry	Biological Sciences
Either Biology or Geography or	Either Geography or any
Group V (i.e. technical group of subjects)	Group V (i.e. technical group of subjects)

The above clusters may change from year to year.

(c) For direct entry a candidate should have obtained a minimum aggregate grade of C+, obtained atleast a C+ in English/Kiswahili and a minimum C+ in each of the following subjects: Mathematics, Physics, Chemistry and Physical Sciences.

(d) Holders of a recognized Diploma in Electrical and Electronics Engineering or related discipline are eligible for admission.

(e) Those holding qualifications equivalent to the above from institutions recognized by Softcore UniversitySenate are eligible for admission.

6.0 EXAMINATION REGULATIONS

1. The University Common Regulations for undergraduate examination and faculty specific regulations shall apply.
2. Except for courses indicated in 3 below, each course shall be examined by continuous assessment and end of semester examination with the following distribution of marks:

End of Semester Examinations	70%
Continuous Assessment	30%
Continuous assessment marks are distributed as follows:	
• Practicals	10%
• Assignments and sit-in tests	20%

3. The exceptions to the above rule are:-

(a) For ECE 220: Workshop Practice, the marks for the assessment of practical work and technical report shall be distributed as follows:

Assessment of practical work	70%
Final technical report	30%

(b) For ECE 320 and ECE 420 Industrial Attachment I and II, the marks from assessment of practical work and technical report shall be distributed as follows:

Assessment at place of attachment	30%
Final technical report	70%

(c) For ECE 426 and ECE 510 Engineering Project I and II, the distribution of marks will be as follows:

Assessment of two (2) seminar presentations on the project	20%
Final project report	60%
Final oral examination	20%

(d) All courses not bearing ECE code are taught by other departments and therefore shall be examined according to the specific regulations of the concerned teaching department.

(e) Courses bearing ECC code are engineering common courses and are taught by engineering departments.

7.0 DEFINITION OF A UNIT

1 Unit is equivalent to 1 lecture hour per week per semester
1 Unit is equivalent to 2 Tutorial hours per week per semester
1 Unit is equivalent to 3 Hours of laboratory/field work per week per semester

8.0 COURSE CODING

Each course is identified by a two-part code. The first part of the code refers to the year of study, the second for semester and third for serial number of the course. Thus, the course ECE 123 is a course in first year of Electrical and Communication Engineering, and is of a level that places it among courses in the 1 series for first years, 2 for second semester and 3 for serial number of the course in that semester, all courses arranged in alphabetical order.

9.0 EXIT LEVEL OUTCOMES

The curriculum for the degree of Bachelor of Science in Electrical and Communication Engineering prepares candidates for further studies and as Professional practice as Engineers. The required Exit Level Outcomes are as follows:

(i) Engineering problem solving ability;
(ii) Application of fundamental and engineering knowledge;
(iii) Engineering design and synthesis;
(iv) Investigations, experiments and data analysis;
(v) Engineering methods, skills, tools and information technology;
(vi) Professional and General Communication;
(vii) Impact of engineering activity on society and the environment;
(viii) Team and multidisciplinary working skills;
(ix) Independent learning ability or lifelong learning; and
(x) Professional ethics and practice.

COURSE STRUCTURE

YEAR 1

CODE	COURSE TITLE	UNITS
Semester 1		
CDM 100	HIV and AIDS Prevention and Management	3
ECC 103	Introduction to Engineering	2
ECC 105	Fundamentals of Computing and Applications	4
COS 100	Communication Skills	3
MAT 101	Pure Mathematics I	3
MIE 161	Engineering Drawing I	3
SCH 100	Fundamentals of Chemistry I	4
SPH 110	Fundamentals of Physics I	4
		26
Semester 2		
ECC 104	Applied Mechanics	3
ECE 121	Workshop Technology	3
SPH 111	Fundamentals of Physics II	4
ECC 102	State, Society and Development Concepts	3
MAT 103	Pure Mathematics II	3
MIE 164	Engineering Drawing II	3
SCH 101	Fundamentals of Chemistry II	4
STA 104	Statistics I	3
		26
	Total Number of Units	**52**

YEAR 2

CODE	COURSE TITLE	UNITS
Semester 1		
CSC 201	Computer Programming I	4
ECE 211	Physical Electronics	3
ECE 212	Electric Circuit Theory and Analysis I	3
ECE 213	Power Systems I	3
MAT 201	Engineering Mathematics I	3
MIE 221	Solid Mechanics I	3
MIE 231	Fluid Mechanics I	3
STA 205	Statistics II	3
		25
Semester 2		
ECE 221	Basic Electronics	3
ECE 222	Computer Applications for Engineers	3
ECE 223	Computer Programming II	3
ECE 224	Electrical Measurements	3
ECE 225	Electrical Machines I	3
ECE 226	Electric Circuit Theory and Analysis II	3
MAT 202	Engineering Mathematics II	3
MIE 213	Material Science	3
MIE 274	Thermodynamics I	3
		27
	Total Number of Units	**52**
ECE 220	**Workshop Practice (Minimum of 8 Weeks)**	**3 Units**

YEAR 3

CODE	COURSE TITLE	UNITS
Semester 1		
ECC 301	Scientific and Technical Communication Skills	3
CSC 310	Object Oriented Programming	3
ECE 312	Electromagnetics I	3
ECE 313	Electrical Machines II	3
ECE 314	Analogue Electronics I	3
ECE 315	Mechatronics and Manufacturing Automation	3
ECE 316	Digital Electronics I	3
ECE 317	Power Systems II	3
MAT 301	Engineering Mathematics III	3
		27
Semester 2		
ECE 321	Control Systems I	3
ECE 322	Electromagnetics II	3
ECE 323	Network Analysis and Synthesis	3
ECE 324	Digital Electronics II	3
ECE 325	Signals and Systems	3
ECE 326	Analogue Electronics II	3
ECE 327	Electrical Machines III	3
ECE 328	Principles of Communication Systems	3
MAT 302	Differential Equations	3
		27
	Total Number of Units	**54**
ECE 320	**Industrial Attachment I (Minimum of 8 weeks)**	**3 Units**

YEAR 4

CODE	COURSE TITLE	UNITS
Semester 1		
ECE 411	Control Systems II	3
ECE 412	Electronic Circuit Design	3
ECE 413	Instrumentation	3
ECE 414	Microprocessors	3
ECE 415	Power Electronics I	3
ECE 416	Digital Communication Systems	3
ECE 417	Power Systems III	3
ECE 418	Entrepreneurship for Engineers	3
MAT 401	Complex Analysis	**27**
Semester 2		3
ECC 402	Research Methods	3
ECC 404	Economics for Engineers	3
ECC 406	Engineering Management	3
ECE 421	Power Systems IV	3
ECE 422	Data Communication and Computer Networks	3
ECE 423	Microprocessor Systems Design	3
ECE 424	Power Electronics II	3
ECE 425	State Space Design and Digital Control	**24**
	Total Number of Units	**51**
ECE 420	**Industrial Attachment II (Minimum of 8weeks)**	**3 units**

YEAR 5

CODE	COURSE TITLE	UNITS
Semester 1		
ECC 501	Operations Research	3
ECE 510	Engineering Project	3
ECE 511	Engineering Product Design	4
ECE 512	Software Engineering	3
ECE 513	Non-linear and Multivariable Control	3
ECE 514	Transmission Lines	3
	ELECTIVE I	3
	ELECTIVE II	3
		25
Semester 2		
ECC 502	Law, Ethics and Professional Practice	3
ECE 521	Digital Signal Processing	3
ECE 522	E-Commerce	3
ECE 523	Industrial Electronics	3
ECE 524	Project Management	3
ECE 525	Electroacoustics	3
ECE 510	Engineering Project	4
	ELECTIVE III	3
	ELECTIVE IV	3
		28
Electives		
ECE 511E	Power Systems Analysis	
ECE 512E	Special Electrical Machines	3
ECE 513E	Electrical Machine Drives and Industrial Applications	3
ECE 514E	Radar and Satellite Engineering	3
ECE 515E	Optoelectronics and Photonics	3
ECE 516E	Antenna and Radio Wave Propagation	3
ECE 521E	Electrical Machines Design	3
ECE 522E	High Voltage Technology	3
ECE 523E	Power System Protection	3
ECE 524E	Microwave Engineering	3
ECE 525E	Wireless and Mobile Communication	3
ECE 526E	Telecommunication Switching and Networks	3
		3
	Total Number of Units	**53**

COURSE DESCRIPTION

FIRST YEAR

SEMESTER I

CDM 100 – HIV AND AIDS PREVENTION AND MANAGEMENT (3 Units)

Pre-requisites: None

Course Purpose

This course seeks to expose students to the origin, demography and distribution of HIV and AIDS by addressing the biological concepts related to it. It aims at addressing vulnerability and mitigation of impacts and, how work place policy has been developed in its wake. Media; Technological; Engineering; Economical; Biostatistical; Counselling; and, Pedagogical issues surrounding HIV and AIDS shall be addressed.

Expected Learning Outcomes:

By the end of the course the lecturer should be able to:

(i) assist the student become familiar with the origin, demography and distribution of HIV and aids;
(ii) familiarize students with vulnerability and mitigation of impacts in HIV and aids;
(iii) assist the student be knowledgeable about the relationship of HIV and aids to various socio-economic and technological processes (media, engineering, biostatistics, counselling and pedagogy).

Course Content

Definition of concepts: HIV and AIDS, Prevention, Management; Origin, demography and distribution of HIV and AIDS; biological concepts in HIV and AIDS; vulnerability and mitigation of impacts; Work place policy; Media and HIV and AIDS; Technological and Engineering issues in HIV and AIDS; Economical; Biostatistical; Counselling; and, Pedagogy.

Mode of Delivery

Lectures, Class discussions, e-learning, group presentations.

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment

Final Examination	70%
Continuous Assessment Tests	30%
Total	100%

Recommended textbooks

(i) Students are encouraged to do wide readership of any material related to HIV and AIDS as provided for by various bodies that carry out research on the same (KEMRI, CDC, NASCOP, NACC,WHO,KAVI among others)
(ii) Students are also encouraged to make thorough use of the internet/library research

ECC 103 – INTRODUCTION TO ENGINEERING (2 Units)

Pre-requisites: None

Course Purpose:

The aim of this course is to introduce students to the engineering profession, professional concepts, ethics and responsibility.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. identify general steps involved in engineering design;
ii. demonstrate an understanding of steps involved in engineering problem solving;
iii. distinguish between the roles of the various engineering disciplines;
iv. recognize themselves as individuals undergoing a particular stage of human development, how their well-being is affected by the university's academic and social systems, and how they can facilitate their development within the university environment;
v. use ethical reasoning to address to evaluate ethical dilemmas in engineering;
vi. perform basic operations with forces and their related parameters;
vii. use general engineering codes and symbols.

Course Content:
Historical perspective of Engineering: Origins of engineering, influential inventions, industrial revolution, electrical and communication revolution. Engineering Challenges: Competition amongst nations, pollution, green house effect, energy, future challenges. Getting started in Engineering: Structure of Engineering Education, Study habits, problem solving, professional life. Engineering Design: The design process, creativity, patents, Engineering codes and standards; engineering symbols and abbreviations. Introduction to Engineering as a profession: Supply and demand, technological spectrum; functions of engineering; professional practice; introduction to engineering ethics; safety and professional liability. Case studies: By using principles and methods of analysis developed in lectures, students will review two major engineering projects from conceptualization; analysis, construction; testing of a prototype to the communication of project information to various stakeholders.

Mode of Delivery
Lectures, Class discussions, e-learning, group presentations.

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, e-materials
Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. Final examination 70% , CATs and assignments 30%

Recommended textbooks:
(i) Mark T. Holtzapple and W. Dan Reece, *Foundations of Engineering*, by 2nd edition, 2002, McGraw-Hill.
(ii) Paul H. Wright, *Introduction to Engineering (3rd Edition)*, Wiley (2002), ISBN 0-471-05920-X
(iii) John Dustin Kemper, *Introduction to the Engineering Profession*, Oxford University Press, ISBN: 0-19-510727-6
(iv) Saaeed Moaveni, *Engineering Fundamentals: An Introduction to Engineering*, Cengen Learning, ISBN 13-978-1-4390-6208-1

ECC 105 – FUNDAMENTALS OF COMPUTING & APPLICATIONS (4 Units)

Pre-requisites: None
Course Purpose:
To expose students to knowledge and skills of computer hardware, applications and database management systems.
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
(i) use a computer under the windows operating environment;
(ii) use word processors, spreadsheets, presentations and databases;
(iii) describe basic features of common operating systems;
(iv) describe basic features of computer networks including the use of the internet, email and other social networking.

Course Content:
Hardware Overview: Mouse, Keyboard layout, Storage media, Operating Systems - starting up/shutting down, Starting/closing Applications, Directories, management, Storage media. Word Processing: Document creation, Editing tests, Formatting, Printing, Tables; Columns, Mail Merge, Document templates, Managing large documents. Spreadsheets: Creating a worksheet; Editing a worksheet; Worksheet formatting; Working with charts; Sorting and Summarizing; Databases Functionalities; Printing. Presentation Package: Presentation; Views, Objects; Editing objects; Slides: Shows, Transition, Special effects. Internet and E-Mail: Computer networks; intranets, the Internet, www. Browsing/Surfing; Searching, Portals, Blogs, Electronic mail; Sending/Receiving,cc,bcc, attachment, mailing list, spam, phishing, Database Management Systems: Creating a database; Database Components; Tables, Forms; Queries; Reports; Database security.
Mode of Delivery
Lectures, Class discussions, e-learning, group presentations, laboratory tests.

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, computer

Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended books:

(i) Andrew S. Tanenbaum and Todd Austin, *Structured Computer Organisation*, Pearson, ISBN 13: 978-0-13-291652-3
(ii) Brian Williams and Stacey Sawyer, "*Using Information Technology*," Seventh Edition, 2007,T TMcGraw-Hill, ISBN: 0072260718.
(iii) Hardware and operating systems: Computer laboratory with Windows, MAC OS and Linux operating systems
(iv) Application Software: Microsoft Excel, Word, PowerPoint, Access, Web Authoring Software

COS 100 – COMMUNICATION SKILLS (3 Units)

Course Purpose:
To equip students with skills to acquire knowledge and effectively communicate their views to others orally and in writing.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to demonstrate:

(i) capacity to obtain information from listening;
(ii) ability to obtain and synthesize information on a subject from various written sources;
(iii) ability to communicate in writing;
(iv) ability to make oral presentation.

Course Content:
Study skills: planning work, organising and budgeting time and resources, filing, critical thinking. Library skills: understanding library of congress classification, utilizing library & other education resources, collecting and summarising information; note taking & making, Listening skills: active listening, preparing lecture, structure, understanding gist, recognising change of topic; understanding instructions. Reading skills: skimming, scanning, inference and prediction; critical reading, discipline-specific reading skills. Interpretation of non-linear texts: constructing and using statistical tables, indices, maps, graphs. Examination skills: preparing for examination, understanding examination rubrics, writing examinations.

Mode of Delivery
Lectures, Class discussions, e-learning, group presentations.

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended Textbooks:

i. Matthew McKay , Martha Davis , Patrick Fanning (2009) *Messages: The Communication Skills-Third Edition* ISBN-13: 978-1572245921 ISBN-10: 1572245921 New Harbinger Publications
ii. Bennie Bough (2005)*101 Ways to Improve Your Communication Skills Instantly, 4th Edition*
iii. GoalMinds, Inc.; ISBN-10: 097409708X
iv. Gerald J. Alred , Charles T. Brusaw , Walter E. Oliu(2008) *Handbook of Technical Writing, Ninth Edition Hardcover -Ninth Edition*, ISBN-10: 0312575122, St. Martin's Press
v. Gary Blake , Robert W. Bly (2000) *Elements of Technical Writing 1st Edition* ISBN-10: 0020130856: Longman
vi. Thomas E. Pearsall ,Kelli Cargile Cook (2009) *The Elements of Technical Writing (3rd Edition)* ISBN-10: 0205583814 Longman

MAT 101 – PURE MATHEMATICS I (3 Units)

Pre-requisites: None

Course Purpose:

To introduce the students to core zero engineering mathematics units including algebraic expressions, logarithmic functions, exponential functions, sequences, series, binomial expansion, polynomials, trigonometry and vectors.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. solve algebraic problems;
ii. solve two simultaneous equations both algebraically and geometrically;
iii. explain and solve simple problems involving proportion;
iv. solve simple inequalities, both geometrically and algebraically;
v. explain and solve equations involving exponential and logarithmic functions;
vi. solve problems using growth and decay models;
vii. define a sequence, a series and binomial expansions;
viii. find the sum of an arithmetic series and geometric series;
ix. obtain the binomial expansions of $(a+b)^s$ and $(1+ x)^s$ where s is a rational number;
x. use the binomial expansion to obtain approximations to simple rational functions;
xi. define the sine, cosine, tangent and cotangent of an acute angle;
xii. state and use the fundamental identities arising from Pythagoras' theorem;
xiii. solve triangle related problems given sufficient information about its sides and angles;
xiv. solve simple problems in geometry using vectors;
xv. define the vector product of two vectors and use it in simple applications.

Course Content

Algebra: sets, unions, intersections, complements, algebraic structures such as rational indices, multiplication, addition and partial fractions. Series: arithmetic, geometric, logarithmic, infinite; summation of infinite series. Polynomial functions constant: linear, quadratic, remainder factor, division. Functions and mappings: inverse, constant, step, even, odd, composite. Trigonometry: trigonometric and hyperbolic functions, logarithmic and exponential functions. Vector Algebra: scalars and vectors, components, addition, scalar and vector products, unit vectors, geometric interpretations, applications to mechanics.

Mode of Delivery

Lectures, Class discussions, e-learning, group presentations.

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course assessment

During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended books:

(i) K.A Stroud, *Foundation Topics in Engineering Mathematics*, *6th Edition*, ISBN-13 978-1-4039-4246-3.
(ii) Raymond A. Barnett; Michael R. Ziegler; Karl E. Byleen; Dave Sobecki, *Precalculus*, MacGraw Hill, ISBN 978–0–07–351951–7

MIE 161 – ENGINEERING DRAWING I (3 Units)

Pre-requisites: None

Course Purpose:

To introduce students to different types of lines & use of different types of pencils in an engineering drawing, how to represent letters & numbers in drawing sheet, know about different types of projection and projection of points ,straight lines, solids etc. Students to know development of different types of surfaces and isometric projection.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

(i) competently use standard equipment for technical drawing;
(ii) sketch engineering components free hand or with the aid of drawing equipment;

(iii) appreciate the importance of engineering graphics in engineering;
(iv) describe the basic principles of technical/engineering drawing;
(v) explain different steps in producing drawings according to BS 308.

Course Content:
Introduction: definition of terms used in engineering drawing, application of engineering drawing, various types of engineering drawing, use and care of drawing equipment and instruments, lettering, type and use of various lines, standard conventional symbols and abbreviations. Simple geometric constructions: triangles, quadrilaterals, polygons and blending of arcs with circles and lines. Dimensioning: linear dimensioning types and placement of dimensions; angular dimensioning and method of placement of figures. Orthographic projection: definition, placement of principal views in respect to 1st and 3rd angle projection. Sectioning: types of sections, naming of cutting planes, naming of sectional views in orthographic projection. Free hand drawing: orthographic views in free hand drawing.
Mode of delivery:
Lectures, e-learning
Instruction Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, T-square, drawing set and tables, Pencils, drawing papers.

Course Assessment

Written Tests:	20%
Assignments:	40%
Written Examination :	40%
Total:	**100%**

Recommended book:

(i) David A. Madsen, *Engineering Drawing and Design*, Cengage Learning (2012), ISBN 13-978-1-111-30957-2.
(ii) Bethune J.D.(2003). Engineering Graphics with autoCAD2002. Prentice-Hall Inc, New Jersey, U.S.A.
(iii) Fredrick E.G. and Henry C.S.(2003).Technical Drawing. Pearson Education Inc New Jersey, U.S.A.
(iv) Gill P.S. (1992). A Text Book of Machine Drawing. S.K. Kataria& sons, New Delhi.
(v) Hewitt T.H. (1974). Advance Geometrical and Engineering Drawing. English University press, London.
(vi) Maguire D. (1998). Engineering Drawing. Arnold, London.

SCH 100-FUNDAMENTALS OF CHEMISTRY I (4 Units)

Pre-requisites: None
Course Purpose

To provide students with an introduction of the basic principles of chemistry as illustrated through laboratory experiments and to apply these principles in engineering.

Expected Learning Outcomes:
Upon completion of this module, students should be able to:

(i) explain and use the gas laws;
(ii) discuss energy changes in chemical reactions;
(iii) analyse the rates of chemical reactions;
(iv) explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system;
(v) distinguish between the three laws of thermodynamics;
(vi) explain acid-base equilibria and solubility equilibria.

Course Content

Atoms: Masses of atoms; relative atomic masses; formulae of compounds formed by atoms; Molecular masses; the mole; solutions formed by compounds; concentration of solutions; Molarity. Redox reactions: transfer of electrons; types of redox reactions; oxidation numbers. Electronic structure: evidence for the electronic structures of atoms; Electromagnetic radiation; interaction with electrons; atomic spectra of hydrogen atom; electrons and orbitals; electronic structures and periodic table. Periodic properties: s and p block elements, d-

block (transition) series; non-metals; transition metals, Nuclear structure and reactivity: stable and unstable isotopes; nuclear equations; chain nuclear reactions; atomic bombs; use of radioisotopes and application of radioactivity. Introduction to organic molecules: their structure, nomenclature, classification and general properties; Basic reactions of aliphatic compounds: alkanes, alkynes, alkenes, alcohols, aldehydes, ketones and carboxylic acids; Basic reactions of the benzene ring.

Mode of Delivery
Lectures, Class discussions, e-learning

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended textbooks:

(i) Ralph A. Burns, *Fundamentals of Chemistry (4th Edition*), ISBN-10: 0130337196.
(ii) David E Goldberg, *Fundamentals of Chemistry*, ISBN-13: 978-0073221045

SPH 110 – FUNDAMENTALS OF PHYSICS I (4 Units)

Pre-requisites: None

Course Purpose
To introduce students to principles both in terms of concepts and problem-solving skills in mechanics, properties of matter and sound required during the study of advanced topics in engineering.

Expected Learning Outcomes:
Upon completion of the module, the student is expected to:

i. explain, qualitatively and quantitatively, the role of photons in phenomena such as the photoelectric effect, x-rays and Compton scattering;
ii. be able to independently solve the Schrödinger equation for simple one-dimensional systems;
iii. be able to discuss and interpret experiments displaying wavelike behaviour of matter, and how this motivates the need to replace classical mechanics by a wave equation of motion for matter;
iv. explain qualitatively band theory;
v. compare the strengths and weakness of free electron and nearly free electron theories;
vi. state Bloch theorem;
vii. describe the concepts of Brillouin zone, density of states, fermi energy, effective mass and holes;
viii. demonstrate an understanding of the idea of linear momentum conservation;
ix. solve problems regarding one and two dimensional kinematics;
x. solve problems regarding the dynamics of linear motion using Newton's laws and energy methods;
xi. solve simple problems in rotational kinematics and dynamics;
xii. solve basic problems in statics and Newtonian gravitation;
xiii. solve basic problems regarding heat and gases;
xiv. demonstrate entry-level general laboratory skills including elementary data analysis.

Course Content
Mechanics and Properties of Matter: Vectors, Rectilinear motion, Newton's laws of motion and their applications, Friction and its applications, Composition and resolution of forces, Uniform circular motion, Newton's law of gravitation, Simple harmonic motion, Conservation of energy and momentum, Flow of liquids: Viscosity, Surface tension, Elasticity, Elastic constants and their importance. Thermal physics: Expansion of solids, liquids and gases, Scales of temperature and thermometers, Mechanisms of heat transfer: Perfect gas-absolute temperature, Zeroth law, Specific heat capacities of gases at constant pressure and volume, Kinetic theory of gases-derivation of the relation for pressure. Sound: Equation of wave motion, Velocity of sound in solids and fluids, Standing waves on strings and pipes, Doppler Effect, beats, ultrasound.

Mode of Delivery
Lectures, Class discussions, e-learning, group presentations, laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended textbooks:
(i) Avadhanulu and Kshirsagar, *Engineering Physics,* Chand and Company- Fifth Revised Edition.
(ii) Hugh D. Young, Roger A. Freedman, A. Lewis Ford, University Physics, Pearson, ISBN-13: 978-0-321-69686-1
(iii) David Halliday, Robert Resnick and Jerle Walker, *Fundamentals of Physics*, John-Wiley and Sons (2002)
(iv) Arthur Beiser, Shobhit Mahajan, S Rai Choudhury, *Modern Physics*, Tata, MCGraw Hill, ISBN: 0070151555

SEMESTER II

ECC 104 – APPLIED MECHANICS (3 Units)

Pre-requisites: None

Course Purpose:
To introduce the students to core zero applied mathematics units including kinematics, statics, dynamics, momentum and simple harmonic motion.
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
i. demonstrate knowledge of relative motion and motion under a constant acceleration, including projectiles;
ii. calculate work done by a force, kinetic energy, power and use these quantities in solving problems;
iii. describe angular velocity and centripetal acceleration;
iv. calculate the moment of inertia of a number of simple plane bodies;
v. describe the principle of conservation of momentum;
vi. define impulse and solve problems involving impulsive forces;
vii. demonstrate knowledge of relative motion and motion under a constant acceleration, including projectiles;
viii. understand motion in a circle with uniform angular speed.

Course Content:
Kinematics of a Particles: Kinematics of a particle in a straight line, scalar and vector quantities, addition of vectors, unit vectors. Composition and resolution of velocities and accelerations, relative motion. Newton's laws of motion, applications to connected bodies, circular motion, projectiles. Simple Statics: The fundamental theorem of statics, including reduction of a plane system of forces, theorems of moments, conditions of equilibrium in a plane, Centre of gravity, equilibrium of particles and rigid bodies under co-planar forces, frameworks, Friction, coefficient of friction. Dynamics of Rigid Bodies: Moments and couples, Angular velocity and angular acceleration, Moment of Inertia. Momentum and Energy: Momentum, impulse; conservation of momentum. Energy, conservation of energy; energy/work principle, power. Simple Harmonic Motion: Hooke's Law, simple harmonic motion, motion in a circle with variable angular velocity.
Mode of Delivery
Lectures, Class discussions, e-learning, group presentations, laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended books:
(i) B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 2004
(ii) J. N. Wartikar, *Applied Mathematics Volume I* ,

ECE 121 – WORKSHOP TECHNOLOGY (3 Units)

Course Purpose:
To introduce students to electrical and mechanical workshop safety, electrical wiring and bench-work

Expected Learning Outcomes:

i. identify and understand importance of various electrical and electronics components
ii. explain basic construction and operation of various laboratory equipments
iii. use laboratory measuring instruments to measure some electrical quantities
iv. perform basic maintenance and troubleshooting of laboratory and industrial equipments,
v. carry out machine operations in a mechanical workshop
vi. use electrical symbols to develop circuit layout diagrams

Course Content
Safety at work: Safety precautions against electrical shock, protection against injury to working personnel in hazardous environments based on the factories act, first aid requirements. Mechanical workshop: Bench work and marking out, use of marking off table, and instruments, basic operation of machine tools. Electrical workshop: Electrical symbols, circuit diagrams layout, documentation. Electrical wiring: electrical tools, cables and switches, earthing, galvanizing and plating. Assembly of basic electronic components. Computer aided design, software, plotting.

Mode of Delivery
The method of instruction will be lectures, interactive tutorials, laboratory tests, e-learning and any other presentations /demonstrations the lecturer will deem fit towards enhancing understanding of the concepts taught in class.

Instructional Materials
Chalkboard, Whiteboard, LCD/Overhead Projector, Handouts, E-materials

Course Assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended Textbooks

(i) S.K Garg (2009) Comprehensive Workshop Technology (Manufacturing Processes) Laxmi Publications,: New Delhi India
(ii) F.G Thompson (1992) *Electrical Installation and Workshop Technology, Vol. 2, 4th Edition*, Paerson Education Publishers: ISBN-10: 0582085594
(iii) Richard R. Kibbe , *Workshop and Machine Tool Practices 8th edition*, Prentice Hall Publishers ISBN 0131721038
(iv) R. P Singh (2009) *Electrical Workshop 2nd edition*, I.K International Publishing House pvt Ltd, ISBN-10: 8189866710
(v) Frederic P. Hartwell, Herbert P. Richter (2014) *Practical Electrical Wiring, 22nd edition*, Park Publishing Inc. ISBN-10: 0971977984
(vi) Trevor Linsley (2011) *Introduction to Electrical Installation Work; 3rd edition*, Newness- Elsevier Ltd: USA. ISBN-10: 0080969402

SPH 111 – FUNDAMENTALS OF PHYSICS II (4 Units)

Pre-requisite: SPH 110-Fundamentals of Physics I
Course Purpose:
Teach the fundamentals of classical physics including the electrostatics, electrodynamics, solid-state physics, sound and optics

Expected Learning Outcomes:
Upon completion of this module, students should be able to:
(i) have a working knowledge of elementary quantum mechanics and its application to the explanation of atomic structure and atomic spectroscopy;
(ii) have a working knowledge of basic electrostatics, electrodynamics, and magnetism leading to the development of Maxwell's equations;
(iii) have a working knowledge of geometrical and physical optics and some familiarity with electrical circuits;

(iv) have basic skills in laboratory practice including a working knowledge of data analysis and graphical presentation of results.

Course Content
Electricity and magnetism: Properties of magnetic materials and their uses; Direct and alternating current; Behaviour and measurement of resistance; inductance and capacitance. Cells: Electrical and chemical effects; electrolysis; construction of lead acid and alkaline cells; charging of Battery. Transistors and diodes: Diode and rectification of current; Transistor characteristics and application; Working principle and application of the Cathode Ray Oscilloscope. Optics: Review of mirrors and lenses; Defects in lenses; Types of microscopes and telescopes; Particle and wave theories of light; Phenomena and application of interference, diffraction and polarisation of light. Modern physics: Bohr's theory and Heisenberg's quantum concept; Explanation of atomic spectra; X-rays; Structure of the nucleus; Natural and artificial radioactivity; Applications of radioactivity; Introduction to Nuclear fission, fusion and the nuclear reactor.

Mode of Delivery
The method of instruction will be lectures, interactive tutorials, laboratory tests, e-learning and any other presentations /demonstrations the lecturer will deem fit towards enhancing understanding of the concepts taught in class.

Instructional Materials
Chalkboard, Whiteboard, LCD/Overhead Projector, Handouts, E-materials.

Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended textbooks:

(i) Hugh D. Young, Roger A. Freedman, A. Lewis Ford, *University Physics*, Pearson, ISBN-13: 978-0-321-69686-1
(ii) P. Appala Naidu, M. Chandra Shekar , *Applied Physics*, V.G.S. Book links.
(iii) C. Kittel, *Introduction to Solid State Physics*, Wiley Eastern Ltd. Mark Ratner and Daniel Ratner, *Nanotechnology*, Pearson Education

ECC 102 - STATE, SOCIETY AND DEVELOPMENT CONCEPTS (3 Units)

Pre-requisites: None
Course Purpose
To introduce students to key concepts and theories of the state, state-society interactions, political systems, as well as sovereignty and legitimacy; different forms of government.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
(i) discuss, analyse and evaluate competing perspectives on the significance of state, society and culture in development;
(ii) demonstrate the ability to critically analyse and present key concepts in the study of politics and power;
(iii) recognise and evaluate the significance of institutional and national practices for development.

Course Content
Definitions of a nation society, and government. Basic concepts of development; Economic conception, social conception, cultural environmental conceptions, Objectives of development. Theories of development: classical, neo–classical and current theories. Relationship between socio – economic development, modernization and economic growth, analysis of contemporary development problems in Africa; problems of power, authority and influence. Philosophical and organizational strategies for development; agents of development; external trade and foreign aid, public accountability and development.

Mode of Delivery

Lectures, Class discussions, e-learning, group presentations.

Course Assessment

Continuous Assessment and Tests 30% , End of Semester Examinations 70%

Mode of Delivery

The method of instruction will be lectures, interactive tutorials and any other presentations /demonstrations the lecturer will deem fit towards enhancing understanding of the concepts taught in class.

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course assessment

During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended textbook

(i) Kathleen Staudt, Managing *Development: State, Society, and International Contexts*, Sage, ISBN: 978-080-394-0064.

MAT 103 – PURE MATHEMATICS II (3 Units)

Pre-requisites: Pure Mathematics I

Course Purpose:

To introduce the students to core zero engineering mathematics units including matrix algebra, complex numbers, differential equations and integration.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

(i) solve systems of linear equations by use of the matrix;
(ii) compute limits, derivatives, and definite & indefinite integrals of algebraic, logarithmic and exponential functions;
(iii) analyze functions and their graphs as informed by limits and derivatives;
(iv) solve applied problems using matrices, differentiation and integration.

Course Content:

Matrices: matrix algebra, determinants, transpose inverse of n x n matrix, eigen values, eigen vectors, rank of a matrix. Complex Numbers: Review of Complex Numbers; De-Moivre's theorem and its applications; Exponential form of Complex numbers; Logarithm of Complex numbers. Trigonometric and Hyperbolic functions. General linear differential equation with constant coefficients; evaluating the particular integral. Euler-Cauchy differential equation. Differentiation: solution of first-order differential equations by separable variable methods. Ordinary differential equations. Linear first-order differential equations. Integration: Integration of areas and volumes, polar coordinates and areas of sectors.

Mode of Delivery

Lectures, Class discussions, e-learning

Instruction Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment

(i) Continuous Assessment and Tests 30%
(ii) End of Semester Examinations 70%

Recommended book:

(i) Raymond A. Barnett; Michael R. Ziegler; Karl E. Byleen; Dave Sobecki, *Precalculus*, MacGraw Hill, ISBN 978–0–07–351951–7
(ii) Denis G. Zill, *A First Course in Differential Equations with Modelling Applications*, Cengage, ISBN-13: 978-0-495-10824-5

MIE 164 – ENGINEERING DRAWING II (3 Units)

Pre-requisites: MIE 161 - Engineering Drawing I

Objective

To enable learners to produce engineering drawings of different components, assemblies and circuits using a variety of sketching and drawing techniques.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

(i) competently use standard equipment for technical drawing;
(ii) sketch engineering components free hand or with the aid of drawing equipment;
(iii) present engineering components as drawings in orthographic and isometric projections;
(iv) use sections, interpenetration and development to produce clear engineering drawings;
(v) produce parts drawings and assembly drawings of various engineering components;
(vi) use codes of practice for engineering drawing.

Course Content:

Orthographic projection(auxiliary views): 1st auxiliary views of an inclined lines, shaped blocks. Use of auxiliary views in getting true length of lines, true angles of inclination to respective principal planes and true shapes of inclined surface.2nd auxiliary views of shaped blocks. Interpenetration and surface development of pyramids, prisms, cylinders, cone, and spheres. Development of simple transition pieces and use of triangulation method. Pictorial drawing: isometric projection and oblique projection. Loci: link mechanisms, ellipse, parabola, helixes, epicycloids, hypocycloid, involute, etc.

Mode of delivery

Lectures, demonstration, e-learning

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, T-square, drawing set and tables, Pencils

Course Assessment

Written Tests:	20%
Assignments:	40%
Written Examination :	40%
Total:	**100%**

Recommended books:

(i) Bethune J.D.(2003*). Engineering Graphics with autoCAD2002*. Prentice-Hall Inc, New Jersey, U.S.A.
(ii) Fredrick E.G. and Henry C.S.(2003).*Technical Drawing.* Pearson Education Inc New Jersey, U.S.A.
(iii) Gill P.S. (1992). *A Text Book of Machine Drawing*. S.K. Kataria& sons, New Delhi.
(iv) Hewitt T.H. (1974). *Advance Geometrical and Engineering Drawing.* English University press, London.
(v) Maguire D. (1998). *Engineering Drawing.* Arnold, London.

SCH 101 – FUNDAMENTALS OF CHEMISTRY II (4 Units)

Pre-requisites: SCH 100- Fundamentals of Chemistry I

Course Purpose

To provide students with an introduction of the basic principles of organic chemistry and their applications to engineering.

Expected Learning Outcomes:

Upon completion of this module, students should be able to:

(i) explain and use the gas laws;
(ii) discuss energy changes in chemical reactions;
(iii) analyse the rates of chemical reactions;
(iv) explain chemical reactions at equilibrium and predict the shift in equilibrium when a stress is applied to the system;
(v) distinguish between the three laws of thermodynamics;
(vi) explain acid-base equilibria and solubility equilibria.

Course Content

Properties of gases: Kinetic molecular theory of gases, ideal gas laws, deviation from ideality and Van der Waal's equation, Maxwell – Boltzmann distribution. Physical equilibria: Raoult's Law and its application to

distillation. Solid – liquid equilibrium (SLE), colligative properties and their application in determination relative molecular mass. Liquid – liquid equilibrium (LLE) between two immiscible liquids, the distribution law and steam distillation. Chemical equilibria: Reversible chemical reaction; equilibrium constants and their dependence on concentration and pressures; Le Chatelier's Principle. Ionic equilibria: Ionization of water, acids, bases and salts; pH and buffer solutions; Theory of acid/base indicators. Solubility and solubility products. Factors affecting solubility. Electrochemistry: Electrochemical processes, half reactions, standard cells and electrode potential, electromotive force (EMF) of a cell. Introduction to elemental qualitative and quantitative analysis: Determination of empirical and molecular formulas of organic and inorganic compounds: Determination of the elemental composition, determination of the empirical formulae, determination of molecular formulae, mole concept, stoichiometry, combustion analysis. Practicals will include measurements, vapour pressure determinations, titrimetric methods and solubility products.

Mode of Delivery

Lectures, Class discussions, e-learning, group presentations, laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.
Recommended textbooks:
(i) Ralph A. Burns (Author), *Fundamentals of Chemistry (4th Edition*), ISBN-10: 0130337196.
(ii) David E Goldberg, *Fundamentals of Chemistry*, ISBN-13: 978-0073221045

STA 104 –STATISTICS I (3 Units)

Pre-requisites: Pure Mathematics I
Course Purpose:
A student completing this course is expected to understand probability reasoning and work with probability and statistical distributions.
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. organize, present and interpret statistical data, both numerically and graphically;
ii. use various methods to compute the probabilities of events;
iii. analyze and interpret statistical data using appropriate probability distributions, e.g. binomial and normal;
iv. apply central limit theorem to describe inferences;
v. construct and interpret confidence intervals to estimate means, standard deviations and proportions for populations;
vi. perform parameter testing techniques, including single and multi-sample tests for means, standard deviations and proportions;
vii. perform a regression analysis, and compute and interpret the coefficient of correlation.

Course Content:
Tabular and graphical representation of samples: frequency, relative frequency, absolute frequency, and distribution function; sample mean, sample variance and standard deviation. Random experiments and events: Venn diagram, union intersection, mutually exclusive events, multiplication rule, and complementation rule. Discrete random variables: probability function, probability distribution function, mean and variance of a distribution. Continuous random variables: continuous distributions, Binomial distributions, normal probability distribution.
Mode of Delivery

Lectures, Class discussions, e-learning
Instruction materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment

(i) Continuous Assessment and Tests 30%
(ii) End of Semester Examinations 70%

Recommended books:

(i) David Freedman, Robert Pisani, Roger Purves, *Statistics*, 4th Edition, 2007, W.W. Norton & Co, ISBN13: 9780393929720

(ii) Jessica M. Utts, Robert F. Heckard. *Mind on Statistics*, Cengage Learning, 2012, ISBN-13: 978-0-538-73348-9

SECOND YEAR

SEMESTER I

CSC 201 – COMPUTER PROGRAMMING I (4 Units)

Pre-requisites: Pure Mathematics I

Course Purpose:

The course aims to develop the ability to select appropriate algorithms for problem-solving by computer. The students will also be expected to become proficient in the use of one high-level structured language.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. explain the basic terminology used in computer programming;
ii. write, compile and debug programs in a structured programming language, e.g. C or Pascal;
iii. use different data types in a computer program;
iv. design programs involving decision structures, loops and functions;
v. explain the difference between call by value and call by reference;
vi. explain the dynamics of memory by the use of pointers;
vii. use different data structures and create/update basic data files.

Course Content:

Introduction: Programming languages, compilation and interpretation, problem specification, algorithms, flow chart, pseudo code, basic programming techniques, data types and declaration, header file and linkage, variables and constants, arrays, input/output, termination, remark, control structures, branching, conditional structures, repetition and loops, basic library functions, social impact of computer age, computers in office, industry and education. Computer Problem-Solving: Programs and algorithms, problem-solving aspect, top-down design. Software tools for program development - editors, interpreters, compilers. Fundamental Algorithms e.g., Exchanging the values of two variables, counting, summation of a set of numbers, factorial computation, base conversion, etc. Array techniques: Array order reversal, finding the maximum number in a set, finding the k^{th} smallest element, removal of duplicates from an ordered array. Data types and declarations: type integer, real, char, Boolean, enumerated and sub-range. Statements: Expressions and Assignments, Input and output of data. Basic Control Structures: Compound statements, repetitive statements (while, repeat and for statements). Procedures and Functions: The procedure concept, block structure and scope. Variable and value parameters. Functions. Information hiding and the layered model in software development. Methods of documentation. Structured data structures: Arrays, records and sets. Files: the file concept, text files. Pointers: the pointer concept, programming a stack.

Lab Outline:

Students to write programs in a structured programming language to amongst others do the following:

i. find the sum of individual digits of a positive integer;
ii. generate a Fibonacci sequence;
iii. generate prime numbers;
iv. find the roots of a quadratic equation;
v. find the factorial of a given integer;
vi. solve Towers of Hanoi problem;
vii. add two matrices; multiply two matrices;
viii. implement a stack using arrays and pointers;
ix. implement a queue using arrays and pointers.

Mode of Delivery

Lectures, Class discussions, e-learning, group presentations, laboratory tests

Instruction Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, computer

Course Assessment

Continuous Assessment and Tests	30%
End of Semester Examinations	70%

Recommended books:

(i) Guttag, John, *Introduction to Computation and Programming Using Python*. MIT Press, 2013. ISBN: 9780262519632.
(ii) Zelle, John M. *Python Programming: An Introduction to Computer Science.* 1st ed. Franklin Beedle & Associates, 2003. ISBN: 9781887902991. (Be sure to get the 1st edition, not the 2nd.)
(iii) David Evans, *Introduction to Computing: Explorations in Language, Logic, and Machines,* CreateSpace (August 15, 2011); Lulu.com (August 19, 2009). ISBN-10: 1463687478
(iv) Carol Critchlow, David Eck, *Foundations of Computation*, Hobart and William Smith Colleges (2011).
(v) Allen B. Downey, *How To Think Like A Computer Scientist: C++ Version*, CreateSpace (March 20, 2009); eBook(1999)
(vi) Brian Williams and Stacey Sawyer, "*Using Information Technology*," Seventh Edition, 2007,T TMcGraw-Hill, ISBN: 0072260718.
(vii) William Stallings, "*Computer Organization and Architecture: Designing for Performance*," Seventh Edition, 2006, Prentice Hall, ISBN: 0131856448.

ECE 211 – PHYSICAL ELECTRONICS (3 Units)

Pre-requisites: SPH 111 - Fundamentals of Physics II

Course Purpose:

To introduce the basic concepts of physical mechanisms governing semiconductor device behavior

Expected Learning Outcomes:

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

(i) Draw and explain band diagrams for doped and undoped semiconductors.
(ii) Calculate carrier concentrations using the Fermi distribution function.
(iii) Calculate current density, mobility and conductivity.
(iv) Use Hall effect measurement results to determine mobility, carrier concentration and carrier type.
(v) Describe band diagrams, charge density, electric field and potential distribution for a pn junction.
(vi) Describe pn-junction current-voltage characteristics and variation of pn junction parameters with bias.
(vii) Calculate junction breakdown voltages for pn junctions

Course Content

Atomic Structure & Quantum Concepts: atomic structure; energy levels in an isolated atom, quantization, inter-atomic forces; bonds and bands, free electron energy spectrum. Schrodinger wave equation, potential wave problem. Electrical Conduction: Electrical conduction in metals; classical and quantum free electron theories; energy band theory; distinction between metals, insulators, and semi-conductors; equilibrium properties of semiconductors, intrinsic and extrinsic semi-conductors; Fermi energy, Fermi Dirac distribution functions; energy carrier phenomenon, metal-semiconductor contacts, transport properties of semiconductors, carrier transport and recombination, conductivity and its variation with temperature; experimental techniques for determination of the energy barrier. Currents in a p-n junction: the diode equation; junction capacitance; the varactor diode; characterization of the junction; tunnelling phenomenon; solar cells and the light-emitting devises. Gaseous and Plasma processes: arc, glow discharges.

Mode of delivery

Lectures, Class discussions, e-learning, group presentations, laboratory tests

Instructional materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Recommended textbooks

(i) Sheng S. Li (2006) *Semiconductor Physical Electronics, 2nd edition* Springer science, USA. ISBN-10: 0387288937
(ii) Bill Wilson (2009), *Introduction to Physical Electronics,* Orange Grove Texts Plus. ISBN-10**:** 1616100443

(iii) Lonngren Karl E. (1988), *Introduction to Physical Electronics 1st edition*, Allyn and Bacon ISBN-10: 0205111416
(iv) Ben Streetman, Sanjay Banerjee (2005) *Solid State Electronic Devices* (Prentice Hall Series ISBN-10: 013149726X

ECE 212 – ELECTRIC CIRCUIT THEORY AND ANALYSIS I (3 Units)

Pre-requisites: MAT 101: Pure Mathematics I, SPH 111: Fundamentals of Physics II
Course Purpose:
To develop problem solving skills and understanding of circuit theory through the application of techniques and principles of electrical circuit analysis to common circuit problems.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
(i) analyze electric circuits containing resistors, voltage sources, and current sources;
(ii) calculate real power on circuit components;
(iii) apply circuit theorems in the solution of given circuits;
(iv) derive Thevenin and Norton equivalent circuits;
(v) determine the responses of RLC circuits to applied signals.

Course Content:
Physical foundation of electric circuits: electric current; electromotive force; resistance; conventional current; Ohm's law; work, energy, and power; conductance; efficiency; real and ideal sources; resistive networks. Kirchoff's voltage and current laws: voltage divider rule; current divider rule; series- and parallel-connected sources; voltage and current source conversions; mesh analysis; nodal analysis. Network theorems: (Superposition, Thevenin's, Norton's, and Maximum Power Transfer) with independent and dependent sources; capacitance and capacitors; inductance and inductors; electromagnetic induction. Alternating current fundamentals: phasor representation of alternating current; AC voltage and current relationships for pure resistance; inductive and capacitive circuits; wye-delta transformations.

Mode of Delivery
Lectures, Class discussions, e-learning, group presentations, laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Study of DC series circuits, parallel circuits, Kirchoff's current and voltage laws, current divider theorem, voltage divider theorem, network theorems, simple RLC circuits, transformer operation, and simulation of basic electrical circuits using PSPICE.

Recommended books:
(i) William H. Hayt, Jack Kemmerly and Steven M. Durbin, *Engineering Circuit Analysis*, Seventh Edition, T2006, McGraw-Hill, ISBN: 0073263184.
(ii) J. David Irwin and Robert M. Nelms, *Basic Engineering Circuit Analysis*, Eighth Edition, 2006, John Wiley & Sons, ISBN: 0470083093.
(iii) Robert L. Boylestad, "*Introductory Circuit Analysis*," Eleventh Edition, 2004, Prentice Hall, ISBN: 0131730444.

ECE 213 – POWER SYSTEMS I (3 Units)

Pre-requisites: SPH 111 - Fundamentals of Physics II
Course Purpose:
To demonstrate understanding of basic concepts of single and three phase AC systems and networks, electric power generation, transformers, transmission lines, electric machinery and the use of power in single and three phase networks. To describe the basic principles and needs of modeling, equivalent circuits and analysis in power systems.
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. apply concepts from basic electromagnetics to determine the inductance, capacitance, and resistance of single and three phase transmission lines;
ii. derive the relationships between the voltage and current on a transmission line, and be able to solve for the voltage or current at any point along the line ;
iii. derive the model for short, medium and long transmission line ;
iv. demonstrate understanding of standard model for a real transformer and winding losses;
v. derive the voltage and current relationships for the ideal and practical transformer models;
vi. explain the rationale behind per unit analysis, and be able to use per unit analysis to solve single and three phase circuits;
vii. draw the single line equivalent circuit diagram and be able to derive the impedance and reactance diagrams;
viii. analyze power systems under abnormal operating conditions (symmetrical and asymmetrical short circuit);
ix. explain tariff systems;
x. explain basic protection systems;
xi. calculate the most economical cross sectional area of a conductor.

Course Content:
Sources of electrical energy. Introduction to generation, transmission and distribution of electrical power. Introduction to transmission lines and cables. Introduction to transformers. Three-phase transmission system. Complex power. The power triangle. Direction of power flow. Steady-state operations. Single line equivalent circuit of star-and delta-connected loads. Application of per unit quantities. Impedance diagrams. The Bus Admittance and Impedance Matrices. Tariffs. Synchronous machines in power systems. Power factor and power factor correction.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (30%) and End of semester Examination (70%)

Recommended books:

i. J. Duncan Glover, Mulukutla S. Sarma, Thomas Overbye , *Power System Analysis and Design*, ISBN-13: 978-053454884.
ii. D. P. Kothari, I. J. Nagrath, *Modern Power System Analysis*, McGraw-Hill Education, 2003. ISBN 0070494894
iii. Arthur R. Bergen, *Power Systems Analysis*, Pearson Education, 2009. ISBN 8177588192.
iv. Kothari & Nagrath, *Power System Engineering*, Tata McGraw-Hill Education, 2008. ISBN 0070647917
v. Abhijit Chakrabarti, Sunita Halder *Power System Analysis: Operation and Control 3rd ed*. PHI Learning Pvt. Ltd., 2010. ISBN 8120340159
vi. N. V. Ramana, Ramana N.V., *Power System Analysis*, Pearson Education India, 201. ISBN 8131755924
vii. G.Shrinivasan, *Power System Analysis*, Technical Publications, 2009. ISBN 8184315619
viii. C. L. Wadhwa, *Electrical Power Systems*, New Age International, Jan 1, 2005. ISBN 8122417221

MAT 201 – ENGINEERING MATHEMATICS I (3 Units)

Pre-requisites: MAT 101 - Pure Mathematics I
MAT 103 - Pure Mathematics II

Course Purpose:
To introduce the students to the principles of engineering mathematics covering infinite series, vector algebra and matrices.
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
i. solve systems of linear equations;

ii. analyze vectors geometrically and algebraically;
iii. recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces;
iv. use matrix algebra and the relate matrices to linear transformations;
v. compute and use determinants;
vi. compute and use eigenvectors and eigenvalues;
vii. determine and use orthogonality.

Course Content:
Infinite series: arithmetic and Geometric Series; Convergence of infinite series; Tests for convergence; Maclaurin and Taylor series; Leibnitz's theorem for differentiation; convergence of Power Series; Limiting values of functions; L'Hopitals rule. Vector Algebra: Ratio theorem, Scalar and Vector products, Unit vectors, Geometrical interpretations; Applications to mechanics. Matrices: Solution of linear equations, Crammer's rule, Elementary row operations; Gauss's elimination method; Lower-upper decomposition; Solution of homogeneous equations.

Mode of delivery
Lectures, Class discussions, e-learning

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment

Continuous Assessment and Tests	30%
End of Semester Examinations	70%

Recommended book:

(i) K.A. Stroud, *Engineering Mathematics*, 6th Edition (2006), Palgrave Macmillan, ISBN 13-978-1-4039-3
(ii) Dr Anthony Croft, Robert Davison, *Mathematics for Engineers: A Modern Interactive Approach*, Prentice Hall; 2 edition (11 Dec 2003). ISBN-10: 013120193X
(iii) K. A. Strouf and Dexter J. Booth, *Engineering Mathematics*, Palgrave Macmillan; 6th edition edition (2007). ISBN-10: 1403942463

MIE 221 – SOLID MECHANICS I (3 Units)

Prerequisites: SPH 110: Fundamentals of Physics I.
ECC 104 - Applied Mechanics

Course Purpose:
To introduce students to continuum mechanics, elasticity theory and solid mechanics.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
i. apply linear elastic material laws to calculate deformations of deformable bodies;
ii. integrate deformable body concepts with static equilibrium to solve statically indeterminate problems;
iii. model simple beams;
iv. design a structural component including the concept of factor of safety;
v. interpret two dimensional stresses and strains using coordinate transformations;
vi. calculate maximum normal/shear stresses and strains;
vii. model thin walled pressure vessels.

Course Content:
Introductory concepts of mechanics of materials; loading, static and dynamic forces. Stress and strain in tension and shear; definition of stress, uniaxial tension/compression. Members with variables cross-section; compound members. Elastic constants. Torsion analysis; Solid circular shafts, hollow circular shafts, thin-walled tubes, Bending moments and shearing forces; types of beams and loadings, Shear Force (S.F.) and Bending Moment (B.M.) diagrams, relation to intensity offered. Simple bending theory; review of geometric properties, stresses due to pure bending, Shear formula; stresses due to shear.

Mode of Delivery
Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment

Continuous assessment: 30%
Written Examination: 70%

Recommended books:

(i) R.K. BANSAL *Engineering Mechanics and Strengthening of Materials*
(ii) Gere J.M & Timoshenko S.P. (1984) *Mechanics of Materials* ISBN, 2nd Edition
(iii) Case J., Chilver L. & Carl T.F.R. (1999) *Strength of Materials and Structures*
(iv) *Mechanics of Materials –2nd Edition*, MadhukarVable

MIE 231 – FLUID MECHANICS I (3 Units)

Pre-requisites: ECC 104 - Applied Mechanics
SPH 110 - Fundamentals of Physics I

Course Purpose:

To introduce students to the basic laws and principles used to describe equilibrium and motions of fluids and the principles of operation of hydraulic machinery.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. describe general fluid properties;
ii. apply fundamental knowledge of mathematics to modeling and analysis of fluid flow problems;
iii. draw free body diagrams on fluid elements to show the magnitude and direction of forces acting on submerged surfaces;
iv. classify fluid and rotor-dynamic machines;
v. explain and describe centrifugal and mixed flow pumps and fans and the related effects on systems;
vi. select appropriate pumps and fans for the design of pump and fan systems;
vii. identify and describe hydraulic turbines and their classifications;
viii. increased ability to work with computers for the purpose of solving problems and communicating solutions on fluid mechanics.

Course Content:

Properties of fluids: density, specific gravity, vapour pressure, viscosity, surface tension and capillarity, bulk modulus.
Fluid statics: Pressure, manometers ,barometer and atmospheric pressure, hydrostatic forces on submerged plane surfaces, hydrostatic forces on submerged curved surfaces, Buoyancy and stability. Fluid kinematics: Lagrangian and Eulerian descriptions, flow visualization, plots of fluid flow data, Reynolds transport theorem(RTT). Mass and Energy equations: Conservation of mass, concepts of control surface and control volume ,mechanical energy, Bernoulli's equation, general energy equation, energy analysis of steady flows. Bernoulli's theorem and applications: pitot tubes, orifices, nozzles, venturi meters, notches, time to empty tanks. Flow in pipes: Laminar and turbulent flows in pipes, Reynolds number, Fluid friction and head loss, major losses, minor losses, piping networks and pump selection, flow rate and velocity measurement.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment

Continuous assessment: 30%
Written Examination: 70%

Recommended books:

(i) R.S. Khurmi, *Textbook Of Hydraulics, Fluid Mechanics and Hydraulic Machines*, S Chand & Co Ltd, ISBN-10: 8121901626.
(ii) P.N. Modi and S.M Seth, *Hydraulics, fluid mechanics and Hydraulic machinery*, ISBN-10: 8190089374.
(iii) Rajput, *Fluid Mechanics and Hydraulic Machines, S. Chand and Company, ISBN: 81-219-1667-4.*
(iv) Bruce R. Munson, *Fundamentals of Fluid Mechanics*, John Wiley and Sons (2012) ISBN-10: 1118399714

STA 205 – STATISTICS II (3 Units)

Pre-requisites: Basic Statistics I

Course Purpose

To enable the students to appreciate the richness of statistical science and to invite them to probabilistic thinking.

Expected Learning Outcomes:

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

(i) explain and perform arithmetic operations on probability;
(ii) state and apply common theorems used in statistics;
(iii) apply statistical knowledge in solving problems in situation such as quality control and data analysis.

Course Description

Addition and multiplication of probabilities, conditional probability. Bayes' theorem. Binomial, Poisson and Normal Distributions. Elementary treatment for large and small samples, chi-squared, f and t tests. correlation and regression analysis: linear multiple. Method of least squares, curve fitting. Estimation. Testing of significance. Correlation and regression analysis: linear, multiple. Method of least squares, curve fitting. Estimation. Testing of significance. Confidence bounds. Application of statistics in Quality, Control. Stochastic Processes. Statistical Inference.

Mode of Delivery

Lectures, Class discussions, e-learning

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment

Continuous Assessment and Tests	30%
End of Semester Examinations	70%

Recommended textbooks

(i) Douglas C. Montgomery, George C. Runger, Norma F. Hubele, *Engineering Statistics*, ISBN: 0470631473.
(ii) Robert M. Bethea, R. Russel, *Applied Engineering Statistics*, ISBN-10: 0824785037.

SEMESTER II

ECE 221 – BASIC ELECTRONICS (3 Units)

Pre-requisites: ECE 211 – Physical Electronics

Course Purpose:

To introduce the basic concepts of electronics and electronic devices including diodes, transistors and their applications.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. explain the construction, operation of P-N diode and derive the current diode equation;
ii. describe the construction and application of Schottky diode, zener diode, tunnel diode, varactor diode, LED, laser diode;
iii. explain half-wave and full-wave rectifier circuits;
iv. describe clipper, clamper circuits, and voltage multipliers;
v. describe the operations of BJT transistors;
vi. state and explain the application of BJTs;
vii. describe the construction and operations of FETs;
viii. explain the wave shaping circuits.

Course Content:

Diodes: *pn* junction diode, forward and reverse characteristics of a diode, ideal diode, practical diode, equivalent circuit of a diode, current equation of a diode, diode as a switch, Types of diodes (Schottky diode, zener diode, tunnel diode, varactor diode, LED, laser diode). Applications of diodes: Half- and full wave

rectifiers, clipper and clamper circuits, voltage multipliers. Bipolar Junction Transistor (BJT): Operation, *npn* and *pnp* transistors, unbiased transistor, DC biasing of a transistor, static characteristics, DC circuit analysis, load line, operating point and bias stabilization; Transistor as an amplifier; Transistor biasing configurations(Common emitter, common base, common collector); Darlington pair. Field-Effect Transistor (FET): FET biasing techniques (Common drain, common source and common gate, fixed bias and self bias configurations, voltage divider biasing); Metal Oxide Silicon FET (MOSFET); Universal JFET bias curve. Wave Shaping: Clipping, clamping circuits, RC differentiating and integrating filter circuits.

Mode of Delivery
Lectures, Class discussions, e-learning, group presentations, laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Labs start by introducing features that promote understanding the characteristics of basic circuits that use resistors, capacitors, diodes, bipolar junction transistors and field-effect transistors. The students then use this understanding to design and construct more complex circuits such as rectifiers, amplifiers and power supplies.

Recommended books:
(i) Robert Boylestad and Louis Nashelsky, *Electronic Devices and Circuit Theory*, Ninth Edition, 2006, Prentice Hall, ISBN: 0131189050.
(ii) Robert Paynter, *Introductory Electronic Devices and Circuits: Electron Flow Version*, Seventh Edition, 2006, Prentice Hall, ISBN: 0131716395.
(iii) B.L and A.K. Theraja, *Basic Electronics*

ECE 222 – COMPUTER APPLICATIONS FOR ENGINEERS (3 Units)

Pre-requisites: CSC 201 - Computer Programming I
ECE 212 - Electric Circuit Theory and Analysis I
Course Purpose:
To introduce students to the use of a high-level programming languages, Matlab for scientific problem solving with applications and examples from engineering and the applied sciences.

Expected Learning Outcomes:
Upon completion of this course, the student will be expected to:
i. explain fundamental computing concepts related to processing;
ii. formulate succinctly and correctly the input and output relationships of computational computing;
iii. demonstrate understanding of syntax and functionality of MATLAB and Simulink;
iv. create and use MATLAB and Simulink functions
v. describe Simulink environment
vi. list some of the commonly used signal sources available in Simulink to provide stimulus to a model
vii. list some of the commonly used sink blocks available in Simulink to view the output of a model
viii. state how hierarchical designs are created
ix. explain the sample period concept as implemented in Simulink
x. use MATLAB and Simulink to solve complex scientific and engineering problems.

Course Outline:
Data structures and algorithms. Linear Abstract Data Structures, including Lists, Stacks and Queues; Binary Trees and their applications; MATLAB: MATLAB Windows; Expressions, Constants; Variables and assignment statement; Arrays; Graph Plots: Basic plotting; Built in functions; Generating waveforms; Sound replay, load and save; Procedures and Functions: Arguments and return values; M-files; Formatted console input-output; String handling. Control Statements: Conditional statements: If, Else, Elseif; Repetition statements: While, For. Manipulating Text: Writing to a text file; Reading from a text file; Randomising and sorting a list; Searching a list. GUI Interface: Attaching buttons to actions; Getting Input; Setting Output. Applications: Discrete Linear Systems; Spectral Analysis; Filter bank synthesis; Speech Signal Analysis. Circuit simulation software: Pspice; Labview.
Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Recommended books:

(i) Mathworks, *MATLAB and Simulink Student Version*, ISBN 0-9755787-2-3
(ii) Mathworks, *Simulink: Getting Started*, http://www.mathworks.com/help/pdf_doc/simulink/sl_gs.pdf.
(iii) Edward B. Magrab et al, *An Engineers Guide to MATLAB* (3rd Edition), 2010, ISBN-10: 0131991108
(iv) Delores M. Etter, and Jeanine A. Ingber, *Engineering Problem Solving with C++* (3rd Edition). 2011. ISBN-10: 0132492652

ECE 223 – COMPUTER PROGRAMMING II (3 Units)

Pre-requisites: CSC 201 - Computer Programming I
MAT 201 - Engineering Mathematics I

Course Purpose:
To introduce the students to data structures and programming in a structured programming language.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. explain steps of analyzing a problem and to set up strategy prior to writing C code;
ii. demonstrate the ability to use a C development environment ;
iii. demonstrate the ability to create and implement various types of functions in C;
iv. demonstrate the ability to develop and chart algorithms, use the if and if/else forms, use comparison and logical operators in C ;
v. demonstrate the ability to understand and use nested selection structures and switch forms of if/else ;
vi. demonstrate the ability to create and implement repetition structures in C;
vii. demonstrate the ability to create and manipulate sequential access files in C;
viii. demonstrate the ability to create and manipulate User-Defined Simple Data type;
ix. demonstrate the ability to work as a team member on a programming assignment that includes the analysis, design, development, documentation, debugging, and presentation of a successful C project.

Course Content:
Introduction: Algorithm / pseudo code, flowchart, program development steps, structure of C program, identifiers, basic data types and sizes, Constants, variables, arithmetic, relational and logical operators, increment and decrement operators, conditional operator, bit-wise operators, assignment operators, expressions, type conversions, conditional expressions, precedence and order of evaluation, Input-output statements, statements and blocks, if and switch statements; while, do-while, for statements; break, continue, goto and labels. Designing structured programs: Functions,, parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, standard library functions, user defined functions, recursive functions, header files, C pre-processor. Arrays and pointers: definition/declaration, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays. pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions, command line arguments. Derived types: definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, bitfields. Input and output: text files and binary files, streams, standard I/O, Formatted I/O, file I/O operations, error handling. Searching: Linear and binary searching; search methods: Bubble sort, selection sort, Insertion sort, Quick sort, merge sort. Data structures: singly linked lists, doubly linked lists, circular list, representing stacks and queues in C using arrays and linked lists, infix to post fix conversion, postfix expression evaluation. Trees: Binary tress, terminology, representation, traversals, graphs representation, graph traversals (dfs & bfs)

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computers

Course Assessment:
Continuous Assessment Tests (30%), End of semester Examination (70%)
Recommended books:

(i) Computer science, *A structured programming approach using C*, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.
(ii) S. Tanenbaum, Y. Langsam, and M.J. Augenstein, *Data Structures Using C*, PHI/Pearson education.
(iii) R.Kruse, C.L. Tondo, BP Leung, Shashi M , *Data Structures and Program Design in C*, Second Edition, Pearson Education.

ECE 224 – ELECTRICAL MEASUREMENTS (3 Units)

Pre-requisites: Electric Circuit Theory and Analysis I
ECE 211 - Physical Electronics

Course Purpose:
To understand basic functions and principle of working of sensors and components used in Electronic Measurement; and the principles of electronic instruments.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) measure physical parameters using various instruments;
(ii) explain the working of sensors and transducers;
(iii) explain construction principles of instruments;
(iv) explain the operation of measuring instruments and their applications.

Course Content:
Introduction to Electrical Instruments: Generalized measurement system; application of generalized measurement system; static and dynamic characteristics of instruments - accuracy; precision; linearity; sensitivity; resolution; hysteresis; calibration. Errors in Measurements: classification of measurement error and elimination of errors in measurements.
Sensors and Transducers: Active and passive transducers; characteristics; eddy current sensors; piezoelectric transducers; photoelectric and photovoltaic sensors; capacitive sensors; potentiometer; pressure gauges; Linear viable Differential Transformers (LVDT) for measurement of pressure and displacement; resistance temperature detectors; thermal sensors-thermistors; thermocouples. Testing and Measuring Instruments: Analog multimeter; measurement of resistance–Kelvin's double bridge; Wheatstone bridge; megaohm bridge; measurement of inductance–Maxwell bridge, Hey bridge; Measurement of capacitance – Schering bridge; Q-meter; energy meter; power meter. Cathode Ray Oscilloscope: Principle of operation; CRO specifications; sweep modes, delay line, single and dual beam CROs, Chop and alternate modes. CRO measurement of voltage, frequency, phase difference; use of Lissajous figures in the detection of frequency and phase; Digital storage Oscilloscope. Wave Analyzers: Distortion and Harmonic analyzers. Data acquisition and Digital Instruments: single channel and multichannel PC-based instruments; digital displays; Digital multimeter.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:

(i) H. Oliver and J. M. Cage, *Electronic Measurement and Instrumentation*, McGraw Hill, 2008
(ii) C. S. Rangan, G.R. Sarma, and V.S.V. Mani, *Instrumentation Devices and Systems*, Tata McGraw Hill.
(iii) Slawomir Tumanski, *Principles of Electrical Measurement*, CRC Press (2006), ISBN: 13: 978-0-7303-1038.

ECE 225 – ELECTRICAL MACHINES I (3 Units)

Pre-requisites: ECE 212 - Circuit Theory and Analysis I
SPH 111 - Fundamentals of Physics II

Course Purpose:
To introduce students to fundamentals of electrical machines and their applications in drive systems.
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. describe the principles of magnetism;
ii. describe the principles of electromagnetic induction;
iii. understand Theory of electromechanical energy conversion;
iv. understand concepts of fundamental torque equation and rotating and oscillating fields;
v. understand the concept of the equivalent electrical machine circuit;
vi. formulate relevant equivalent circuits;
vii. describe the construction and principle of operation of DC machines;
viii. derive DC motor and generator characteristics in series, shunt and compound modes;
ix. analyze speed control of DC motor;
x. derive generated voltage of DC generator;
xi. calculate required power, efficiency, losses in DC machines;

Course Content:
Magnetics: Magnetic materials, hysteresis loop, saturation and voltage regulation, magnetic terms and units, magnetic flux and m.m.f. relationship, magnetic circuits, Kirchhoff's laws applied to magnetic circuits, stored energy, self and mutual inductance, induced e.m.f. and stored energy. Principles of Electromagnetic energy conversion: Fundamentals of torque production, energy balance equation of an electromechanical system; force and torque as rates of change of stored energy. DC Machines: construction, principle of operation, e.m.f. and torque equations, armature reaction and commutation, calculation of de-magnetising and cross magnetising ampere turns, significance of back e.m.f., machine characteristics, d.c. motor starters, control of motor speed, losses and efficiency.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Characteristics of DC series and shunt motors, DC series and shunt generators.
Recommended books:

(i) B.L. Theraja, *Electrical Technology*, Vol. I
(ii) Steven J. Chapman, *Electric Machinery Fundamentals*, McGraw Hill, ISBN 0-07-011950-3.
(iii) S. K Bhattacharya, *Electrical Machines*, McGraw Hill,
(iv) A.E. Fitzgerald, Charles Kingsley, Jr. and Stephen D. Umans, *Electric Machinery*, Sixth Edition, 2003, McGraw-Hill, ISBN 0073660094.

ECE 226 – ELECTRIC CIRCUIT THEORY AND ANALYSIS II (3 Units)

Pre-requisites: MAT 103 - Pure Mathematics II
SPH 111 - Fundamentals of Physics II
ECE 212 - Electric Circuit Theory and Analysis I
Course Purpose:
To develop problem solving skills and understanding of circuit theory through the application of techniques and principles of electrical circuit analysis to common circuit problems.
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) analyse series and parallel resonant circuits;
(ii) calculate active and reactive powers on the components in circuits;
(iii) describe magnetically coupled circuits;
(iv) construct and assemble circuits from given schematics;
(v) analyze first and second order AC and DC circuits for steady-state and transient response in the time domain and frequency domain;

(vi) analyse and solve electric circuits using simulation software.

Course Content:
RLC Circuits: Complete response of RLC circuit; Series and parallel resonance; lossless LC circuit; complex forcing functions; tuned circuits. Sinusoidal steady-state: Quality factor; power factor and power factor improvement; complex frequency. Three-phase circuits: balanced and unbalanced circuits; source-load connections; power relationships, Star Delta Transformation. Coupled circuits: Magnetically-coupled circuits (mutual inductance, energy considerations, ideal transformers), mutual inductance.AC and DC Network Transient Analysis: Integer-differential equations of circuits; transient analysis; Variable frequency network performance; variable frequency response analysis; sinusoidal frequency analysis. Graph theory: Signal flow graphs and computer applications to the solution of networks; programming using graph theory.

Mode of Delivery
Lectures, Class discussions, e-learning, laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:
Basic *RL* and *RC* circuits, *RLC* circuit, sinusoidal steady-state analysis, AC power circuit analysis, polyphase circuits, frequency domain analysis and Bode plots, network analysis in the s-domain, mutual inductance and transformers, two-port networks, circuit analysis techniques using software packages such as PSPICE, Electronic Workbench, Multi-Sim, and Lab View.
Recommended books:
(i) William H. Hayt,T JackT Kemmerly and Steven M. Durbin, *Engineering Circuit Analysis*, Seventh Edition, T2006, McGraw-Hill, ISBN: 0073263184.
(ii) Muhammad H. Rashid, *Introduction to PSpice Using OrCAD for Circuits and Electronics*, Third Edition, 2004, Prentice Hall, ISBN: 0131019880.
(iii) J. W. Nilsson and S. Riedel, *Electric Circuits, 9/E with Mastering Engineering online tool*. Edition/Copyright: 9/E Published Date: 2011, Publisher: Pearson-Prentice Hall ISBN: 9780132845649

MAT 202 – ENGINEERING MATHEMATICS II (3 Units)

Pre-requisites: MAT 201 - Engineering Mathematics I
Course Purpose
To apply the principle of differentiation and integration to solve basic mathematical and engineering problems.

Expected Learning Outcomes:
At the end of the course the student should be able to:
(i) identify types and sources of numerical errors;
(ii) evaluate the magnitudes of numerical errors;
(iii) apply numerical methods to carry out numerical interpolation, differentiation and integration.

Course Content:
Introduction to error analysis: sources of errors, absolute and relative errors, error bounds, error propagation. Iteration methods for finding the roots of polynmial and transcendental equations; Newton-Raphson, modified Newton-Raphson, secant and Regula-Falsi methods. Theorem on convergence and convergence rates. Simple iteration method. Interpolation, differentiation and Integration: finite difference operators, shift operator, backward and central differences. Interpolation using finite differences; Newton-Gregory backward and forward methods, Everett's Bessel's and Sterling methods, Lagrange and Newton divided difference interpolation methods. Inverse interpolation. Numerical differentiation using finite differences. Numerical integration: Newton-Cotes methods, trapezoidal rule, Simpson's rule, $3/8^{th}$ rule, Weddle's rule Boole's rule. Gauss integration.

Mode of Delivery

Lectures, Class discussions, e-learning

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment

(i) Continuous Assessment and Tests 30%
(ii) End of Semester Examinations 70%

Recommended books:

(i) K.A. Stroud, *Engineering Mathematics*, 6th Edition (2006), Palgrave Macmillan, ISBN 13-978-1-4039-3
(ii) Dr Anthony Croft, Robert Davison, *Mathematics for Engineers: A Modern Interactive Approach*, Prentice Hall; 2 edition (11 Dec 2003). ISBN-10: 013120193X
(iii) K. A. Strouf and Dexter J. Booth, *Engineering Mathematics*, Palgrave Macmillan; 6th edition edition (2007). ISBN-10: 1403942463

MIE 213 – MATERIALS SCIENCE (3 Units)

Pre-requisites: SCH 101 - Fundamentals of Chemistry II

Course Purpose:

To enable the students to understand the concepts of atomic bonding, crystal structures, imperfections, diffusion, mechanical properties, magnetic properties, electrical properties, and dislocations as related to processing and performance of engineering materials; and how to select materials in engineering.

Expected Learning Outcomes:

Upon completion of this course, the student will be expected to:

(i) demonstrate an ability to analyze crystalline structures, and calculate miller indices, packing factor and density of selected unit cells, non-crystalline behaviour, and anisotropy;
(ii) apply materials microstructure in the design of materials and their processing to obtain required properties;
(iii) demonstrate the effect of materials microstructure at the atomic scale on the engineering properties of materials.

Course Content:

Crystalline structure of materials; crystal patterns, allotropy, Miller indices, lattice defects, dislocation and slip mechanisms, and grain microstructure. Binary equilibrium diagrams; construction of equilibrium phase diagrams; types of equilibrium diagrams, the Lever rule, alloy theory, reasons for alloying.Macro and Micro Examination of metallic Surfaces.Non-ferrous alloys; aluminium, copper, titanium and their alloys.Engineering polymers; overview of structure of polymers and polymerization processes. Classification of plastics, common plastics, processing, and their uses, polymer processing, degradation process. Ceramics; nature and properties of ceramics and glasses.Composite materials; fiber and particle reinforcement of polymeric, metallic and ceramic matrices. . Material Testing

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course assessment

Continuous assessment: 30%
Written Examination: 70%

Recommended books:

(i) William D. Callister Jr., David G. Rethwisch, *Materials Science and Engineering: An Introduction*, John Wiley and Sons,
(ii) L.H. Van Vlack, *Elements of Materials Science and Engineering*, Addison Wesley Publishing company, New York,
(iii) W.D. Callister, Jr, *Material Science and Engineering-An Introduction*, John Wiley and Sons, Inc, New York.
(iv) J.F. Shackelford, *Introduction to Materials Science for Engineers*, Mazwell Macmillan International Editions, Singapore.

MIE 274 – THERMODYNAMICS I (3 Units)

Pre-requisites: SPH 110 -Fundamentals of Physics I
MAT 103 - Pure Mathematics II

Course Purpose:
To provide students with knowledge and skills required for the analysis and design of power, propulsion, heating, and cooling systems using thermodynamic principles.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) state the laws and principles of thermodynamics and define the principal thermodynamic properties of steam and ideal substances;
(ii) use the 1st band 2nd law of thermodynamics to calculate heat transfer, work done and entropy changes in a thermodynamic system;
(iii) apply ideal cycle analysis to simple heat engine cycles to estimate thermal efficiency and work as a function of pressures and temperatures at various points in the cycle.

Course Content:
Fundamentals; Energy, heat and work. Gas Laws. Thermodynamic systems, boundaries and properties. First Law of thermodynamics and its application to non-flow systems and state flow processes; First law for open systems, classification of steady-state steady-flow devices. Properties of fluids; equation of state of a pure substance and definition. Thermodynamic diagrams; steam tables. Real fluids; properties and processes. Second Law of Thermodynamics; heat engine; efficiency; process efficiency; statements due to Plank, Kelvin and Celsius; Carnot principle; Thermodynamic temperature scale; reversibility and irreversibility; entropy; perfect gas.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment
Continuous assessment: 30%
Written Examination: 70%

Recommended books:

(i) Robert T. Balmer, *Modern Engineering Thermodynamics*, Elsevier, ISBN-10: 0123850738.
(ii) Claus Borgnakke and Richar E. Sintag, *Fundamentals of Thermodynamics*, John Wiley and Sons, ISBN 13:978-0-470-04192-5

ECE 220 – WORKSHOP PRACTICE (3 Units)

Pre-requisites
ECE 121 – Workshop Technology
ECE 221 - Analogue Electronics I
ECE 226 - Electric Circuit Theory II
MIE 213 - Material Science
ECC 105 - Fundamentals of Computing and Applications
ECE 223 - Computer Programming II
MIE 164- Engineering Drawing II

Course Purpose:
To provide an opportunity to students, through structured practical training modules, to understand and appreciate the kind of practical skills required in normal engineering workshop practices involving the selection and operation of some commonly used workshop tools and machines.

Expected Learning Outcomes:
Upon completion of this course, the student will be expected to:

i. explain workshop safety and set-up;
ii. design simple electronic circuitry and assembly;

iii. demonstrate hands-on knowledge of electrical installation and cabling;
iv. use computer applications;
v. demonstrate hands-on knowledge in machining, welding and metal works;
vi. explain the principles of surveying and structures;
vii. demonstrate understanding of chemical engineering and textile plants;
viii. explain workshop documentation and inventory keeping.

Mode of Delivery

(i) Internal attachment in workshops
(ii) Field supervision

Instructional Materials

(i) Electrical and Electronic tools and equipment
(ii) Electronic/ electrical components and materials
(iii) Industrial visits
(iv) Computer labs
(v) Machining, welding and soldering tools, materials and equipment

Course Assessment

(i) Lab Assignments	30%
(ii) Field / Industrial Visit assessment	30%
(iii) Attachment report	40%

Recommended books:

(i) Francis Thompson, F. G. Thomson and H. E MacDonnell, *Electrical Installation and Workshop Technology*, Vol. 3 (1993).
(ii) Roberts and Lapidge, *Manufacturing Processes*, McGraw Hill. ISBN 007053151X
(iii) O. E. Okorafor, *Fundamentals of Engineering Workshop Practice - Materials & Processes* [2011, E-Version].

YEAR THREE

SEMESTER I

ECC 301 – SCIENTIFIC AND TECHNICAL COMMUNICATION SKILLS (3 Units)

Pre-requisites: COS 100- Communication Skills

Course Purpose

This course explains all the skills necessary for oral and written communication applicable in the university, industry and commerce.

Expected Learning Outcomes:

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

(i) explain the importance of scientific and technical communication;
(ii) write various forms of technical communication;
(iii) understand all types of skills applicable in science and technology i.e. reading skills; writing skills, listening skills, speaking and interview skills, thinking skills and library skills;
(iv) conduct research and do short oral presentation;
(v) correct style and grammar faults in technical documents.

Course Content

Principles of organizing, developing and writing technical information and reports. Forms and convention common to scientific and technical disciplines; presentation of technical information to various audience; principles and techniques of oral presentation as medium; computer graphic and visual presentation techniques. Presentation of case studies; an audience for particular communication adaptation; designing and managing illustrations; and designing written documents. Research skills; understanding research, types of research, identifying potential research areas, methods of research, stages of research, writing reports with procedures, results, conclusions and recommendations; using sources to produce articles about new technologies or newsworthy events using both text and graphic elements in an effective way. Recognizing and correcting common grammar and style faults.

Mode of Delivery

Lectures, Class discussions, e-learning, group discussions

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Mode of examination

The course shall be assessed through the following:

(i)	Assignment	10%
(ii)	Sit-in-tests (CATs)	20%
(iii)	End of semester examination	70%

Recommended textbooks

i. *Effective Communication Skills for Scientific and Technical Professionals* by Harry Chambers.
ii. *Communicating in Science: Writing a Scientific Paper and Speaking at Scientific Meetings* by Vernon Booth.
iii. *Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students* by Robert Barrass.
iv. *Scientists Must Speak: Routledge Study Guides by* D. Eric Walters and Gale C. Walters.
v. *Communicating Science: Contexts and Channels* , by Eileen Scanlon, Elizabeth Whitelegg and Simeon Yates.
vi. *How to Write and Publish a Scientific Paper* by Robert A. Day and Barbara Gastel .
vii. *Open Science: Sharing Knowledge in the Global Century* by Julian Cribb and Tjempaka Sari Hartomo.

CSC 310 – OBJECT ORIENTED PROGRAMMING (3 Units)

Pre-requisites

ECE 223 - Computer Programming II
MAT 103 - Pure Mathematics II

Course Purpose:

To understand the concepts of object-oriented programming and master Object Oriented Programming using C++.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. explain trends in computer programming as they relate to object-oriented programming and C++ language;
ii. analyze a problem and to set up strategy prior to writing C++ code;
iii. use a C++ development environment;
iv. create and invoke functions and pass information to functions;
v. develop and chart algorithms, use the if and if/else forms, use comparison and logical operators in C++;
vi. use nested selection structures and switch forms of if/else;
vii. create and implement repetition structures in C++;
viii. use posttest loops and nested repetition structures in C++;
ix. create and manipulate sequential access files in C++;
x. create and manipulate User-Defined Simple Data type;
xi. work as a team member on a programming assignment that includes the analysis, design, development, documentation, debugging, and presentation of a successful C++ project.

Course Content:

Object Oriented Programming and C++. Procedural Programming; Object-Oriented Programming; C++ Programming Environment; Working with variables and constants; Creating comments, I/O functions in a C++ program; Elements of data structures. Evaluating C++ Expressions: Using C++ Binary Arithmetic; Precedence and Associativity of Arithmetic Operations, Shortcut Arithmetic; Unary Operators; Evaluating Boolean Expressions; Performing Operations on struct Fields. Selection Structures: Using the if statement; the Nested if; the switch statement; the Conditional Operator; the Logical AND; the Logical OR; Selection with Structure Fields. Repetition Statements: The while loop; Writing typical Loops; The for Loop; Nested Loops; Using Loops with Structure Fields. Arrays, Strings, and Pointers: Arrays; Storing Values in Arrays; Accessing and Using Array Values; Creating Arrays of Structure Objects; Using Strings; Using Pointers. Using C++ Functions: Writing simple Functions; Putting Functions within Files; Returning Values; Passing Values; Passing Arrays; Overloading Functions. Using Classes: Creating Classes; Encapsulating Class Components; Implementing Class Functions; Using Static Class Members; Polymorphism. Advanced Topics: Class Features and Design Issues; Friends and Overloading Operators; Inheritance; Using Templates; Handling Exceptions; Advanced Input and Output; The cin and cout class objects; Using Enumerators; Recursion and Recursive Functions to Sort a List.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, computers
Course Assessment:
Continuous Assessment Tests (30%), End of semester Examination (70%)
Recommended books:

(i) Walter Savitch, *Problem Solving with C++: The Object of Programming*, ISBN-10: 080537440X.
(ii) Bjarne Stroustrup, *The C++ Programming Language*, ISBN-10: 0321958322.

ECE 312 – ELECTROMAGNETICS I (3 Units)

Pre-requisites: SPH 111 - Fundamentals of Physics II, ECE 226 - Electric Circuit Theory II, MAT 202 - Engineering Mathematics II
Course Purpose:
To introduce students to basic theory of electromagnetic field theory using vector calculus in order to lay a foundation of studying succeeding courses.
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. apply vector analysis methods in electromagnetic fields;
ii. define electric and magnetic fields according to their force effect;
iii. explain the physical meanings of the differential equations for electrostatic and magnetostatic fields ;
iv. calculate the electric field from the stationary charge distributions and magnetic fields from steady current distributions;
v. solve simple electrostatic boundary value problems;
vi. describe and use simple models of electric and magnetic field interactions with materials;
vii. explain the concept of electromotive force.

Course Content:
Vector Analysis: Vector algebra, Coordinate systems, Component scalars and vectors, Dot product, Cross product, Coordinate and unit vector definitions. Vector definitions and coordinate transformations, Separation distances, Constant coordinate surfaces, Differential lengths, surfaces and volumes. Electrostatics: Coulomb's Law; electric field intensity, electric potential; electric dipole; Gaus's Law; potential energy; spherical, linear, planar charge distribution. Dielectrics Static Fields: Electric polarization; electric field inside and outside dielectrics; electric susceptibility; electric displacement. Boundary Value Problems: method of images, Point charge, conducting sphere, Green function for the sphere, Two dimensional charge and potential problems; basic finite element analysis; Laplace equation using spherical coordinates; Behavour of fields in conical hole or near sharp point, use of cylindrical coordinates, Spherical Green function expansion. Magnetostatics: solution of magnetic fields; Biot-Savart Law; force between current-carrying conductors; magnetic induction; Ampere's law; toroid; solenoid
Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended Books:

(i) William Hayt and John A. Buck, *Engineering Electromagnetics*, Seventh Edition, 2006, McGraw-Hill, ISBN: 0073104639.
(ii) F. T. Ulaby, E. Michielssen, U. Ravaioli, *Fundamentals of Applied Electromagnetics*, Pearson Prentice Hall, 2010

ECE 313 – ELECTRICAL MACHINES II (3 Units)

Pre-requisites: ECE 226 - Electric Circuit Theory and Analysis II, ECE 225 - Electrical Machines I

Course Purpose:
To introduce the students to the principles of single phase and three phase transformers and motors.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. explain the working principle of power transformers;
ii. carry out transformer tests;
iii. describe 3-phase transformer connections;
iv. explain the operation of 3-phase transformers in parallel and infinite bus;
v. calculate required power, efficiency, losses in transformers;
vi. describe the fundamental operating principle of 3-phase induction motors;
vii. analyze equivalent circuit of 3-phase induction motors;
viii. calculate 3-phase induction motor parameters;
ix. describe starting, speed control methods, braking and overload protection of 3-phse induction motors;
x. solve power flow, torque and speed problems in 3-phse induction motors;
xi. describe the operational importance of the synchronous machine in modern power systems.

Course Content:
Single Phase Transformer: Theory of ideal transformer, useful and leakage fluxes, leakage reactance, e.m.f. equation, equivalent circuit, voltage regulation, transformer tests, rating, temperature rise, cooling, losses and efficiency. Three Phase Transformer: Terminal markings, alternative three phase connections, group numbers, parallel operation, auto-transformer, Scott or T-T connection, instrument transformers, operation on infinite bus bars. Three-Phase Induction Motor: Effect of slip on rotor circuit (current and current frequency, e.m.f., and reactance), speed/torque/load/slip characteristics, torque calculations, power balance equations, output power calculations, transformer equivalent circuit, determination of circuit parameters, starting currents and starting methods, circle diagrams, traditional methods of speed control, braking and overload protection, rating, heating, losses and efficiency, applications of induction motors. Synchronous Machine: Role of the synchronous machine in modern power systems, introduction to system dynamics and basic power flow.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (30%), End of semester Examination (70%)
Recommended books:

(i) M. V. Deshpande, *Electrical Machines*, 2011, ISBN: 9788120340268
(ii) Er. R.K. Rajput, *Electrical Machines in S.I.UNITS*, Edition : Fifth Edition, latest reprint ISBN: 9788131804469
(iii) J.B.Gupta, *Electrical Machines (AC & DC Machines)*, 4th edition 2012, ISBN: 8188458147
(iv) J.B.Gupta & S.Hasan Saeed, *Electrical Machines and Automatic Control*, 2nd edition, 2011. ISBN: 9789350140284

ECE 314 – ANALOGUE ELECTRONICS I (3 Units)

Pre-requisites: ECE 211 - Physical Electronics, ECE 221-Basic Electronics

Course Purpose:
To introduce the students to design of Bipolar Junction Transistor (BJT) and Unijunction Transistor (UJT) amplifiers, oscillators and circuits employing power electronic devices.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) design and analyse BJT transistor amplifiers and switching circuits;
(ii) describe FET biasing circuits;
(iii) design and analyze FET amplifiers;
(iv) design and analyze oscillator circuits;
(v) design elementary circuits using power devices;

(vi) use software to analyze electronic circuits.

Course Content:
Amplifier analysis: Transistor as an amplifier, hybrid model of a transistor, small-signal analysis, large-signal analysis, gain calculation of single-stage amplifier, cascading, multistage gain calculations. Classification of amplifiers on the basis of biasing: Class A amplifier, class B amplifier, class AB amplifier, class C amplifier, push-pull amplifier, and complementary symmetry amplifier. Classification of amplifiers on the basis of coupling: RC-coupled amplifier, transformer-coupled amplifier, direct-coupled amplifier. Classification of amplifiers on the basis of frequency: Audio-frequency amplifier, radio-frequency amplifier, tuned amplifiers. Feedback: Feedback concept, feedback amplifiers, voltage feedback amplifier, current feedback amplifier. Effect of feedback on frequency response. Practical amplifier considerations: Input and output impedance, amplifier loading, impedance matching. Oscillators: Basic theory, tank circuit, damped and undamped oscillations, phase-shift oscillator, Colpitt oscillator, Hartley oscillator, Wein Bridge oscillator, Clapp oscillator. current mirrors, current sources, active loads, tunnel diodes and UJT

Lab Outline:
Transistor curve tracer, introduction to PSPICE and AC voltage dividers, characterization and design of emitter and source followers, characterization and design of AC variable-gain amplifier, design of test circuits for BJTs and FETs, design of FET ring oscillators, design and characterization of emitter-coupled transistor pairs, tuned amplifier and oscillator, design of oscillators.

Mode of Delivery
Lectures, Class discussions, e-learning, laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Recommended books:

(i) Robert Boylestad and Louis Nashelsky, *Electronic Devices and Circuit Theory*, Ninth Edition, 2006, Prentice Hall, ISBN: 0131189050.
(ii) Robert Paynter, *Introductory Electronic Devices and Circuits: Electron Flow Version*, Seventh Edition, 2006, Prentice Hall, ISBN: 0131716395.
(iii) Thomas Floyd, *Electronics Fundamentals: Circuits, Devices, and Applications*, Sixth Edition, 2004, Prentice Hall, ISBN: 0131111388.
(iv) Thomas Floyd and David Buchla, *Basic Operational Amplifiers and Linear Integrated Circuits*, Second Edition, 1999, Prentice Hall, ISBN: 0130829870.

ECE 315 – MECHATRONICS AND MANUFACTURING AUTOMATION (3 Units)

Pre-requisites: ECE 224 - Electrical Measurements, MIE 231 - Fluid Mechanics, ECC 104 - Applied Mechanics, ECE 223 - Computer Programming II

Course Purpose:

To teach the applications and design of systems that involve the integration of mechanical, electronic, and computer engineering.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) explain the design principles of modern mechatronics components;
(ii) explain underlying principles and alternatives for mechatronics systems design;
(iii) design mechatronic and industrial automation processes;
(iv) evaluate appropriate technology and create and devise realistic industrial systems.

Course Content:
Overview of Mechatronics: mechatronic design approach, system interfacing, electromechanical systems. Physical System Modeling: modeling electromechanical systems, structures and materials, modeling of mechanical systems for mechatronics applications, fluid power systems, rotational and translational

microelectromechanical systems. Mechatronic sensors: linear and rotational sensors, acceleration sensors, force measurement, torque and power measurement, flow measurement, temperature measurements, distance measuring and proximity sensors, light detection, image, and vision systems, integrated micro-sensors. Actuators: Electro-mechanical actuators, piezoelectric actuators, hydraulic and pneumatic actuation systems. Mechatronic Systems and Controls: the role of controls in mechatronics, control system design via H2 optimization. Design of Mechatronic Systems: optimization, hardware-in-the-loop, simulation and rapid prototyping of real-time closed-loop, computer control of electromechanical systems. Manufacturing systems: CNC machines and part programming, computer aided design, industrial robotics, Computer-Integrated-Manufacturing, Group Technology, Cellular manufacturing, Flexible manufacturing systems, Just-in-time production.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:

Continuous Assessment Tests (30%), End of semester Examination (70%)

Recommended books:

(i) Godfrey C. Onwubolu, *Mechatronics: Principles and Applications*, 2005, Elsevier Butterworth-Heinemann, ISBN: 0750663790.
(ii) John Billingsley, *Essentials of Mechatronics*, 2006, John Wiley & Sons, ISBN: 047172341X.
(iii) Rolf Isermann, *Mechatronic Systems: Fundamentals*, 2005, Springer, ISBN: 1852339306.
(iv) Devdas Shetty and Richard Kolk, *Mechatronics System Design*, 1997, Thomson-Engineering, ISBN: 0534952852.
(v) W. Bolton, *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, Third Edition, 2003, Pearson Education, ISBN: 0131216333.

ECE 316 – DIGITAL ELECTRONICS I (3 Units)

Pre-requisites: MAT 101- Pure Mathematics I, ECE 221 - Analogue Electronics I

Course Purpose:

To introduce students to the concepts and tools for the design of digital electronic circuits using sequential and combinatorial logic.

Expected Learning Outcomes:

Upon completion of this course, the student will be expected to:

i. explain concepts and terminology of digital electronics;
ii. derive negated expressions using De Morgan's Theorem;
iii. formulate and employ a Karnaugh Maps to reduce Boolean expressions and logic circuits to their simplest forms;
iv. create circuits to solve problems using gates to replicate all logic functions;
v. design and implement combinational logic circuits;
vi. design and implement sequential logic circuits;
vii. design and evaluate a solution to a digital design problem.

Course Content:

Number System and Codes: Binary, Octal, Hexadecimal and their inter-conversion, Binary Arithmetic (Addition, Subtraction, Multiplication and Division), Diminished radix and radix compliments, BCD codes, 8421 code, Excess-3 code, Gray code. Logic Gates, Boolean Algebra and Logic Families: Axiomatic definition of Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Boolean Functions, Canonical and Standard forms, Digital Logic Gates. Various Logic Families like TTL and ECL, MOS and CMOS devices. Combinational Logic Design: The K-map method, Two, Three, Four and Five variable maps, Sum of products and Product of Sums Simplification, NAND and NOR implementation, incompletely specified functions, Ex-OR functions, The tabulation method, Determination of Prime implicants, Selection of Essential Prime implicants, The cube notation, Sharp operation, Iterative Consensus, Generalized Consensus, Minimization of Multiple output switching functions, Determining Prime implicants using Generalized Consensus, Finding a Minimum cover, Breaking cyclic and similar structures. MSI and PLD Components: Binary adder and subtractor, Multiplexers, Decoders / Demultiplexers, Read Only Memory, Programmable

Logic Arrays, Programmable Array Logic. Sequential Logic Design: S-R Flip-flops, JK flip-flop, D flip-flop, T flip-flop, master slave flip-flop. Flip-flop excitation table, Classification of sequential circuits, Registers; A to D and D to A converter circuits. Design and analysis of synchronous and asynchronous sequential circuits: Counters, Sequence Detector and Sequence Generator.

Lab Outline:
To verify the truth table of logic gates realize AND, OR, NOT gates; realize AND, OR gates using diodes and resistors; verify the Boolean algebra function using digital IC gates (consensus theorem) only; realize the function F (A, B, C, D) =(C+D) (A+B) (B+D) using NOR gates only; design a half/full adder circuit using FF for 2 bits; design a half/full sub tractor circuit using FF for 2 bits; design a binary to gray code converter; design a function using K-map and verify its performance using SOP and POS form; design BCD to seven-segment display using 7447 IC; implement F (A, B, C) =E (1, 3, 4, 5, 6) with a multiplexer; design a modulus N counter and a ring counter; design a shift register using flip-flops.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:

(i) Roger L Tokheim, *Digital Electronics: Principles and Applications*, Student Text with MultiSIM CD-ROM, Sixth EditionH, 2002, McGraw-Hill, ISBN: 0078309816.
(ii) Morris Mano and Charles R. Kime, *Logic and Computer Design Fundamentals*, Third Edition, T2003, Prentice Hall, ISBN: 013140539X.T
(iii) M. Morris Mano, *Digital Design & XILINX 6.3 XSE PKG*, First Edition, 2005, Prentice Hall, ISBN: 0131678485.
(iv) Samir Palnitkar, *Verilog HDL*, Second Edition, 2003, Prentice Hall, ISBN: 0130449113.

ECE 317 – POWER SYSTEMS II (3 Units)

Pre-requisites: ECE 213 - Power Systems I
ECE 226 - Electric Circuit Theory and Analysis II

Course Purpose:
To provide students with a complete overview of operation of an interconnected power system. Students to develop appropriate models for an interconnected power system, and know how to perform power flow, economic dispatch, and short circuit analysis.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) model of a power system;
(ii) calculate some calculation on finally power lines;
(iii) derive equivalent circuits of component of power systems: overhead lines, cables generators and any other loads.

Course Content:
Derivation of power systems parameter equations: Overhead lines standard parameters, generalised circuit constants and equivalent circuits, Underground cables, Transformers and loads, Load flow studies. Switch-gear; Fuses, Circuit breakers, isolators, insulators, bushing, reactors; Faults in Power systems: Symmetrical fault calculations on three phase systems. Unsymmetrical fault calculations on three phase systems: Single line to ground, double line to ground, line to line faults. Symmetrical components: significance of positive, negative and zero-sequence components, sequence impedance network equations, zero sequence diagram, phase shift, delta -star transformations, short-circuit capacity of a bus, effects of neutral grounding of faults on three-phase system, effects of neutral impedance on faults on three-phase unloaded synchronous generator, effects of impedances on fault currents, faults with broken conductors, unbalanced operation of three-phase transformer.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended book:

(i) J.D. Glover, M.S. Sama, and T.J. Overbye, *Power Systems Analysis and Design*, 4th ed., Thompson-Engineering.

MAT 301 – ENGINEERING MATHEMATICS III (3 Units)

Pre-requisites: MAT 202 - Engineering Mathematics II
Course Purpose:
To introduce students to the analysis and synthesis of Fourier series and transforms, Laplace transforms, functions of several variables and vector analysis.

Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) calculate the coefficients of both the complex and the real Fourier series for a variety functions, and to use them to solve some ordinary differential equations;
(ii) calculate Fourier transforms, discrete or continuous, for a variety of simple functions and use these to compute convolutions in simple cases;
(iii) solve the Laplace, heat and wave equations for a variety of boundary conditions in domains of simple geometry and with simple boundary conditions; the techniques available will include, separation of variables, Laplace and Fourier Transform methods;
(iv) solve functions of several variables and vector analysis;
(v) apply above methods to solve problems in different areas of engineering.

Course Content:
Fourier series: Orthogonal and orthonormal functions, periodic functions, odd and even functions; expansion of functions in Fourier series over full and half range; Dirichlet's conditions; differentiation and integration of Fourier Series; the Fourier integral and Fourier transform. Laplace transforms: properties of Laplace transforms; differentiation and integration of Laplace transform; diverse Laplace transform; application to solution of differential equations. Convolution theorem. Functions of several variables: limits, continuity, differentiability, total derivatives. Taylor's and mean value theorem, tangent planes, critical, maxima, minima and saddle points, change of variables, Jacobians, implicit functions. Vector analysis: gradients, divergence and curl, line, surface and volume integrals. Green's, divergence and Stoke's theorems.

Mode of Delivery

Lectures, Class discussions, e-learning

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment

Continuous Assessment and Tests	30%
End of Semester Examinations	70%

Recommended text books

(i) Raymond A. Barnett; Michael R. Ziegler; Karl E. Byleen; Dave Sobecki, *Precalculus*, MacGraw Hill, ISBN 978–0–07–351951–7
(ii) K.A Stroud, *Foundation Topics in Engineering Mathematics*, *6th Edition*, ISBN-13 978-1-4039-4246-3

SEMESTER II

ECE 321 – CONTROL SYSTEMS I (3 Units)

Pre-requisites: MAT 301 - Engineering Mathematics III

ECE 226 - Electrical Circuit Theory and Analysis II
ECC 104 - Applied Mechanics

Course Purpose:
To introduce students to the concepts of open-loop and closed-loop systems and their transfer functions. Teach the methods for the analysis and design of closed-loop feedback systems.

Expected Learning Outcomes:
Upon completion of this module, students will demonstrate:

(i) apply knowledge of control system terminology, configuration, techniques and applications to describe and design system parameters;
(ii) model systems in both time and frequency domain;
(iii) design first order and second order systems to yield desired transient characteristics;
(iv) use feedback control technique to determine stability of the system;
(v) demonstrate understanding how root locus and bode plot techniques are used them to determine stability of systems.

Course Content:
Dynamic models and dynamic response: Models of dynamic systems in differential equation form; electrical, mechanical, electro-mechanical systems, hydraulic systems, gear-trains and rotational systems. Modeling of the system using block diagram. Linearization, time scaling and amplitude. Transfer functions; transfer function representation of a model. Time domain analysis: Response to typical input signals; impulse, step, ramp and parabolic functions. Step response performance specifications; rise time, settling time, overshoot. Steady state errors: Steady state errors in unity and non- unity feedback systems. Static error constants and system type. Feedback control system concept and stability: Essential principles of feedback. Block diagrams; block diagram modeling of feedback system. Signal flow graphs. Sensitivity of control systems to parameter variation. Disturbance signals in feedback signals. Stability analysis; concept of stability, Routh_ Hurwitz stability criterion, other stability criterion, relative stability of feedback systems, stability of closed loop systems. Determination of root location in the S-plane. Root Locus method: Root loci, plotting of root loci, System poles and zeros. Rules for root locus construction. System compensation using phase- lead, phase – lag and phase lead – lag networks on S-plane. Frequency Response Concept of Frequency Response; asymptotic approximation (Bode Plots), M and N- circles. Nyquist stability criterion, Nyquist diagram and stability, gain and phase margins. Stability using Nyquist diagram and bode plots. Closed loop frequency response. Stability of control systems with time delays. System compensation using phase- lead, phase – lag and phase lead – lag networks on the Bode diagram.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:
simulation of step response and impulse response with unity feedback using MATLAB; Determination of root locus, Bode plot, and Nyquist plot using MATLAB; determination of PI, PD and PID controller action of first-order simulated process. Frequency response design examples using MATLAB.

Recommended books:

(i) Benjamin C. Kuo, *Automatic Control Systems*, Eighth Edition, 2003, John Wiley & Sons, ISBN: 0471381489.
(ii) Katsuhiko Ogata, *Modern Control Engineering*, Fourth Edition, 2002, Prentice Hall, ISBN: 0130609072
(iii) Norman S. Nise, *Control Systems Engineering, sixth Edition*, 2011, John Wiley & Sons, ISBN: 0471445770.

ECE 322 – ELECTROMAGNETICS II (3 Units)

Pre-requisites: ECE 312 - Electromagnetics I, MAT 301 - Engineering Mathematics III

Course Purpose:
To introduce electromagnetic waves and establish the fundamentals of devices in electromagnetic applications, as required by engineers in energy systems, telecommunications, computing and other technologies.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. explain physical meanings of Maxwell's equations;
ii. apply basic applications of Maxwell's equations;
iii. describe properties of electromagnetic plane waves;
iv. analyze how energy and momentum is stored and transported in an electromagnetic field;
v. analyze the propagation, reflection and transmission of plane waves;
vi. analyze propagation in simple types of waveguides;
vii. analyze the electromagnetic fields generated by given dynamic charge/current distributions using Maxwell's equations;
viii. calculate the reflection and transmission of power for uniform plane waves incident on planar material boundaries for low loss or conducting media;

Course Content:
Maxwell's equations: conservation of electric charge, scalar and vector potential, retarded potential, Lorentz condition; the divergence of E; the curl of B. Non-homogeneous wave equation. Propagation of Electromagnetic Waves: plane waves in free space; E and H in homogeneous, isotropic, linear, stationary media. Wave propagation in non-conductors: wave propagation inside conducting media, wave propagation inside good conductors, skin depth; Wave propagation in ionized gases: Plasma angular frequency. Wave propagation inside ferrite materials: permeability tensor; Reflection and Refraction: Snell's law, Fresnel's equation, Brewster angle, Reflection and refraction at interfaces of different media, Wave polarization.
Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:

(i) William Hayt and John A. Buck, *Engineering Electromagnetics*, Seventh Edition, 2006, McGraw-Hill, ISBN: 0073104639.
(ii) F. T. Ulaby, E. Michielssen, U. Ravaioli, *Fundamentals of Applied Electromagnetics*, Pearson Prentice Hall, 2010
(iii) Any other books recommended by the course lecturer

ECE 323 – NETWORK ANALYSIS AND SYNTHESIS (3 Units)

Pre-requisites: ECE 226 - Electric Circuit Theory and Analysis II, MAT 301 - Engineering Mathematics III

Course Purpose:
To learn the basic analysis and synthesis techniques used in electronics and communication systems.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. analyse circuits in time and frequency domain;
ii. describe the characterization of two port networks;
iii. calculate the parameters of a two port network;
iv. describe the concept of transfer function of a network and the nature of response to external inputs;
v. synthesize a network in different forms from the transfer function and given polynomials;
vi. describe various types of filters and their frequency responses;
vii. explain the concept and design of frequency selective filters;

viii. apply graph theory to in the solution of given networks.

Course Content:
Review of Laplace Transform. Network Topology and Graph theory: Incidence matrix; mesh, loop, and tree; cut set, directed graph; circuit matrix, cut-set matrix; fundamental circuits and cut-sets. Network functions: Driving-point functions; driving point impedance; two-port parameter matrices; transfer polynomials, polynomial composition of network parameters. Passive network synthesis: Introduction to concept of positive realness; test for positive realness; Cauer synthesis; Foster synthesis. Filter concepts: filter parameters and approximation techniques, Butterworth, Chebyshev, Elliptical, Bessel approximations, Filter design using image parameters and other appropriate methods, Frequency and impedance transformation, Normalization, Introduction to active filter design.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:

(i) Sudhakar, Shyammohan S. Palli, *Circuits and Networks Analysis and Synthesis*, Second Edition, Tata McGraw-Hill, 2002
(ii) Vasudev. K. Aartre, *Network Theory and Filter Design*, Wiley – Eastern Ltd, Second Edition, 1993.
(iii) Franklin F.Kuo (1999), *Network Analysis & Synthesis*, John Wiley &Sons
(iv) Vanval Kenburg, *Network Analysis*, Prentice Hall of India Pvt. Ltd, New Delhi, 1994.
(v) Wia K. Chen, *Graph Theory and its Engineering Applications*, World Scientific, Chicago

ECE 324 – DIGITAL ELECTRONICS II (3 Units)

Pre-requisites: ECE 316 - Digital Electronics I
ECC 105 - Fundamentals of Computing and Applications

Course Purpose:
To introduce the concepts and tools for the design of digital electronic circuits.

Expected Learning outcomes
Upon completion of this course, a student should be able to:

i. explain the fabrication steps of ICs;
ii. describe the classes of ICs;
iii. describe the medium scale integrated logic circuits;
iv. design multiplexers, de-multiplexers, decoders, encoders, comparators, adders and sub-tractors;
v. explain the operation and application of memory devices;
vi. describe sequential and timing circuits;
vii. design sequential and timing circuits;
viii. describe the operation of Analogue to Digital and Digital to Analogue converters(A/D, D/A);
ix. explain Programmable logic devices (FPLDs)/field programmable gate arrays (FPGAs), and Verilog HDL;
x. apply Veriwell Verilog Simulator in logic circuit simulation.

Course Content:
Integrated circuits (ICs): Introduction to fabrication of ICs, Simple monolithic ICs, classification of ICs. Medium scale integrated logic circuits: Types of MSI logic circuits, block diagram and operation of multiplexer, demultiplexer, decoder, encoder, comparator, adder and sub-tractors. Introduction to microcomputers: Elements and organisation of a computer system; Semiconductor Memories: Introduction, Memory organisation, Classification and characteristics of memories, Sequential memories, ROMs, R/W memories. Content addressable memories, Programmable logic arrays and Charged-Coupled device memory. Operation and application of memory devices: Read only memory (ROM), Programmable ROM (PROM), Electrically erasable ROM ((EPROM, EEPROM), Random Access Memory (SRAM, DRAM, DRAM cell

arrays), Programmable logic array (PLA), flash memory, memory addressing, address multiplexing, bus contention. Design of sequential and timing circuits: Multivibrators, application of logic gates in timing circuits, OP-AMP and its application in timing circuits, 555 timer; Analogue to Digital and Digital to Analogue conversions (A/D, D/A); Programmable logic devices (FPLDs)/field programmable gate arrays (FPGAs), and Verilog HDL: Introduction to field programmable gate arrays (FPGAs), introduction to Verilog HDL (VHDL), gate-level and dataflow modeling, use of simulation software such as Veriwell Verilog Simulator.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, computer
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Basic logic gates; Verilog simulation and hardware implementation of combinational circuits such as MUX/DEMUX, encoder/decoder, arithmetic logic unit (ALU); Verilog simulation and hardware implementation of sequential circuits such as flip-flops, registers, shift registers, counters; implementation of logic circuits using SPLDs; project solving a real-life problem.
Recommended books:
(i) Roger L Tokheim, *Digital Electronics: Principles and Applications,* Student Text with MultiSIM CD-ROM, Sixth EditionH, 2002, McGraw-Hill, ISBN: 0078309816.
(ii) Morris Mano and Charles R. Kime, *Logic and Computer Design Fundamentals*, Third Edition, T2003, Prentice Hall, ISBN: 013140539X.T
(iii) M. Morris Mano, *Digital Design & XILINX 6.3 XSE PKG*, First Edition, 2005, Prentice Hall, ISBN: 0131678485.
(iv) Samir Palnitkar, *Verilog HDL*, Second Edition, 2003, Prentice Hall, ISBN: 0130449113.

ECE 325 – SIGNALS AND SYSTEMS (3 Units)

Pre-requisites: ECE 226 - Circuit Theory and Analysis II
MAT 301 - Engineering Mathematics III
Course Purpose:
To introduce students to the basic concepts of signals, system modeling, system classification; to develop students' understanding of time-domain and frequency domain analysis of continuous time signals; and to provide the students with the necessary tools to analyse electrical networks and systems.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
i. describe common signals types and systems;
ii. discuss the operation and application of linear systems;
iii. apply transformation techniques and various analysis relating to the response of a linear system to any input signal;
iv. find the amplitude spectrum, phase spectrum of the various signals and also systems;
v. characterize and analyze the system in s-domain;
vi. understand, and resolve the signals in complex frequency domain using Laplace transform;
vii. characterize the system in s-domain;
viii. apply Laplace transforms to analyze electrical circuits;
ix. determine the correllogram, auto correlation, cross correlation, energy spectral density, and power spectral density of discrete and continuous signals;
x. carry out computer based simulations related to signals and systems.

Course Content:
Classification of signals: Random and deterministic; analogue and discrete or digital signals; energy and complex signals; energy and power signals, periodic and non-periodic signals. Singularity functions: Unit step function, unit impulse function, derivate of singularity function. Harmonic analysis of periodic signals: Trigonometric analysis of Fourier series, complex exponential series; frequency spectra; power content of a periodic signal, Parsevals theorem for Fourier series; Fourier transform for non-periodic signals in frequency domain; Properties of the Fourier transform. Convolution: Properties of convolution; Convolution with delta functions; Convolution theorems and deterministic signals; relation between autocorrelation functions, power

and energy spectral densities; correlation of power signals. System representation and classification: System representation; continuous-time and discrete-time systems, Linear systems, additivity, homogeneity; Time-invariant systems, Linear time–invariant systems, impulse Response and frequency response, filter characteristics of linear systems, amplitude and phase distortions, filter characteristics of linear systems; Random signals. Statistical analysis of random signals: Sampling of signals; sampling theorems; periodic delta functions and its spectrum; periodic impulse function and its spectrum; signal recovery from its sampled version.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:

Computer simulation of signals and systems using software e.g. MATLAB or equivalent).

Recommended books:

(i) A.V. Oppenheim, A.S. Willsky, and S.H. Nawab, *Signals and Systems*, Prentice Hall, ISBN-10: 0138147574.
(ii) Simon Haykins and Barry Van Veen, "*Signals and Systems*", 2nd Edition, John Wiley and Sons,

ECE 326 – ANALOGUE ELECTRONICS II (3 Units)

Pre-requisites: ECE 314 - Analogue Electronics I

Course Purpose:

To introduce the students to design of circuits that incorporates operational amplifiers

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

(i) design and analyse differential amplifier circuits;
(ii) design linear and non-linear op-amp circuits;
(iii) design power amplifiers using op amp as the building block for different classes of amplifiers
(iv) use a relevant software to simulate op amp circuits

Course Content:

The differential amplifier and its characteristics. The ideal opamp. Feedback arrangements. Concept of virtual ground. Circuit details of a simple opamp. The Practical Op-amp: 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 impedance, inverting and non-inverting configurations. Linear Opamp Circuits: Active integrator, effect of finite gain, effects of offsets on performance, active differentiator; Stability. Analogue simulation using software . Analogue computer. Basic Opamp Difference amplifier; Instrumentation amplifier. Voltage to current and current-to-voltage converters. Non-Linear Opamp Circuits: Voltage comparators. Multivibrators. Sinewave generators. Function generator. Precision rectifiers. Log/antilog amplifiers. Power amplifiers. Analysis of Class A and B amplifiers, distortion, integrated circuit amplifiers.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:

Transistor curve tracer, introduction to PSPICE and AC voltage dividers, characterization and design of emitter and source followers, characterization and design of AC variable-gain amplifier, design of test circuits for BJTs

and FETs, design of FET ring oscillators, design and characterization of emitter-coupled transistor pairs, tuned amplifier and oscillator, design of oscillators.

Recommended books:

(i) Thomas Floyd, *Electronics Fundamentals: Circuits, Devices, and Applications*, Sixth Edition, 2004, Prentice Hall, ISBN: 0131111388.

(ii) Thomas Floyd and David Buchla, *Basic Operational Amplifiers and Linear Integrated Circuits*, Second Edition, 1999, Prentice Hall, ISBN: 0130829870.

ECE 327 – ELECTRICAL MACHINES III (3 Units)

Pre-requisites: ECE 313 - Electrical Machines II, ECE 226 - Electric Circuit Theory and Analysis II

Course Purpose:

To introduce the students to the principles of single phase induction motors and synchronous machines by analysing steady state and transient performances.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. describe the construction of the single phase induction motor;
ii. analyze the product of rotating magnetic field;
iii. describe the construction and operation of synchronous machines in steady state performance;
iv. explain armature reaction and starting methods of synchronous machines;
v. analyze equivalent circuit characteristics, phasor diagrams and power angle diagram;
vi. explain V and O curves;
vii. discuss synchronous machine operation in parallel and in the infinite bus-bar;
viii. describe the use of synchronous machines for power factor correction;
ix. discuss dynamic braking, rating, heating, losses and efficiency of synchronous machines;
x. analyze the transient performance of synchronous machines.

Course Content:

Single phase induction motors: Construction, analysis of product of rotating magnetic field, the quadrature field theory, double revolving field theory, locked rotor torque, industrial application of single phase induction motors. Synchronous machines (steady state performance): Construction, salient pole and non-salient pole rotors, operating principle, starting methods, armature reaction, equivalent circuits, phasor diagrams, power-angle diagrams and equations, V and O curves, parallel operation, operation on infinite bus-bars, synchronous motor starting and use for power factor correction and dynamic braking, rating, heating, losses and efficiency of synchronous machines. Synchronous machines (transient performance): Synchronous machine transients, transformation to direct and quadrature axis variables, basic machine relations in direct quadrature zero (*dqo*) variables. Analysis of sudden three phase short circuit, transient power – angle characteristics, effects of additional rotor circuits, models of synchronous machines for transient analysis, synchronous machine dynamics.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Recommended books:

(i) V.K. Mehta, *Principles of Electrical Machines*

(ii) PK Mukherjee and S Chakravorti, *Electrical Machines*, Dhanpat Rai Publications M. V. Deshpande, *Electrical Machines*, 2011, ISBN: 9788120340268

(iii) Er. R.K. Rajput, *Electrical Machines in S.I.UNITS*, Edition : Fifth Edition, latest reprint ISBN: 9788131804469

(iv) J.B.Gupta, *Electrical Machines (AC & DC Machines)*, 4th edition 2012, ISBN: 8188458147

(v) J.B.Gupta & S.Hasan Saeed, *Electrical Machines and Automatic Control*, 2nd edition, 2011. ISBN: 9789350140284

(vi) M.A.Salam, *Fundamentals of Electrical Machines*, 2009. ISBN: 9788173196829

(vii) B.L Theraja, *Electrical Technology Volume II - DC & AC Machines*

ECE 328– PRINCIPLES OF COMMUNICATION SYSTEMS (3 Units)

Pre-requisites: ECE 314 - Analogue Electronics II, MAT 103 - Pure Mathematics II, STA 104 - Statistics I, ECE 226 - Electric Circuit Theory and Analysis II

Course Purpose:
To introduce students to the analysis and design of analog communication systems

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) explain various analogue modulation and demodulation methods;
(ii) compare the performance of Amplitude , Frequency Modulation and Phase modulation;
(iii) analyze and design basic AM and FM transmitters and receivers;
(iv) formulate and interpret the presentation and processing of signals in communication systems;
(v) evaluate the influence of noise on communications signals.

Course Content:
Introduction: definition and importance of communications, History of electronic communication; basic communication block diagram; Electromagnetic spectrum; bandwidth; frequency management. Amplitude modulation: AM spectrum; Modulation Index; Power content; DSB-SC; Hilbert Transform; SSB-SC; Vestigial Sideband Transmission (VSB); Performance comparison of various AM systems. Angle Modulation: Phase Modulation; Frequency modulation (FM); Phasor representation; Wideband FM; FM bandwidth for arbitrary signal; FM generation (Direct method, reactance modulator, Varactor diode method, FET reactance modulator). Demodulating FM waves: classification of FM demodulators; Frequency discriminator; slope detector; Phase discriminator; Performance comparison of FM demodulating methods. AM and FM transmitters and receivers: AM transmitter; SSB transmitter; SSB receivers; FM transmitter; Tuned radio frequency and super heterodyne receivers; Diversity receivers; FM receivers. Noise in communication systems: Noise performance in various modulation schemes, noise figures and signal-to-noise ratio. Communication Signal Transmission: Review of the Fourier transform; signal transmission through a linear system;; signal distortion over a communication channel; signal energy and energy spectral density; signal power and power spectral density; numerical computation of the Fourier transform.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:
Following the theoretical guidelines students to carry out practicals on the following:

a) circuits for various analog modulation schemes and other techniques such as AM, FM, and phase modulation and their waveform generations through circuits/modules;
b) performance comparisons of linear modulation schemes based on SNR calculations and investigate noise characteristics.

Recommended book:

(i) John M. Wozencraft, Irwin Mark Jacobs, *Principles of Communication Engineering*, John Wiley and Sons, ISBN-10: 0881335541
(ii) B.P. Lathi, *Modern Analog and Digital Communications*, Oxford Series in Electrical and Computer Engineering, ISBN-10: 0195331451
(iii) L. W. Couch, *Digital and Analog Communication Systems*, 6th Ed. 2003. ISBN: 0135990289.
(iv) Sanjay Sharma, *Communication Systems (Analog and Digital)*, S.K. Kataria and Sons,

MAT 302– DIFFERENTIAL EQUATIONS (3 Units)

Pre-requisites: MAT 301 - Engineering Mathematics

Course Purpose:
To introduce students to ordinary differential equations and partial differential equations.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. solve differential equations of first order using graphical, numerical, and analytical methods;
ii. solve and apply linear differential equations of second order (and higher);
iii. solve linear differential equations using the Laplace transform technique;
iv. find power series solutions of differential equations;
v. develop the ability to apply differential equations to significant applied and/or theoretical problems;
vi. be familiar with the modeling assumptions and derivations that lead to PDEs;
vii. recognize the major classification of PDEs and the qualitative differences between the classes of equations;
viii. be competent in solving linear PDEs using classical solution methods.

Course Content:
Ordinary Differential Equations: Solution of Linear differential equations; Airy's equation; Legendre's equation; solutions using generalised power series; Bessel's functions. Partial Differential Equations: Linear first-order homogeneous partial differential equations; classification of second-order linear homogeneous partial differential equations; one dimensional wave equation; method of separation of variables applied to the wave equation, Heat, conduction, and diffusion equations. Laplace's equation. Solution in polar, cylindrical and spherical coordinates.

Mode of Delivery

Lectures, Class discussions, e-learning

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment

Continuous Assessment and Tests	30%
End of Semester Examinations	70%

Recommended books:

(i) R. Kent Nagle, Edward B. Saff & Arthur David Snider (2008). *Fundamentals of Differential Equations and Boundary Value Problems*, Fifth Edition. Pearson Education Inc.
(ii) Henry Edwards & David E. Penney (2008). *Differential Equations and Boundary Value Problems*, Fourth Edition. Pearson Education Inc.

ECE 320 – INDUSTRIAL ATTACHMENT I (3 Units)

Pre-requisites: ECE 220 - Workshop Practice

Course Purpose:
To expose students to the day-to-day work environment of a professional engineer. Provide student with opportunities to use their initiative to translate theories learnt in classrooms and perform assignments in an actual working environment. Instill in the students the right kind of work attitudes and professionalism through interaction with people in the organizations, and observation of their future roles in industry. To lessen the on-the-job training requirements so that they can become effective and productive to their respective organizations much sooner than is usual for fresh graduates.

Expected Learning Outcomes
At the end of the course, a student should be able to:

(i) apply theoretical knowledge in industrial application;
(ii) acquire skills in communication, management and team-work;
(iii) practice ethical and professional work culture;
(iv) implement Health Safety Environment (HSE) practices at workplace.

Course Content:
Engineering technical skills:
Engineering and management: responsibilities and daily routines of an engineer/technologist and administrative duties;
Human relations: working with people to get things done;

Computer applications: using the computer as an aid in planning, designing and analysis of engineering projects and work processes;
Costing: awareness of cost effectiveness in engineering proposals/designs;
Safety: awareness of importance of safety in the organization;
Quality control: awareness of quality in all jobs done;
Productivity: awareness of measures taken to improve the productivity at the workplace;
Marketing: awareness of methods of product promotion.

Course Assessment

(i)	Industry based supervisor assessment	10%
(ii)	University Supervisor assessment	20%
(iii)	Log-book	30%
(iv)	Attachment report	40%

Recommended books:

A. M. Chang, *Engineering Management: Challenges in the New Millennium*, ISBN-10: 0131446789.

(i) C. Ray Asfahl , David W. Rieske, *Industrial Safety and Health Management (6th Edition)*, Prentice Hall, ISBN-10: 0132368714

(ii) Brian Scanlon, *Marketing of Engineering Services*, Thomas Telford Ltd, ISBN-10: 0727713485

YEAR FOUR

SEMESTER I

ECE 411-CONTROL SYSTEMS II (3 Units)

Pre-requisites: ECE 321 - Control Systems I

Course Purpose:
To introduce students to the concept of design of compensators and how they are used in realizing the desired operational characteristics both in time and frequency domain for systems. Introduce state space analysis and show how the technique is used in analysis internal characteristics of a plant.

Expected Learning Outcomes:
Upon completion of this module, students will demonstrate:

(i) design compensation schemes based on proportional integral, proportional and differential and proportional to differential compensation controllers;
(ii) apply state space analysis in frequency domain;
(iii) apply state space analysis in time domain;
(iv) design control systems through state variable feedbacks.

Course Content:
Compensation of feedback control systems: Types of compensators. Dynamic compensation using; proportional (P), derivative (D), integral (I) proportional and derivative (PD), proportional and integral (PI), proportional derivative and integral (PID) controllers, Dynamic compensation and system simulation using operational amplifier; Design of compensators: Cascade compensation; improving transient response and steady- state response using cascade compensation. Feedback compensation; System compensation using phase- lead, phase – lag and phase lead – lag networks on the Bode diagram and S-plane. Integrator anti – windup; Ziegler – Nicholas tuning of PID controllers. Compensation on the Bode diagram using analytical and computer methods. Introduction to tate space analysis: State variable system description, state vector differential equation, state equation form block diagram, state equation from transfer function, transfer function from state equation. Transfer function matrices and stability. Solution of state equation; characteristic equation of a state model, time solution by transition matrix and inverse Laplace techniques. Canonical forms, Control of multivariable systems; controllability and observability, stabilizability, irreducibility and minimum realization. Basic elements of design of control system in the time domain and state variable feedback.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:

Design of compensators using MATLAB both in frequency and time domain. Develop state space equations and matrices and determine controllability and observabilty of system in MATLAB

Recommended books:

(i) Benjamin C. Kuo, "*Automatic Control Systems*," *Eighth Edition, 2003,* John Wiley & Sons, ISBN: 0471381489.
(ii) Katsuhiko Ogata, "*Modern Control Engineering," Fourth Edition, 2002*, Prentice Hall, ISBN: 0130609072
(iii) Norman S. Nise, "*Control Systems Engineering," sixth Edition, 2011*, John Wiley & Sons, ISBN: 0471445770.
(iv) Any other books recommended by the course lecturer

ECE 412 – ELECTRONIC CIRCUIT DESIGN (3 Units)

Pre-requisites: ECE 326 - Analogue Electronics III

Course Purpose:

To impart to the students methods, tools and skills for the design of analog and digital electronic systems.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

(i) explain the concept of integrated circuits fabrication;
(ii) describe the levels of manufacturing integrated circuits (IC`s);
(iii) design and describe the working principles of instrumentation amplifiers, function generators, frequency modulators and phase-locked loop circuits.

Course Content:

Integrated Circuits: fabrication - limitations. Integrated Circuit Op amps: conventional, Norton, and trans-conductance types. Working principles. Design of circuit systems such as waveform generators, precision rectifier systems, automatic gain amplifiers, four quadrant multipliers. Chopper-stabilized opamp and its applications in instrumentation systems. Integrated Circuit instrumentation amplifiers: working principles. Design of bridge and thermocouple amplifiers. Integrated Circuit waveform generators: principle of operation. Design of function generators and frequency modulators. Audio pre- and power amplifier Integrated Circuits. Design of audio systems. Phase-locked loop Integrated Circuits: Principles of operation, use in frequency multiplication and phase shifting. Tone and telemetry decoding: frequency packing and pulse generation. Design examples.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Recommended book:

(i) C. D. Motchenbacher and J. A. Connelly, Low-*Noise Electronic System Design*, 1993, John Wiley & Sons ISBN: 0471577421.
(ii) Kenneth R. Laker and Willy M. C. Sansen, *Design of Analog Integrated Circuits and Systems*, 1994, McGraw-Hill, ISBN: 007036060X.
(iii) Steve Heath, *Embedded Systems Design*, Second Edition, 2002, Newnes, ISBN: 0750655461.
(iv) Rob A. Rutenbar, Georges G. E. Gielen and Brian A. Antao, *Computer-Aided Design of Analog Integrated Circuits and Systems*, 2002, Wiley-IEEE Press, ISBN: 047122782X.

ECE 413 – INSTRUMENTATION (3 Units)

Pre-requisites: ECE 224 - Electrical Measurements
ECE 324 - Digital Electronics II
ECE 326 – Analogue Electronics III

Course Purpose:
To introduce the concepts and the methods and instruments for the measurement of electrical and non-electrical quantities.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
(i) explain the instrumentation principles and techniques;
(ii) describe the principle of operation and application of various transducers;
(iii) define and describe the principle of the analog to digital converter (ADC) and digital to analog converter (DAC);
(iv) describe the basic operation of analog multi-meter, digital multi-meter, oscilloscope and function generator;
(v) explain the operation of microprocessor based instrumentation and intelligent instrumentation system.

Course Content:
Instrument systems: Elements of instrumentation systems, intelligent vs dumb instruments, factors affecting system selection; linearity, accuracy, precision, resolution, sensitivity, hysteresis. Transducers: Passive and active types. Transducer selection. Transducer characteristics. Resistive, inductive, capacitive, and Hall-effect types. Applications in measuring devices. Signal conditioning circuits: Bridge circuits; instrumentation amplifiers, choppers and chopper-stabilized amplifiers, charge amplifiers, Voltage-to-frequency and frequency-to-voltage conversion. Analog-Digital and Digital-to-Analog conversion. Analysis of measurement systems that measure parameters such as stress and strain, displacement, pressure, acceleration, temperature, humidity. Opto-electronic measurements. Advanced instrumentation: microprocessor-based instrumentation; computer interfacing techniques; data acquisition software; virtual Instruments; intelligent instrumentation systems.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Design, construction, and analysis of measurement circuits, data acquisition circuits, instrumentation devices, and automatic testing; measurement of electrical parameters using different lab instruments; calibration of measurement instruments; use of data acquisition systems for presentation and interpretation of data; use of microcomputers to acquire and process data; use of simulation and instrumentation languages (LabVIEW).
Recommended books:
(i) Klaas B. Klaassen and Steve Gee, *Electronic Measurement and Instrumentation*, 1996, Cambridge University Press, ISBN: 0521477298.
(ii) Kalsi, H.S., *Electronic Instrumentation*, 2nd edition, Tata McGraw-Hill, 2004.
(iii) Larry D. Jones, A. Foster Chin, *Electronic Instruments & Measurements*, 2nd Edition, Prentice Hall, 1991
(iv) Kevin JamesH, *PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control*, 2000, Newnes,ISBN: 0750646241.

ECE 414 – MICROPROCESSORS (3 Units)

Pre-requisites: CSC 310 - Object Oriented Programming
ECE 324 - Digital Electronics II

Course Purpose:
To enable students familiarize the architecture of 8086 processor assembling language programming and interfacing with various modules and their industrial and real time applications.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
i. select a microprocessor suitable to the application;
ii. perform the detailed hardware design of a microprocessor system;

iii. program the microprocessor using suitable techniques including use of allocation schemes and device drivers;
iv. solve a wide range of real-world microprocessor applications;
v. write structured, well-commented, understandable programs in assembly language and in a higher-level language;
vi. analyze the software aspects of digital systems using microprocessors.

Course Content:

Introduction to 8 Bit and 16 Bit Microprocessors – H/W Architecture: Introduction to microprocessor, computer and its organization, Programming system, Address bus, data bus and control bus, Tristate bus, clock generation, Connecting Microprocessor to I/O devices , Data transfer schemes, Architectural advancements of microprocessors. Introductory System design using microprocessors, 8086 – Hardware Architecture, External memory addressing, Bus cycles, Companion Chips, Maximum mode bus cycle, 8086 system configuration, Memory Interfacing, Minimum mode system configuration, Maximum mode system configuration, Interrupt processing, Direct memory access. 16-Bit Microprocessor Instruction Set and Assembly Language Programming: Programmer's model of 8086, operand types, operand addressing, assembler directives, instruction set -Data transfer group, Arithmetic group, logical group, control transfer group, miscellaneous instruction groups, programming.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computers

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:

i. writing programs for 16-bit arithmetic operations, sorting and searching of data, string manipulation operations and digital clock and stop watch using 8086.

Recommended books:

(i) Krishna Kant, *Microprocessors and Microcontrollers Architecture, Programming and System Design using 8051, 8086, 8051 and 8096*, PHI 2007.
(ii) Douglas V Hall, *Microprocessors and Interfacing, Programming and Hardware*, TMH, 2006.
(iii) Kenneth J. Ayala, *The 8086 Microprocessor: Programming & Interfacing the PC*, Delmar Publishers, 2007.

ECE 415 – POWER ELECTRONICS I (3 Units)

Pre-requisites: ECE 226 - Electric Circuit Theory and Analysis II, ECE 314 – Analogue Electronics II

Course Purpose:

To introduce the students to semiconductor devices and circuits used to convert electrical power of a given form into a desired form.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

(i) describe the relationship of basic semiconductor physics and properties of real devices;
(ii) use circuit mathematics and characteristics of linear and non-linear devices to formulate and analyze system designs;
(iii) evaluate power electronics design at the systems level, identify the critical areas, and typical alternative solutions;
(iv) explain basic principles of power and limitations of computer simulations of circuit behaviour.

Course Content:

Power Semiconductor Devices: Diodes, power transistor (BJT), Power metal oxide semiconductor field effect transistor (MOSFET), Insulated Gate Bipolar Transistor (IGTBT). Thyristor (SCR): Construction, Operation, Volt-Ampere characteristics, Switching characteristics, Power loss and thermal impedance, Current rating, over voltage protection, over- current protection, heat in power semiconductor, design of snubber circuit, series-connected semiconductors, and parallel- connected semiconductors. DIAC, TRIAC, Gate-Turn-Off thyristor (GTO), MOS-Controlled thyristor (MCT). Unijunction Transistor (UJT). Ratings, thermal consideration and cooling techniques for power devices. Diodes and Phase-Controlled Rectifiers: Single-phase and three-phase diode bridge rectifiers with: R load, RL load, CR load; Effect of source inductance; Distortion, Displacement,

and Power factors; Single-phase and three-phase half and bridge thyristor converters with RL load. Design of DC and AC power supplies: DC power supplies: fly back converter, forward converter, push- pull converter, half- bridge converter, full- bridge converter

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Design of converters; single-phase and three-phase uncontrolled, half-controlled and fully-controlled rectifiers; buck, boost and polarity inverting converters; flyback converter.
Recommended books:

(i) Cyril W. Lander, *Power Electronics*, Third Edition, 1993, McGraw-Hill UK, ISBN: 0077077148.
(ii) Muhammad H. Rashid, *Power Electronics: Circuits, Devices and Applications*, Third Edition, 2004, Prentice Hall, ISBN: 0131011405.
(iii) Ned Mohan, William P. Robbins and Tore M. Undeland, *Power Electronics: Converters, Applications and Design*, Media Enhanced, Third Edition, 2003, John Wiley & Sons, ISBN: 0471429082.

ECE 416 – DIGITAL COMMUNICATION SYSTEMS (3 Units)

Pre-requisites: ECE 328 - Principles of Communication Systems

Course Purpose:
To enable students understand the fundamental principles of digital transmission systems as used in fixed and mobile telephony, wired and wireless computer networks, data storage and digital broadcasting.

Expected Learning Outcomes:
At the end of the course, students will be able to:

(i) describe binary and duo binary pulse Amplitude Modulation (PAM);
(ii) design digital coding schemes;
(iii) derive error performance equations for digital modulation schemes(ASK,FSK,PSK,DPSK);
(iv) state strengths and weaknesses of M-ary PSK with QAM signaling schemes;
(v) design a basic digital communication systems.

Course Content:
Signal digitization: Pulse Amplitude Modulation (PAM), sampling theorems and sampling circuits, Pulse code modulation (PCM). Quantization and signal conditioning: Uniform and non-uniform quantization; companding methods; vocoders; signal-to- quantization noise ratio. Waveform coding: Pulse transmission, PCM, Pulse-shaping; Delta modulation; adaptive delta modulation; Differential Pulse Code Modulation (DPCM), M-ary encoding. Digital Modulation: Amplitude shift keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature Amplitude Modulation (QAM) and Differential Phase Shift Keying (DPSK). Signal recovery in ASK, FSK and PSK; Gaussian Minimum Shift Keying (GMSK); Performance comparison. Information theory: information sources, entropy, channel capacity; Source Coding; entropy coding. Error control: Error control coding techniques; Transmission errors; Error detection methods; intersymbol interference and the eye pattern; Linear block codes; Cyclic codes; convolution codes. Multiplexing: Frequency division multiplex (FDM), Time Division Multiplexing (TDM), plesiochronous digital hierarchy (PDH). Spread spectrum communication: Direct sequence and frequency hopping methods; synchronization, spreading codes and their generation. Data transmission: Local data transmission protocals (Ethernet, token ring); Modems; high Asymmetric Digital subscriber line (ADSL); Very–high Speed Digital subscriber line (VDSL), integrated services digital network (ISDN).

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Recommended books:

(i) Sklar, *Digital Communications*, Prentice Hall, ISBN-10: 0130847887.
(ii) L. W. Couch II, *Digital and Analog Communication Systems*, 6th Ed. 2003. ISBN: 0135990289.
(iii) P. Lathi , Zhi Ding , *Modern Digital and Analogue Communication Systems*, 3rd Ed. Oxford University Press, ISBN-10: 0195331451

ECE 417 – POWER SYSTEMS III (3 Units)

Pre-requisites: ECE 317 - Power Systems II

Course Purpose:

To provide students develop appropriate models for an interconnected power system and perform power flow, economic dispatch, and short circuit analysis.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

(i) model a power system;
(ii) derive equivalent circuits of component of power systems: overhead lines, cables generators and any other loads;
(iii) perform calculations on power system losses;
(iv) compare different computation methods of performing load flow.

Course Content:

Economics of electric power generation: Characteristics and efficiencies of: hydro, thermal, gas and diesel power plants. Cost of electrical energy, expressions for cost of electrical energy, methods of determining depreciation, importance of high load factor, plant capacity and plant use factors, load curves and maximum demand, station operating schedule, load growth forecasting. **Economics of power transmission:** Design and layout of power systems, power circle diagrams, economic choice of conductor size and transmission voltage. **Protection:** Review of fault calculations, principle of operation, characteristics and application of fuses, electromagnetic and thermal over - current relays. Protection schemes: Circuit breaker ratings, voltage and current transformers, distance protection. Circuit interruption and switching over – voltages: Arc extinction and re – ignition, resistance switching, switching surges. Chopping magnetizing current. **Power system over – voltage:** Sources of system over – voltages. Corona: Corona usefulness, corona losses, radio interference. Protection against corona atmospheric over – voltages.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:

Continuous Assessment Tests (30%), End of semester Examination (70%)

Recommended book:

(i) J.D. Glover, M.S. Sama, and T.J. Overbye, "*Power Systems Analysis and Design"*, 5th ed., Thompson-Engineering.
(ii) John J. Grainger, William D. Stevenson, Jr," *Power System Analysis design*".
(iii) P.S R Murty, *Power System Analysis*
(iv) V. K. Mehta, *Principle of Power System*
(v) B.L. Theraja, *Electrical Technology Volume III - Transmission and Distribution*
(vi) B.L Theraja, *Electrical Technology Volume II - DC & AC Machines*

ECE 418 – ENTREPRENEURSHIP FOR ENGINEERS (3 Units)

Course Purpose:

To introduce students to entrepreneurial skills and forms of business organizations

Expected Learning Outcomes

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

(i) explain the role of small business in economic development;
(ii) describe management problems facing small businesses;
(iii) explain cost and benefit factors associated with a small enterprise management.

Course Content:
Introduction: Definition, entrepreneurship and management. Theories (sociological, economic, psychological, financial and trait), entrepreneurial personality and business acumen, Driving forces to entrepreneurship, myths and realities, stages of entrepreneurial development, preparations of entrepreneurs. Issues in entrepreneurship: Ethical, social and cultural, economic and political. Record keeping: ledger, income statement, balance sheet, assets and liabilities, analysis of simple financial statements. Budgeting: personal and simple business budgets, financial projections. Stock Exchange: stocks, shares, bonds, stock market ratios, share valuation. Simple investment analysis: cost of capital, working capital, decision on capital expenditure, return on capital

Mode of Delivery

Lectures, Class discussions, e-learning

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course assessment
During the period of study, assessment will be conducted by CATs (Continuous Assessment Tests), regular assignments and final Examination at end of the unit. The course will be evaluated by 70% final examination and 30% CATs.

Recommended Textbooks:

(i) David A. Harper (2003) *Foundations of Entrepreneurship and Economic Development*; Taylor and Francis Group: New York
(ii) Veerabhadrappa Havinal (2009) *Management and Entrepreneurship*; New Age Publishers Limited; New Delhi
(iii) William Bygrave and Andrew Zacharakis (2011) *Entrepreneurship-2nd edition*; John Wiley and Sons Ltd: USA

MAT 401 – COMPLEX ANALYSIS (3 Units)

Pre-requisites: MAT 302 – Differential Equations

Course Purpose:
To enable students learn the concepts of complex variables and Z-transform.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
(i) represent complex numbers algebraically and geometrically;
(ii) define and analyze limits and continuity for complex functions as well as consequences of continuity;
(iii) apply the concept and consequences of analytic and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra;
(iv) analyze sequences and series of analytic functions and types of convergence;
(v) evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula;
(vi) represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.

Course Content:

Functions of a complex variable: elementary complex functions, analytic functions of a complex variable. Differentiation, Cauchy Riemann equations. Complex power series. Integration of complex functions - Cauchy's Integral theorem. Cauchy's integral theorem for multiply-connected regions. Expansion of functions

as Taylor and Laurent series. Calculus of residues. The Z-transform and its inversion. Pole-zero configuration. Geometric aspects of complex variables, conformal mapping. Some applications of complex variable theory.

Mode of Delivery

Lectures, Class discussions, e-learning, laboratory tests

Recommended books:

(i) Lars Ahlfors, *Complex Analysis*, McGraw-Hill Inc, ISBN-10: 0070006571.
(ii) Theodore W. Gamelin, *Complex Analysis*, Springer-Verlag New York

SEMESTER II

ECC 402 – RESEARCH METHODS (2 Units)

Pre-requisite: ECC 301 - Scientific and Technical Communication Skills

Course Purpose

This course prepares students on proposal writing, carry out research and write a project/technical report.

Expected Learning Outcomes

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

(i) identify and analyze research problems in context;
(ii) write a research proposal;
(iii) explain how a research project is managed;
(iv) apply ethical issues in research.

Course Content

Role of research in Technology. Problem identification. Situational analysis. Project proposal: objectives, literature review, research area/materials, methodologies, expected results, discussion. Project work: data collection techniques, data analysis techniques, information presentation methods. Research organization: planning, budgeting and costing of research projects.

Mode of Delivery

Lectures, Class discussions, e-learning, group discussions

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course assessment

(i) Proposal assignments (2)	20%
(ii) Two sit-in-tests (CATs)	40%
(iii) End of semester proposal	40%

Recommended textbooks and references

(i) *Mixed methods research: A research paradigm whose time has come. Johnson* by R. B., & Onwuegbuzie and A., J.
(ii) *Methodology and action research* by Mann, S.
(iii) Neill, J. (2007). *Qualitative versus quantitative research: Key points in a classic debate.* wilderdom.com
(iv) *How to Write and Publish a Scientific Paper* by Robert A. Day and Barbara Gastel.
(v) *Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students* by Robert Barrass.

ECC 404 – ECONOMICS FOR ENGINEERS (3 Units)

Pre-requisites: ECC 103 - Introduction to Engineering
ECC 102 - State , Society and Development Concepts

Course Purpose:

To introduce the learners to concepts and techniques of economic analysis used to form engineering decisions and acquire skills to assess cost implication in engineering design and application.

Expected Learning Outcomes

At the successful completion of this course, the student will have demonstrated the ability to:

(i) make economic decisions, sea of problems, role of engineering economics analysis, decision making process, engineering costs, cost estimation methods, estimation of benefits;

(ii) apply the concepts of time-value of money, taking into consideration the impact of interest on investment decisions;
(iii) select the appropriate evaluation method for comparing between alternate investment opportunities;
(iv) evaluate when an asset should be replaced based on the use of replacement analysis both before and after tax.

Course Content:
Introduction: microeconomic theory, utility, demand, supply, production and costs, economic systems, macroeconomic theory, aggregate demand, theory of economic development. Making Economic Decisions: The role and purpose of engineering economic analysis, economic decision-making process. Cash Flow Analysis: Cash flow diagram, computing cash flow, time value of money, interest and equivalence, compound interest formulas: single payment, uniform series, arithmetic and geometric gradient series, nominal and effective interest rates and continuous compounding. Assumptions in solving economic problems, economic rules, application of present worth analysis, Annual cash flow analysis, annual cash flow calculation, Analysis period, Impact of taxes on decisions, Accounting and engineering economy: after-tax cash flow. Capital Budgeting: Internal rate of return, Minimum attractive rate of return, Present worth versus Interest Rate, Incremental internal rate of return, Multiple IRRs, External Rate of Return (ERR), Modified Internal Rate of Return (MIRR), Future worth, benefit cost and payback period analysis techniques, Sensitivity and break-even analysis. Depreciation: Basic aspects of depreciation, Causes of depreciation, book value, depreciation methods, depreciation and asset disposal, depreciation for tax purpose (capital cost allowance factor), and calculation of capital cost allowance factor, taxation and capital cost allowance.. The role of accounting in engineering economy: Divisions within an organization, Taxes, Individual and corporate, incremental nature of taxes, combined tax rates, After tax cash flow analysis, taxable income, after tax present worth and rate of return. Replacement Analysis: Factors affecting replacement, Replacement analysis techniques, Concept of challenger and defender. Challenger is different from defender. Sequence of identical challengers, challenger is not repeated and defender and challenger with unequal lives, Complications in replacement analysis. After tax replacement analysis. Inflation: Inflation in engineering economy, Measurement of Inflation, Relationship between actual dollar and real dollar, Price Indexes, Inflation and tax calculations, Effect of inflation on MARR and IRR; savings and investment money supply and monetary policy. Public Accounts: revenue and expenditure, balance of payment, balance of trade, Gross National Product and Gross Domestic Product, elements of international trade. Economic analysis: Public decision factors, Interest rates for public projects Benefit-Cost Ratio, conventional and modified Benefit-Cost and Incremental Benefit-Cost, Financing duration and politics of investments, Uncertainty in engineering economic analysis, Range of estimated values for evaluation, Probability and joint probability distributions, expected value, measurement and consideration of risk.

Mode of Delivery
Lectures, Class discussions, e-learning, group discussions
Instruction materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course assessment
Continuous Assessment 30%
End of Semester Examination 70%
Recommended Textbooks:
(i) Riggs(Jan 1, 2004) *Engineering Economics 4th edition*; McGraw-Hill Education (India) Pvt Limited,
(ii) R. Panneerselvam (2001) *Engineering Economics;* PHI Learning Pvt. Ltd.India
(iii) Chan S. Park (2012) *Fundamentals of Engineering Economics 3rd edition*; Pearson Education Publishers
(iv) Chan S. Park (2011) *Contemporary Engineering Economics 5th edition*; Prentice Hall; India
(v) P. Cassimatis (2002) A Concise Introduction to Engineering Economics; Taylor and Francis
(vi) Pamela P. Peterson, Frank J. Fabozzi, CFA (2002) *Capital Budgeting: Theory and Practice*; John Wiley and Sons

ECC 406 – ENGINEERING MANAGEMENT (3 Units)

Course Purpose:
To introduce students to skills and techniques involved in the management of people and engineering activities in the production of goods and services;

Expected Learning Outcomes:
Upon completion of this course, students will be able to:

(i) perform tasks in an organization related to organizing, planning, and controlling project and process activities;
(ii) select appropriate management techniques for improving organizational structures, work procedures, and quality performance of operational tasks;
(iii) analyze the factors that affect changes in the work environment, and be aware of the approaches in implementing change in an organization;
(iv) explain imperatives of ethical and business behaviours in engineering organizations in a fast-changing business environment;
(v) develop business excellence models and be able assess organization's performance making reference to their criteria;
(vi) explain the principles of total quality management and peculiarities of their implementation;
(vii) use the available computer software in engineering management.

Course Content:
Introduction: General management concepts; Functions and types of industrial organizations; Organizational structures; Corporate objectives, strategy, and policy. Industrial Management: Roles of managers; Process of management, leadership, planning, organizing, motivating, and control of social and engineering activities. Quality management: Business excellence models; Organization's commitment to satisfy customer's needs; Quality management methods. Management of Change: Strategic leadership and innovation; Organizational change; Leading planned change; Organizational development; Stress management; Factors that affect the execution of change. Effects of Environmental Factors: The effects of extraneous factors on the operations of engineering organizations, such as ethics and corporate social responsibilities issues.
Mode of Delivery

Lectures, Class discussions, e-learning, group discussions

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Use of computer software in engineering management
Recommended books:

(i) Morse and Babcock, *Managing Engineering and Technology*, 5th edition. Prentice Hall. ISBN: 9780136098096.
(ii) James M. Kouzes and Barry Z. Posner, *The Leadership Challenge* 5th Edition. Publisher: Jossey-Bass, 2012. ISBN 978-0470651728.

ECE 421– POWER SYSTEMS IV (3 Units)

Pre-requisites: ECE 417 - Power systems III

Course Purpose:
To introduce students to the design of transmission lines and the development of detailed models of power system components and their application in the analysis of the dynamic behavior of interconnected power systems in response to small and large disturbances.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) calculate underground Cable Parameters;
(ii) explain the principles of electrical power system planning and operation;
(iii) model steady-state and dynamic performance of simple power systems using: power flows; short-circuit fault current calculations and the various forms of power system stability assessments;
(iv) analyze steady-state and dynamic performance of simple power systems using: power flows; short-circuit fault current calculations and the various forms of power system stability assessments;
(v) carry out simulation studies of practical power systems operating under steady-state and dynamic conditions using commercial power system analysis software.

Course Content:

Mechanical design of transmission lines: Catenary curve, sag tension calculations, support at different levels. Power system stability: The stability problem. Synchronous machine characteristics; rotor angle stability, equations of motion, swing equation, equal area criterion, critical clearing angle Transfer of power between active sources. Two finite machines. Point –by- point method. Factors affecting transient stability. Role of automatic voltage regulator in improving stability. Effect of grounding on stability and prevention of steady state pull – out.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended book:

(i) J.D. Glover, M.S. Sarma and T.J. Overbye, "*Power System Analysis and Design*", Thomson Learning, 2008
(ii) Hadi Saadat, "*Power System Analysis*", McGraw-Hill, ISBN No 0-07-284869-3.
(iii) John j. Grainger, William D. Stevenson, JR, "*Power System Analysis*",Tata McGRaw-Hill, 2003, ISBN- 0-07-0661293-5.

ECE 422– DATA COMMUNICATION AND COMPUTER NETWORKS (3 Units)

Pre-requisites: ECE 416 - Digital Communication

Course Purpose:

To introduce students to basic concepts, theories and components in data communications and computer network and their applications in local area networks and industrial communication and control.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. define data communications and telecommunications;
ii. define and diagram five network topologies;
iii. list the layers in the Internet and OSI models and describe their functions;
iv. list several standards organizations and identify several data communication standards;
v. describe the components of a data communication interface and relate it to a specific interface standard;
vi. list the advantages and disadvantages of common data communication media;
vii. identify several codes that are used for error detection and how error correction is accomplished;
viii. describe a data link protocol and define how it controls the transfer of frames;
ix. define multiplexing and switching and explain how and why each is used in data communications;
x. describe communication and control systems used in industrial plants.

Course Content:

Introduction: Overview of Data Communications and Networking. Physical Layer : Analog and Digital, Analog Signals, Digital Signals, Analog versus Digital, Data Rate Limits, Transmission Impairment, More about signals. Digital Transmission: Line coding, Block coding, Sampling, Transmission mode. Analog Transmission: Modulation of Digital Data; Telephone modems, modulation of Analog signals. Multiplexing: FDM, WDM, TDM, Transmission Media: Guided Media, Unguided media (wireless). Data Link Layer: Error Detection and correction - Types of Errors, Detection, Error Correction; Data Link Control and Protocols-Flow and Error Control, Stop-and-wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC. Point-to-Point Access- Point–to-Point Protocol (PPP), PPP Stack, Multiple Access Random Access, Controlled Access, Channelization. Network Layer: Host to Host Delivery: Internetworking, addressing and Routing Network Layer Protocols: ARP, IPV4, ICMP, IPV6 and ICMPV6 Transport Layer: Process to Process Delivery: UDP; TCP congestion control and Quality of service. Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP) and file transfer (FTP) HTTP and WWW. Local area Network: Ethernet - Traditional Ethernet, Fast Ethernet, Gigabit Ethernet; Token bus, token ring; Wireless LANs - IEEE 802.11, Bluetooth virtual circuits: Frame Relay and ATM. Industrial Communication and Control Networks: Transmission methods, Network topology, Contemporary networks – Profibus, Controller Area Network (CAN), DeviceNet, CANopen, Actuator Sensor Interface (AS-1),Industrial Ethernet.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:

(i) Behrouz A. Forouzan, *Data Communications and Networking*, Tata McGraw-Hill
(ii) S. Tannenbum, D. Wetherall, *Computer Networks*, Prentice Hall, Imprint of Pearson 5th Ed

ECE 423 – MICROPROCESSOR SYSTEMS DESIGN (3 Units)

Pre-requisites: ECE 414 – Microprocessors, ECE 324 - Digital Electronics II

Course Purpose:
To enable students acquire skills in design of microprocessor-based systems and applications

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. describe the programming basic techniques for using input/output resources;
ii. describe the operation of the programmable hardware interruptions controller PIC (8259A);
iii. describe and use the keyboard controller (8042);
iv. describe and use the Real-Time Clock RTC (MC146818);
v. describe and use the Video controller and the display.
vi. Perform hardware interfacing to the microprocessor
vii. Write a software for parallel/ serial communications to the interfaced hardware
viii. Design an embedded system and interface it to a microprocessor

Course Content:
Design of microprocessor systems: memory, static/dynamic RAM, technology and timing, ROM, PROMs, EPROMs, PLAs, DMC chips address decoding, EDAC I/O, microcomputer buses, bus interface and arbitration circuits, bus standards, peripherals, keyboards, LCD, CRT controllers, printers, secondary memory. Peripheral interfacing: Memory interfacing and I/O interfacing with 8086, parallel communication interface, serial communication interface, timer-keyboard/display controller, interrupt controller, DMA controller (8237). simple hardware interfacing, memory technologies, serial busses, UART, SPI and inter-integrated interface A/D and D/A conversions, data acquisition systems using microprocessors, timer module, pulse accumulator, PWM, parallel/serial communication interface. Embedded system design considerations: external peripherals, power supply design, printed circuit board (PCB) design, hardware/software debugging, flash programming. Applications: stepper motor and temperature control.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:

(i) David J. Comer, *Microprocessor-based System Design*, 1996, Oxford University Press, ISBN: 0030637813.
(ii) Muhammad Ali Mazidi and Janice Gillispie-Mazidi, *80X86 IBM PC and Compatible Computers: Assembly Language, Design, and Interfacing Volumes I & II*, Fourth Edition, 2003, Prentice Hall, ISBN: 013061775X.
(iii) Nagy, *Embedded System Design using the TI MSP430 Series*, Elsevier Science, 2003.

ECE 424 – POWER ELECTRONICS II (3 Units)

Pre-requisites: ECE 415 - Power Electronics I

Course Purpose:
To enable students develop skills to design power control circuits for the conversion of electrical power of a given form and application.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
(i) explain the operation of single phase and three phase inverters for dc- to - ac conversion;
(ii) design and analyze dc-to-dc circuits;
(iii) describe phase control of cycloconverters and basic operation of motor drives with their applications;

Course Content:
Power converter circuits: Inverters: working principle, types of thyristor inverters, single-phase and three-phase voltage source inverters, single-phase and three-phase current source inverters. A.C voltage controllers: Single-phase and three-phase A.C voltage controllers. Choppers: Step-down chopper, Step-up chopper, Step-down and Step-up chopper. Dual converters: Single-phase and three-phase dual converters. Cycloconverters: Phase-controlled cyclo-converter, cyclo-converter circuits, load and line harmonics, control of cycloconverters, high frequency cycloconverters. Introduction to Solid state control of D.C and A.C motors: Advantages of electronic control of devices, basic characteristic of DC motors, phase control applied for single- phase DC drives, three-phase dc drives and their design, basic control of AC drives speed control of D.C and AC motors using thyristor technology. PWM control circuits: introduction and types of PWM control techniques for power converters, bipolar and unipolar, sinusoidal PWM control techniques for single phase and three phase inverters and their implementation, amplitude and frequency modulation and their application in analysis PWM control techniques, design of basic circuit for controlling a PWM method.

Lab Outline:
Design of converters; single-phase and three-phase uncontrolled, half-controlled and fully-controlled inverters
Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:
(i) Cyril W. Lander, *Power Electronics,* Third Edition, 1993, McGraw-Hill UK, ISBN: 0077077148.
(ii) Muhammad H. Rashid, *Power Electronics: Circuits, Devices and Applications,* Third Edition, 2004, Prentice Hall, ISBN: 0131011405.
(iii) Ned Mohan, William P. Robbins and Tore M. Undeland, *Power Electronics: Converters, Applications and Design,* Media Enhanced, Third Edition, 2003, John Wiley & Sons, ISBN: 0471429082.

ECE 425 – STATE SPACE DESIGN AND DIGITAL CONTROL (3 Units)

Pre-requisites: ECE 411 - Control Systems II, ECE 413 - Instrumentation

Course Purpose:
To enable students design digital controllers using state space technique that meets the required plant specifications.

Expected Learning Outcomes:
Upon completion of this course, students should be able to:
(i) design state feedback controller and state observer using state space technique;
(ii) demonstrate understanding of the analysis and stability of a non- linear system using Lyapunov stability criteria;
(iii) conversion of continuous system to a digital system using Z- transform;
(iv) analyse stability of digital system;
(v) design digital compensators using pole placement.

Course Content:

State space design: A review of state space system description. Controller design; selection pole locations for good design, controller design for multiple input systems. Estimator design; State observers(estimator); design of state observer in observable canonical form, design of full and reduced order state observer, effect of full order state observer on a closed loop systems, disturbance system estimation. Compensator design and introduction of reference input. Integral control design with systems with time delay. Introduction to non-linear control: Lyapunov stability and its application. Digital control: The Z- Transform and Z-Transfer functions, continuous design; digitization procedures, design examples, application limits, approximate continuous designs. Discrete design: analysis tools, feedback properties, stability in the Z - plane. Design examples; design comparisons. State space methods; state regulations in discrete time, observers in discrete time, reduced order observers. Hardware characteristics; Analog to Digital, Digital to Analog, analog prefilters. Word size effects; random effects, systematic effects. Sample – Rate selection; tracking effectiveness, disturbance rejection, parameter sensitivity; control system modularization. Digital compensator: Design, types and design using pole placement.

Mode of Delivery
Lectures, Class discussions, e-learning, laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Design of compensators using MATLAB both in frequency and time domain. Design digital system using z-transform in MATLAB
Recommended books:

(i) Benjamin C. Kuo, "*Automatic Control Systems*," Eighth Edition, 2003, John Wiley & Sons, ISBN: 0471381489.
(ii) Katsuhiko Ogata, "*Modern Control Engineering,"* Fourth Edition, 2002, Prentice Hall, ISBN: 0130609072
(iii) Norman S. Nise, "Control Systems Engineering," sixth Edition, 2011, John Wiley & Sons, ISBN: 0471445770.

ECE 420 – INDUSTRIAL ATTACHMENT II (3 Units)

Pre-requisites: Successful completion of Years 1, 2, 3 and 4.

Course Purpose:
To expose students to the day-to-day work environment of a professional engineer. Provide student with opportunities to use their initiative to translate theories learnt in classrooms and perform assignments in an actual working environment. Instill in the students the right kind of work attitudes and professionalism through interaction with people in the organizations, and observation of their future roles in industry. To lessen the on-the-job training requirements so that they can become effective and productive to their respective organizations much sooner than is usual for fresh graduates.

Expected Learning Outcomes
Upon completion of this course, a student should be able to:

(i) apply theoretical knowledge in industrial application;
(ii) acquire skills in communication, management and team-work;
(iii) practice ethical and professional work culture;
(iv) implement Health Safety Environment (HSE) practices at workplace.

Course Content:
Engineering technical skills: learn engineering and technical skills in the workplace. Engineering and management: learn responsibilities and daily routines of an engineer/technologist and administrative duties. Human relations: work with people to get things done. Computer applications: use computers as an aid in planning, designing and analysis of engineering projects and work processes. Costing: become aware of cost effectiveness in engineering proposals/designs. Safety: awareness of importance of safety in the organization. Quality control: awareness of quality in all jobs done. Productivity: awareness of measures taken to improve the productivity at the workplace. Marketing: awareness of methods of product promotion.
Course assessment

(i) Industry based supervisor 10%
(ii) University Supervisor 20%
(iii) Logbook 30%
(iv) Report 40%

Recommended books:

(i) C M Chang, *Engineering Management: Challenges in the New Millennium*, ISBN-10: 0131446789.
(ii) C. Ray Asfahl , David W. Rieske, *Industrial Safety and Health Management (6th Edition),* Prentice Hall, ISBN-10: 0132368714
(iii) Brian Scanlon, *Marketing of Engineering Services*, Thomas Telford Ltd, ISBN-10: 0727713485

YEAR FIVE

SEMESTER I

ECC 501 – OPERATIONS RESEARCH (3 Units)

Pre-requisites: CSC 201 - Computer Programming I
MAT 201- Engineering Mathematics I and MAT 202 - Engineering Mathematics II

Course Purpose:
To introduce students to use quantitative methods and techniques for effective decision–making; model formulation and applications that is used in solving business decision problems.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) explain characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type;
(ii) build and solve Transportation Models and Assignment Models;
(iii) design new simple models, like: CPM, MSPT to improve decision –making and develop critical thinking and objective analysis of decision problems;
(iv) implement practical cases, by using TORA, WinQSB.

Course Content:
Introduction to Operations Research (OR): Linear Programming (LP), LP and allocation of resources, LP definition, Linearity requirement; Maximization Then Minimization problems. Graphical LP Minimization solution: Simplex method definition, formulating the Simplex model; Linear Programming: Simplex Method for Maximizing; Simplex maximizing example for similar limitations, Mixed limitations; Example containing mixed constraints, Minimization example for similar limitations. Sensitivity Analysis: Changes in Objective Function, Changes in RHS, the Transportation Model. Solution Methods: Feasible Solution: The Northwest Method, The Lowest Cost Method. Optimal Solution: The Stepping Stone Method, Modified; Distribution (MODI) Method. The Assignment Model:- Basic Assumptions, Solution Methods:-Different Combinations Method, Short-Cut Method (Hungarian Method); MSPT:- The Dijkestra algorithm, and Floyd's Algorithm {Shortest Route Algorithm}

Mode of Delivery
Lectures, Class discussions, e-learning

Course Assessment
Continuous Assessment and Tests 30%
End of Semester Examinations 70%

Instruction materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Recommended books:

(i) Wayne L. Winston, *Operations Research: Applications and Algorithms*, ISBN-10: 0534209718
(ii) Taha, Hamdy, *Operations Research*, 7th edition, (USA: Macmillan Publishing Company), 2003
(iii) R. Panneerselvam, *Operations Research*, PHI Learning Pvt. Ltd., Jan 1, 2006
(iv) M. Natarajan, P. Balasubramani, *Operations Research*, Pearson Education India, 2006

ECE 510 – ENGINEERING PROJECT (4 Units)

Pre-requisites: ECC 402 - Research Methods

Course Purpose:

To provide students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing design projects and presenting their proposed solutions in a professional manner.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

(i) identify and formally state problems that can be solved using engineering knowledge and skills;
(ii) demonstrate practical skills in the design of engineering components, assemblies and/or systems;
(iii) demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process;
(iv) develop a design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced;
(v) produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated engineering drawings or source codes and any other relevant information.

Course Content:

Development of a project plan, background research, hazard analysis, setting product specifications based on user requirements, detailed design and analysis, prototype development and final documentation and presentation. Students will be expected to produce a form model, functional prototype, marketing plan, and manufacturing plan of their product.

Additional relevant professional development topics are also covered, including technical public speaking, proposal preparation, personal time management, and other topics. All products developed will respond to the needs of appropriate market segments and should be safe, effective, useful, usable and desirable.

Course Assessment

(i) Supervisor's Progress assessment	10%
(ii) Oral Presentation	20%
(iii) Prototype	30%
(iv) Report	40%

ECE 511 - ENGINEERING PRODUCT DESIGN (3 Units)

Pre-requisites: ECE 224 - Electrical Measurements, ECE 413 - Instrumentation

Course Purpose:

To enable students gain a unique set of skills that is highly desirable in the workforce. This course is project-driven, combining the disciplines of creative design and innovation with studies in engineering science, sustainable material selection and manufacturing processes.

Expected Learning Outcomes:

Upon completion of the course, a student should be able to:

(i) describe an engineering design and development process;
(ii) design printed circuit boards;
(iii) demonstrate individual skill using selected manufacturing techniques, including drilling, pressing, tapping, and rapid prototyping;
(iv) employ engineering, scientific, and mathematical principles to execute a design from concept to finished product;
(v) fabricate an electromechanical assembly from engineering drawings;
(vi) work collaboratively on a team to successfully complete a design project;
(vii) effectively communicate the results of projects and other assignments in a written and oral format.

Course Content:

Product Design and development: An overview of product development and product assessment; Pilot production batch; Concept of availability; Screening test; Environmental effects on Reliability; Redundancy, Failsafe system, Ergonomic and aesthetic design considerations; Packaging and storage; Estimating power supply requirement; Power supply protection devices; Noise consideration of a typical system; Noise in electronic circuits; Measurement of noise; Grounding; Shielding and Guarding Enclosure sizing and supply requirements, materials for enclosure and tests carried out on enclosure; Thermal management. PCB design:

Layout, PCB sizes, General rules and Parameters; Recommendations for decoupling and Bypassing; Design rules for digital circuit PCB and analog circuit PCBs; Noise generation, Supply and ground conductors; Multilayer boards; Component assembly; testing of assembled PCB; Bare board testing; Component assembly Techniques; Automation and computers in PCB design; Soldering techniques, Solderability testing; Study of packages for discrete devices and ICs; IC reliability issues; Parasitic elements; High speed PCB design; Mounting in presence of vibration; Board layout check list. Hardware design and testing methods: Logic analyzer, its architecture and operation; Spectrum analyzer; Network analyzer; Oscilloscope; DSO trigger modes; Examples using MSO; Signal integrity issues; Use and limitations of different types of analysis; Monte Carlo analysis. Software design and testing methods: Phases of software design and Goals of software design; Methods of program flow representation; Structured program construct; Testing and debugging of program; Software design; Finite state machine; Decision to use assembly or high level language for software development; Simulators, CPU Simulators; Emulators. Product testing: Environmental testing for product; Environmental test chambers and rooms; Tests carried out on the enclosures; Electromagnetic compatibility (EMC) testing; Conducted emission test (time domain methods); Radiated emission test Basics on standard used. Documentation: PCB documentation; Product documentation; bill of materials; Production test specification- a case study for real circuit; Interconnection diagram- A case study. Front and rear panel diagrams for selected product; operating manual; Service and Maintenance manuals; Fault finding tree Software.

Mode of Delivery
Lectures, Class discussions, e-learning

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:
Continuous Assessment Tests (30%), End of semester Examination (70%)
Recommended books:

(i) R.G.Kaduskar, V.B.Baru, *Electronic Product Design*, Wiley India
(ii) Walter C Bosshart, *Printed Circuit Board design and technology*, Tata McGraw –Hill-CEDT
(iii) Raymond H. Clark,. *Handbook of Printed Circuit manufacturing*, Van Nostrand Reinhold Company, New York)
(iv) G.C. Loveday, *Electronic testing and fault diagnosis*, Ah wheeler Publication, India)
(v) Gary R. Bertoline; Eric N. Wiebe;, Nathan W. Hartman, William A. Ross, *Technical Graphics Communication*, McGraw Hill Higher Education, ISBN 978–0–07–312837–5

ECE 512 – SOFTWARE ENGINEERING (3 Units)

Pre-requisites: CSC 310 - Object Oriented Programming

Course Purpose:
To help students to develop skills that will enable them to construct software of high quality, easy to understand, modify and maintain.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. design, implement, and evaluate software-based systems, components, or programs of varying complexity that meet desired needs, satisfy realistic constraints, and demonstrate accepted design and development principles;
ii. apply knowledge of computing, mathematics, science, and engineering in the modeling and designing of software systems and in the analysis of tradeoffs inherent in design decisions;
iii. author a software requirements document, formal specifications and software testing plans;
iv. demonstrate knowledge of the distinction between critical and non-critical software systems;
v. demonstrate the ability to manage a project including planning, scheduling and risk assessment/management.

Course Content:
Introductory Concepts: Introduction, Definition, Objectives, Life Cycle–Requirements analysis and specification. Design and Analysis: Cohesion and coupling, Data flow oriented Design; Transform centered design; Transaction centered design; Analysis of specific systems like inventory control, Reservation system. Object-Oriented System Design: Object modelling using UML, use case diagram, class diagram, interaction

diagrams: sequence and collaboration diagrams, state – chart diagrams, activity diagram, unified development process. Implementing and Testing: Programming language characteristics, fundamentals, languages, classes, coding style efficiency. Testing : Objectives, black box and white box testing, various testing strategies, Art of debugging, Maintenance, Reliability and Availability : Maintenance : Characteristics, controlling factors, maintenance tasks, side effects, preventive maintenance – Re Engineering – Reverse Engineering – configuration management – Maintenance tools and techniques. Reliability: Concepts, Errors, Faults, Repair and availability, reliability and availability models, Recent trends and developments. Software Quality: SEI CMM and ISO–9001. Software reliability and fault – tolerance, Software project planning, monitoring, and control. Computer–aided software engineering (CASE), Component model of software development, Software reuse.

Mode of Delivery

Lectures, Class discussions, e-learning

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (30%), End of semester Examination (70%)
Recommended books:

(i) Rajib Mall, *Fundamental of Software Engineering*,
(ii) Tsui and O. Karam, *Essentials of Software Engineering*, Jones and Bartlett, 2010

ECE 513 – NON-LINEAR AND MULTIVARIABLE CONTROL (3 Units)

Pre-requisites: ECE 411 - Control Systems II

Course Purpose:
To introduce students to non- linear systems and develop techniques for analyzing their stability. Introduce students to multivariable system for further analysis of the course in future

Learning Outcomes:
Upon completion of this module, students will be able to:

(i) demonstrate understanding of physical characteristics of non- linear systems;
(ii) analyze the stability of non- linear systems using Lyapunov stability criterion;
(iii) describe multivariable feedback system and operation of a SISO system;
(iv) use Nyquist stability theorem to analyze stability of multivariable feedback systems in frequency domain.

Course Content:
Non-linear Control: Non-linear behaviour and describing function. Stability analysis using describing functions, second, or direct, method of Lyapunov; Popov and circle criteria for stability. The phase-plane method. Introduction to optimal control, model-reference, and adaptive control strategies and their implementations. Multivariable feedback systems in the frequency domain: Introduction: generalization and extension of Single-Input/ Single - Output to Multiple-Input/Multiple-Output Systems. Extension of the Nyquist Stability theorem to MIMO Systems; Direct and inverse Nyquist plots.Direct and inverse Nyquist Array methods, The characteristic locus method. Computer aided analysis and design of a multivariable systems is illustrated with a case design example using suitable control engineering software.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Analyze stability of non – linear system in MATLAB. Design multivariable system and analyze their stability in MATLAB
Recommended books:

(i) Benjamin C. Kuo, *Automatic Control Systems*, Eighth Edition, 2003, John Wiley & Sons, ISBN: 0471381489.
(ii) Katsuhiko Ogata, *Modern Control Engineering*, Fourth Edition, 2002, Prentice Hall, ISBN: 0130609072
(iii) Norman S. Nise, Control Systems Engineering, sixth Edition, 2011, John Wiley & Sons, ISBN: 0471445770.

ECE 514 – TRANSMISSION LINES (3 Units)

Pre-requisite: ECE 322- Electromagnetics II

Course Purpose:

To introduce students to the analysis of transmission lines and design of transmission systems using a Smith chart.

Expected Learning Outcomes:

i. explain transmission line theory;
ii. determine the transmission line parameters
iii. analyze impedance matching concepts;
iv. interpret the Smith Chart;
v. design an impedance matching network using a smith chart
vi. design impedance matching networks for signal transmission systems;
vii. design quarter-wavelength transformers and describe their operation.

Course Content:

Transmission lines: Transmission line fundamentals, Lumped circuit elements. Mode classifications, Transmission line equations, Sinusoidal excitation of transmission lines, Per-unit-length parameters, Distributed model equivalent circuit, Incident and Reflected waves, Propagation constant, Characteristic impedance, Lossless line, Distortion less line, Transmission line circuit, Transmission line input impedance, Terminations, Reflection Coefficient, Standing wave ratio, The Smith Chart: derivation of Smith Chart, typical Smith Chart computations. Correction for transmission loss, Impedance transformation, Quarter - and half - wave length line, Quarter wave transformer, Stub tuner, Power flow on transmission lines, Transients on transmission lines, Lossy lines. Behaviour of transmission lines at high frequency, Physical and electrical parameters of common coaxial lines, computer simulation.

Mode of Delivery

Lectures, Class discussions, e-learning, laboratory tests**,** group discussions

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, antenna/ transmission line training kit, relevant simulation software.

Course Assessment

Continuous Assessment and Tests	30%
End of Semester Examinations	70%

Recommended textbooks

(i) U.A Bakshi (2006). *Transmission Lines and Waveguides*; Technical Publications: Pune
(ii) L. Ganessan, SS Sreeja Mole (2010), Transmission Lines and Waveguides-2nd edition; Tata Mcgraw Hill Publishers: New Delhi.
(iii) Huray, P. G. *Transmission Lines and Waveguides. The Foundations of Signal Integrity, 75-108.*
(iv) Giovanni Miano and Antonio Maffucci *Transmission Lines and Lumped Circuits* ISBN: 978-0-12-189710-9
(v) Philip C. Magnusson , Andreas Weisshaar , Vijai K. Tripathi, Gerald C. Alexander (2000) *Transmission Lines and Wave Propagation, 4th Edition***:** CRC Press.

SEMESTER II

ECC 502 – LAW, ETHICS AND ENGINEERING PRACTICE (3 Units)

Course Purpose:
To provide the students with a general introduction to the legal and ethical aspects of engineering practice; social responsibilities of engineers; and engineering practice laws and code of ethics.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) explain the Kenyan legal framework and the organization and practice of engineering in Kenya;
(ii) explain contemporary professional ethics and the main ethical principles of autonomy, beneficence, non-maleficence and justice;
(iii) demonstrate knowledge and understanding of legal responsibilities with respect to engineering practice;
(iv) demonstrate effective and professional oral and written communication and documentation and use of current information technologies when communicating with individuals, groups and the public.

Course Content:
Law: Professional Practice Laws, Law of Contract, The law of tort, Intellectual property law, environmental laws. Ethics: Ethical theories, ethical decision-making, codes; human and animal experimentation, consent, practices of ethical review boards; research methods and regulations for design, manufacture, certification of engineering devices; data collection, management, analysis, including security, confidentiality, privacy; bioethical dilemmas, impact of technology and research (social, political, financial). Professional Practice: Presentations by faculty and external lecturers on the Professional Engineers Act, professional ethics and responsibilities, practice within the discipline and its relationship with other disciplines and to society, health and safety, environmental stewardship, principles and practice of sustainable development.
Mode of Delivery

Lectures, Class discussions, e-learning, laboratory tests**,** group discussions

Instruction materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment

Continuous Assessment and Tests	30%
End of Semester Examinations	70%

Recommended textbooks

(i) *Ethics in Engineering Practice and Research* by Caroline Whitbeck. Cambridge University Press, 1998.
(ii) F. Lawrence Bennett, *The Management of Engineering: Human, Quality, Organizational, Legal, and Ethical Aspects of Professional Practice*, John Wiley and Sons, ISBN-10: 047159329X.
(iii) Caroline Whitbeck, *Ethics in Engineering Practice and Research*, Cambridge University Press.
(iv) Martin, *Ethics in Engineering*, McGraw-Hill Education (India) Limited, 2003

ECE 521 – DIGITAL SIGNAL PROCESSING (3 Units)

Pre-requisites: ECE 323 - Network Analysis and Synthesis, ECE 325 - Signals and Systems

Course Purpose:
To enable students learn about discrete system analysis using Z-transforms, analysis and design of digital filters, discrete Fourier transforms.

Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) demonstrate an understanding of the techniques used to analyse discrete signals and systems, and their application in the design, implementation and testing of digital filters;
(ii) demonstrate an understanding of the analysis of linear and adaptive filter equalizers, spectrum estimation;
(iii) apply mathematical tools and computation methods for signal processing;
(iv) develop audio and video systems incorporating dsp algorithms.

Course Content:
Discrete-Time Signals, Systems and Transforms: Basic Sampling Theory and D/A Conversion; Discrete-Time Linear Systems; Autocorrelation; Cross-Correlation; Z Transform; Discrete-Time Fourier Transform; Frequency Selective Linear Filtering; Sampling and Reconstruction; Efficient Up-sampling/Down-sampling, Multi-Stage Interpolation, Digital Subbanding. Digital Filter Design: FIR Filters; IIR Filters, Bilinear transformation, Frequency transformations. Discrete Fourier Transform: Definition and Properties; Fast Fourier Transform Algorithms: Divide and Conquer Approach, Radix-2 FFT; Sectioned Convolution. Nonparametric methods of power spectrum estimation: Discrete random processes; Estimation of autocorrelation sequence; Periodogram; Smoothed periodograms. Model-Based Spectrum Estimation: Autoregressive Modeling; Forward/Backward Linear Prediction; Levinson-Durbin Algorithm; Minimum Variance Method; Eigenstructure Methods; Applications in Speech Processing, Communications, and Acoustics. Adaptive Signal Processing: Applications: Equalization, etc; Adaptive Direct-Form FIR Filters – LMS; Adaptive Direct-Form FIR Filters – RLS.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
DSP Kits, Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:
(i) Alan V. Oppenheim, Ronald W. Schafer, *Digital Signal Processing*, ISBN-10: 0132146355.
(ii) S. Salivahanan, A. Vallavaraj, *Digital Signal Processing*,

ECC 522 – E-COMMERCE (3 Units)

Pre-requisites: ECC 404 - Economics for Engineers

Course Purpose:
To introduce the concept of electronic commerce; the effect of electronic on business enterprises, governments and consumers; and the technologies and practice of e-commerce.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
i. explain the components and roles of the Electronic Commerce environment;
ii. use basic electronic commerce functions;
iii. describe the qualities of an effective Web business presence;
iv. describe E-Commerce payment systems;
v. identify and reach customers on the Web;
vi. apply Web marketing approaches and elements of branding;
vii. explain the client/server infrastructure that supports electronic commerce;
viii. explain legal and ethical issues related to E-Commerce.

Course Content:
Electronic Commerce: Overview, Definitions, Advantages & Disadvantages of E – Commerce, Threats of E – Commerce, Managerial Prospective, Rules & Regulations For Controlling E-Commerce, Cyber Laws. Technologies: Networking For E – Commerce, Internet, Intranet & Extranet, EDI Systems. Wireless Application Protocol: Definition, Hand Held Devices, Mobility & Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E – Commerce. Business Models of e – commerce: Model Based on Transaction Type, Model Based on Transaction Party - B2B, B2C, C2B, C2C, e-governance. E – Strategy: Overview, Strategic Methods for developing E – commerce. Four C's: (Convergence, Collaborative Computing, Content Management & Call Center). Convergence – Convergence of technologies, implications of convergence, Convergence and Electronic Commerce; Collaborative Computing - Collaborative product development, contract as per CAD, Simultaneous Collaboration, Security; Content Management - Definition of content, Authoring Tools and Content Management, Content partnership, repositories, convergence, providers, Web Traffic and Traffic Management ; Content Marketing; Call Center - Definition, Need, Tasks Handled, Mode of Operation, Equipment , Strength and Weaknesses of a call center, Customer Premises Equipment.

Supply Chain Management: E–logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, Internet's effect on Supply Chain. E – Payment Mechanism: Payment through card system, E – Cheque, E – Cash. E – Marketing:. Home –shopping, E-Marketing, Tele-marketing. Security in E-Commerce: Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

Mode of Delivery

Lectures, Class discussions, e-learning

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Workstations

Recommended books:

(i) Kalakotia, Whinston: *Frontiers of Electronic Commerce*, Pearson Education.
(ii) Bhaskar Bharat : *Electronic Commerce - Technologies and Applications*, TMH
(iii) Loshin Pete, P.A. Murphy, *Electronic Commerce* , Jaico Publishing Housing.

ECE 523 – INDUSTRIAL ELECTRONICS (3 Units)

Pre-requisites: ECE 412-Analogue Electronics IV

Course Purpose:

To teach students various industrial applications of electronics including heating, welding, speed control of electrical machines, photo-electric devices, x-ray, PLCs, and data acquisition.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. describe the operating characteristics of the industrial electronics control devices;
ii. design the control programming using PLC that will perform a specified operation;
iii. perform experiments in industrial electronics and present technical reports.

Course Content:

Electric heating: Principles and applications; induction and dielectric heating; high-frequency welding, Spot welding control. Industrial control: Speed control of DC, AC, and servo motors. Process control. Measurement of non-electrical quantities: Temperature, displacement, pressure, time, frequency; digital industrial measuring systems, Ultrasonic generation and applications, X-ray applications in industry, Photo-electric devices. Industrial control using PLCs. Data acquisition, Distributed control system in process industries.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:

(i) single-phase full-wave bridge rectifier and linear regulator;
(ii) traffic Light Control System for an Intersection using S7-300 PLC;
(iii) power control in AC circuits using an AC chopper: Lamp Dimmer;
(iv) switched-mode DC-DC conversion using buck converter;
(v) controlling a squirrel-cage induction motor with Simatic S7-300 PLC;
(vi) closed-loop temperature control of an electrical heater.

Recommended books:

(i) Frank D. Petruzella, *Industrial Electronics*, First Edition, 1995, McGraw-Hill, TISBN: 0028019962.
(ii) James A. Rehg, Glenn J. Sartori, *Industrial Electronics*, 1st ed. Prentice Hall, 2005.
(iii) Maloney, Timothy J., *Modern Industrial Electronics*, 5th ed., Prentice Hall, 2004
(iv) Kissell, Thomas E., *Industrial Electronics*, 3rd ed., Prentice Hall, 2003
(v) Schuler, C.M., amd McNamee, W.L., *Modern Industrial Electronics*, McGraw Hill

(vi) Frank D. Petruzella, *Programmable Logic Controllers*, Third Edition, 2005, McGraw-Hill, ISBN: 0078298520.

ECE 524 – PROJECT MANAGEMENT (3 Units)

Pre-requisites: Economics for Engineers

Course Purpose:
To equip the students with the knowledge of how to organize and supervise projects
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) describe the basic principles of project management and project implementation;
(ii) demonstrate an understanding of processes, tools and techniques of project management in an engineering context;
(iii) demonstrate an understanding of the concepts of close-out phases of the project life cycle ;
(iv) describe the importance of project schedules, project time management and performance;
(v) integrate and balance overall project management functions and apply available software tools for project management.

Course Content:
Project management function; project management process; project integration; scope and time frames; quality; human resources; communication; procurement; network scheduling; cost and risk management. Project resources identification and scheduling, resource allocation, creation project flow charts, critical path planning and evaluate reports. Tools such as Programme Evaluation and Review Technique (PERT) charts and Critical Path Method (CPM) charts. Staff selection and team management.
Mode of Delivery

Lectures, Class discussions, e-learning, group discussions

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Recommended book:

(i) Harold Kerzner, *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, John Wiley and Sons, ISBN-10: 1118022270

ECE 525 – ELECTROACOUTICS (3 Units)

Pre-requisites: ECE 328 - Principles of Communication Systems, ECE 416 - Digital Communication

Course Purpose:
To expose the students to the principles of electroacoustics and essential skills necessary for the design of an electroacoustic system.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. explain general two-port description of transducers including their electrical, mechanical and acoustic properties;
ii. describe electroacoustic analogies;
iii. explain the modification of a transducer's electrical behaviour by its mechanical environment and vice-versa;
iv. derive equivalent models for moving coil loudspeakers;
v. explain loudspeaker and microphone performance in terms of frequency response, directivity and distortion;
vi. explain the influence of a baffle, a closed box and a tuned enclosure on the response of a loudspeaker;
vii. describe the principles of pressure and pressure gradient microphones;
viii. describe the frequency limits due to equalisation and diffraction.;
ix. describe the division of a microphone's response into acoustic, mechanical and electrical parts;
x. describe principles of operation of condenser, ceramic, electret and dynamic microphones;
xi. calibrate microphones with standard calibration methods;
xii. recognise and select appropriate techniques for the analysis of electroacoustic problems;
xiii. develop specifications for electroacoustic transducers;

xiv. explain the movement of sound in water and derive sonar equations.

Course Content:
Acoustic plane waves: plane wave acoustic equation; harmonic solutions; acoustic impedance; acoustic standards; decibel scales, Description of electrical, mechanical and electro-acoustic systems as two-port networks, coupling, analogies, acoustic networks. Acoustic Transmission: transmission from one fluid to another; standing waves; transmission through different media; Transmission loss. Loudspeakers: Equivalent models for moving coil loudspeakers, and relationship to practical loudspeakers. Loudspeaker performance in terms of frequency response, directivity, and distortion, and their measurement. The influence of an infinite baffle, closed box and tuned cabinets. The horn equation, simple solutions and application. Microphones: Pressure and pressure gradient principles, diffraction. Diaphragm dynamics and transduction mechanisms; complete frequency responses for various microphone types; Methods of calibration; Directivity of first order microphones, diffuse field response. Architectural Acoustics: Design and application of sound; Reverberation: Reverberation time, sound absorption, Calculation of reverberation time (Sabine formula); optimum reverberation times; standing modes and normal modes in enclosures, acoustical designs, studios and auditoria. Electro-acoustic filters: acoustic, mechanical, and electrical analogues; acoustic resonators; acoustic filters. Underwater Acoustics: Speed of sound in water; Transmission loss; Refraction; Sonar equations. Shockwaves and explosions: The Rankine-Hugoniot equation, Stagnation and critical flow, the shock adiabatic, reference explosions, scaling laws.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:

(i) L.E. Kinsler, A.R. Frey, *Fundamentals of Acoustics, John Wiley and Sons*, ISBN-10: 0471847895
(ii) M.L. Gayford, *Electroacoustics, Microphones, Earphones and Loudspeakers*, Newnes-Butterworth; ISBN-10: 0408000260.
(iii) Bruel and Kjaer Naerum, *Condenser Microphones and Microphone Preamplifiers*, Anon.

ECE 510 – ENGINEERING PROJECT (4 Units)

Pre-requisites: ECC 402 - Research Methods

Course Purpose:
To provide students with opportunities to exercise and demonstrate their ability to co-ordinate their knowledge, experience and judgment in addressing design projects and presenting their proposed solutions in a professional manner.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) identify and formally state problems that can be solved using engineering knowledge and skills;
(ii) demonstrate practical skills in the design of engineering components, assemblies and/or systems;
(iii) demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process;
(iv) develop a design project plan making best use of information technology and identify resources required to complete project milestones when a component is to be produced;
(v) produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated engineering drawings or source codes and any other relevant information.

Course Content:
This course focuses on integrated product development for electrical and communication engineering products. The course consists of modules including the development of a project plan, background research, hazard analysis, setting product specifications based on user requirements, detailed design and analysis, prototype development and final documentation and presentation. Students will be expected to produce a form model, functional prototype, marketing plan, and manufacturing plan of their product.

Additional relevant professional development topics are also covered, including technical public speaking, proposal preparation, personal time management, and other topics. All products developed will respond to the needs of appropriate market segments and should be safe, effective, useful, usable and desirable.

Course Assessment

(i) Supervisor's Progress assessment	10%
(ii) Oral Presentation	20%
(iii) Prototype	30%
(iv) Report	40%

ELECTIVES

ECE 511E – POWER SYSTEMS ANALYSIS (3 Units)

Pre-requisites: ECE 421 - Power systems IV

Course Purpose:

To enable students model and analyze steady-state and dynamic performance of simple power system.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. formulate the Y-BUS matrix for a small power grid by hand;
ii. differentiate among PV, PQ, reference/swing/slack buses in power flow analysis;
iii. describe Automatic Generation Control and its use in power systems;
iv. apply the equal area criterion to calculate the critical clearing time of a faulted network;
v. explain the dynamic principle of power systems and generators.
vi. formulate and solve the economic dispatch problem for a lossless power system with generator minimum/maximum MW constraints;
vii. derive equations for the economic dispatch problem for a power system with transmission system losses, including the penalty factor values;
viii. explain the need for the use of unit-commitment for longer term generator cost optimization;
ix. analyse current issues associated with restructuring in the electricity industry.

Course Content:

Power flow basic considerations, formula of the system array, non-linear algebraic equations. Gauss-Seidel and Newton-Raphson methods. Simplification of the Newton-Raphson method; the fast de-coupled power flow. Power flow studies in system design and operation. Computer simulation of large power systems; Stott-Alsac fast de-coupled algorithm written in Fortran The swing equation. Stability studies; small signal stability, the state matrix and its eigen properties, transient stability. Load forecasting techniques for short-term planning. Economic load dispatch: System constraints; selection of generators, voltage, running spare capacity, transformer tap settings and transmission line. Network security and merit order scheduling. Dispatch neglecting losses; optimum dispatch, physical integration of co-ordination equations for transmission networks. Exact transmission loss formula; modified co-ordination equations, automatic load dispatch using digital computer. Voltage control: generator voltage, voltage control by reactive power insertion, controlling through power flow by means of magnitude and phase-changing transformers. Frequency control: tie-line loading frequency characteristic, speed governing system.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, relevant engineering software

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Recommended books:

(i) R. Bergen and Vijay Vittal, *Power Systems Analysis* (2nd Edition), ISBN-10: 0136919901
(ii) J. Grainger and W. Stevenson Jr, *Power System Analysis*, ISBN-10: 0070612935.
(iii) Prabha Kundur, N.J. Balu, and M.G. Lauby "*Power System Stability and Control*", 1994, McGraw-Hill, New York.

ECE 512E - SPECIAL ELECTRICAL MACHINES (3 Units)

Pre-requisites: ECE 327 - Electric Machines III

Course Purpose:
To introduce students to the general issues concerning the design, principle of operation and characteristics of the following types of electrical machines – servomotors; stepper motors; universal motors and induction micromotors.

Expected Learning Outcomes:
Upon successful completion of this course, the student will be able to:

(i) explain and application of DC servo motors and AC servo motors;
(ii) draw the block diagram and develop the transfer function of a three phase servomotor;
(iii) analyse the synchros-voltage relations of a three phase AC servo motors;
(iv) explain the construction of the variable stepper motor and permanent magnet stepper motor;
(v) explain the principle of operation and application of linear induction motors and micromotors.

Course Content:
Introduction: Machines with special applications. Micromachines: DC servomotors and induction servomotors - construction, principles of operation, methods of speed control, dynamic characteristics and applications, Analysis: Transfer function and block diagram. Tachogenerators: Direct current Tachogenerators, A.C induction Tachogenerator; A.C.Synchronous Tachogenerators - construction, principle of operation, dynamic characteristics and applications. Synchros(Selsyn): Voltage relations construction of single-phase, Synchro indicators, Synchro Transformers; construction, principles operation and application of synchros. Applications. Special Machines: construction, principles of operation and application of universal commutator motor, stepper motor, Linear induction motor, induction voltage regulator (1- phase, 3-phase).

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended Books:

(i) Charles I. Hubert, *Electric Machines: Theory, Operating Applications*, and Controls, Prentice Hall, ISBN13:9780130612106.
(ii) Any other books recommended by the course lecturer

ECE 513E – ELECTRICAL MACHINE DRIVES AND INDUSTRIAL APPLICATIONS (3 Units)

Pre-requisites: ECE 327 - Electrical Machines III
ECE 317 - Power Systems II
ECE 424: Power Electronics II
Course Purpose:
To introduce students to the general issues concerning the design, principle of operation and characteristics of the following types of electrical machines – transformers, induction motors and generators, special induction motors and induction micromotors.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. explain the basic concepts of magnetic circuits as applied to electric machines;
ii. explain the two basic principles (generation of force and emf) that govern electromechanical energy conversion;
iii. describe the operation of dc motor drives to satisfy four-quadrant operation to meet mechanical load requirements;
iv. design torque, speed and position controller of motor drives;
v. use space vectors presented on a physical basis to describe the operation of an AC machine;

vi. explain the basic principles of Permanent Magnet AC (Self-Synchronous AC) drives;
vii. describe the operation of induction machines in steady state that allows them to be controlled in induction-motor drives;
viii. apply speed control of induction motor drives in an energy efficient manner using power electronics;
ix. explain the basic operation of stepper motors and switched-reluctance motor drives;
x. describe energy efficiency of electric drives and inverter-motor interactions.

Course Content:
General issues on electrical drives: Characteristics of loads and operating requirements to be satisfied by the drive; principle of electro-mechanic conversion; reversible operation of electrical machines; thermal, electrical and magnetic limits of electric systems; Block diagram of an electrical drive; review of applications. Electrical machines: Electrical machines for production and transformation of electrical energy; operating aspects (steady-state), range of power and efficiency, rated values. d.c. machine: transfer function, operation fed by SCR rectifier, simple control schemes; induction motor: operation fed from variable-frequency inverter at constant flux; influence of frequency and harmonic equivalent circuit. Power converters: Static power converters: principle of operation and external characteristics; fields of application; rectifier feeding a d.c. machine: analytical description, continuous and discontinuous operation; 3-phase voltage-source inverter: basic operation and PWM control of voltage and frequency (triangular carrier PWM) Induction machine: Steady state equivalent circuit; dynamic model and instantaneous torque, direct-quadrature (dq) transformations and equations in vectorial form; direct and indirect Field Oriented Control; reconstruction of rotor and stator flux; field weakening operation; Current-Source Inverter Drive with regeneration. The doubly fed induction machine. A.C. current control: Control of the currents of a three-phase system (i.e. motor) in different reference systems (abc, αβ, dq); PI regulators; Hysteresis regulators; predictive control; compensation of dq coupling terms. Space Vector PWM: Inverter configurations, voltage reference and basic principles of the method, definition of the hexagon and over modulation, optimal sequence of inverter states, limitation of switching frequency and current ripple. Permanent Magnet Synchronous Motor (Brushless motor): Permanent Magnets, construction and types of rotor, e.m.f. induced in the stator windings; magnet and reluctance torque; d-q dynamic model; a.c. brushless motors; closed-loop torque and speed control; field weakening operation; d.c. brushless motors: operational features and control
Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended book:
(i) J. Hindmarsh and A. Renfrew, *Electrical Machines and Drives,* 1996. ISBN 0080505198
(ii) Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhof, "*Analysis of Electric Machinery and Drive Systems*", 2002, IEEE Press. ISBN 0-471-14326-X.

ECE 514E – RADAR and SATELLITE ENGINEERING (3 Units)

Pre-requisites: ECE 328 - Principles of Communication Systems
ECE 416 - Digital Communication Systems

Course Purpose:
To enable students be familiarize with modern radar and navigation systems and principles of design radio-navigation and location systems, as well as radar systems

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
i. explain principles of operation of radar systems;
ii. apply theoretical and practical knowledge about principles, methods and applications of modern radar systems;
iii. measure and identify the parameters which determine the performance of radar systems;
iv. explain the function of satellite subsystems;
v. apply orbital mechanics formula and tools to spacecraft mission design;

vi. select appropriate launch systems and understand their effect on satellite and payload design and performance;
vii. design and analyse satellite links;
viii. evaluate satellite subsystem performance

Course Content:
Basic Principles of Radar, Antenna parameters, Radar equation. Performance parameters, target cross-section, MTI and Doppler radar: Doppler Effect, CW radar, FM CW, Delay line cancellers, Pulse Doppler Radar. Scanning, Duplexers and Radar receivers: Sequential lobbing, Conical Scanning, Monopulse Tracking RADAR, Tracking with surveillance RADAR, Acquisition, Radar receiver, Radar Displays; Duplexers. Introduction to satellite communication, international regulation & frequency coordination, satellite frequency allocation & band spectrum, active & passive satellites. Orbits and Launching Methods: Kepler's laws, orbital elements, apogee and perigee heights, orbital perturbations, effects of non-spherical earth, atmospheric drag, the geostationary orbit, antenna look angles, polar mount antenna, limits of visibility, earth eclipse of satellite, sun transit outage, launches and launch vehicles, power supply, altitude control, station keeping, thermal control, transponders, antenna subsystem. Earth station: transmit/receive earth stations. space links: Introduction, equivalent isotropic radiated power, transmission losses, link power budget equation, system noise, carrier-to noise ratio. Interference: interference between satellite circuits, combined (C/I) due to interference on uplink and downlink, antenna gain function, pass band interference. Applications: direct broadcast satellite (DBS) services, MSAT, VSATs, GPS.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (30%), End of semester Examination (70%)
Recommended book:
(i) Skolnik M. I, *Introduction to Radar Systems*, McGraw-Hill
(ii) Gerard Maral, Michel Bousquet, *Satellite Communications Systems: Systems, Techniques and Technology*, ISBN: 0-471-49654-5.
(iii) M. Richharia,, *Satellite Communication Systems*, 2nd Edition, McGrawHill Telecommunication Series, ISBN: 0-07-134208-7.
(iv) Kadish J.E. and East T.W.R., *Satellite Communication Fundamentals*, Artech House Books, ISBN: ISBN-10: 1580531369

ECE 515E – OPTOELECTRONICS & PHOTONICS (3 Units)

Pre-requisites: ECE 211 - Physical Electronics
Course Purpose:
To enable the students to understand electronic devices and techniques used in optical communication and displays.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
(i) explain how photo-detectors, LEDs, lasers, and solar cells work, and be able to design simple optoelectronic systems such as fiber optic and free space communication channels, interferometers, simple imaging systems;
(ii) measure several parameters of optoelectronic systems such as attenuation, bit error rate, frequency dispersion, and relate these to the system designs;
(iii) describe the various function of components and devices in optoelectronic and fibre optic systems;
(iv) apply and relate the operation of optoelectronics and fiber optics components, devices and systems;
(v) solve the problems relating to various types of optoelectronic sensors and transceivers for different applications;
(vi) design an optic fiber link for any mobile/data communication system.

Course Content:
Basic semiconductor theory: Light sources, black body, colour temperature, radiometric and photometric units, PN junction carrier recombination and diffusion, injection efficiency, internal and external quantum efficiency, hetro junction, quantum well and super lattices. Optoelectronic Devices: optical modulators, optical transmitters, optical transmitter circuits, LED and laser drive circuits, LED power and efficiency, double hetero LED structure and characteristics, Double hetero junction lasers, quantum well laser, Distributed feedback laser, index guided laser. Optical Modulators: Modulation of light, birefringence, electro optic effect, Kerr Modulators (scanning and switching), self-electro optic devices, MO modulators. Optical Detectors: Introduction to photo detectors, thermal detectors, photoconductors, PMT photodiodes, phototransistors, PIN diode, APD design of photo-detector arrays, CCD, Solar cells. Display devices: Photoluminescence, EL display, LED display, plasma panel display, LCD display. Optical multiplexing: wavelength division multiplexing (WDM), benefits of WDM, Dense wavelength division multiplexing, optical networks. Link budgeting in optical fiber communication

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Optical sources, optical detectors, optical amplifiers, optical transmitters, optical receivers, optical transreceivers, optical fibres, propagation of light through an optical fibre, losses in fibre optic elements, optical modulation, multiplexing, optical systems.
Recommended books:

(i) Harold Kolimbiris, *Fiber Optics Communications*, First Edition, 2004, Prentice Hall, ISBN: 0130158836.
(ii) J. Singh, *Optoelectronics: An introduction to materials and devices*, McGraw-Hill
(iii) Pallab Bhattacharya, *Semiconductor Optoelectronic Devices*, Prentice-Hall, (ISBN: 0-13-495656-1).

ECE 516E – ANTENNA AND RADIO WAVE PROPAGATION (3 Units)

Pre-requisite
ECE 328 – Principles of Communication Systems, ECE 416 - Digital Communications
Course Purpose:
To enable students perform a range of antenna and array designs and apply relevant methods used in their various parameter measurements

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. make basic calculations of propagation loss, taking into account free-space loss and polarization effects, and extend this to a link budget analysis;
ii. analyse, from first principles, the basic properties of a range of antennas, such as dipoles, parabolic reflector antennas, horn antennas, printed patch antennas;
iii. apply numerical modeling tools (by means of the lab experiment) to design antennas, with particular reference to a printed patch antenna;
iv. perform antenna measurements using facilities such as far-field antenna ranges (to measure radiation pattern and/or gain) and network analysers (to measure impedance bandwidth);
v. explain the effect of ground on electromagnetic waves propagation;
vi. explain properties of ionospheric layer used for electromagnetic wave propagation;
vii. explain different modes of wave propagations;
viii. select the antennas for specific mode of wave propagation.
ix. explain principle of operations of video signal generation and transmission
x. explain the operation of visual display systems

Course Content:
Antenna theory: Electromagnetic fields and radiation theory; pattern synthesis, near and far field patterns and focused apertures. Properties of Antenna: Antenna Impedance, Radiation Resistance, Radiation Pattern, Beam area and beam efficiency, gain, directivity and Gain, radiation intensity, half power BW, polarization, antenna losses, antenna efficiency, effective aperture, effective length of antenna, effects of antenna height, antenna temperature, front to back ratio, antenna field zones. Antenna synthesis: Fourier transform method; Woodyard method; Problems in antenna design. Basic Antennas and Arrays: Radiation characteristics of wire antennas: Resonant wire antennas (λ, 2λ), Non Resonant (Rhombic) Antenna; Loop antenna; Folded dipole; Yagi-uda antenna; Antenna Arrays-Uniform linear array, Broad side array, End fire array. VHF/UHF antennas: Helical antenna, Parabolic reflector antenna, Horn antenna, Micro strip (patch) antenna, Turnstile and super turnstile antenna, slot antenna. Terrestrial mobile communication antennas: Base station antennas, Mobile station antennas. Smart Antennas. Propagation principles: Friis transmission formula, atmospheric effects, fading, tropospheric scatter, link budget calculation. Ionosphere Layers and Sky wave propagation: Virtual Height, Critical frequency, Maximum usable frequency (MUF), Skip distance, Lowest Usable frequency (LUF), Optimum Usable frequency (OUF) Space Wave propagation: Tropospheric scattered propagation, Duct Propagation. Application: Principles of colour TV transmission and display systems

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Lab assignments provide students with practical experience to design, analyze, simulate, implement, and evaluate antennas; and use of engineering techniques, skills, and tools, including software methods.
Recommended books:

i. Warren L. Stutzman, Gary A. Thiele, *Antenna Theory and Design*, 3rd Edition, John Wiley and Sons (2013).
ii. Simon Saunders, Alejandro Aragón-Zavala, *Antennas and Propagation for Wireless Communication Systems*, John Wiley and Sons, ISBN: 978-0-470-84879-1
iii. William Gosling, *Radio Antennas and Propagation: Radio Engineering Fundamentals*, ISBN-10: 0750637412
iv. Louis E Frenzel, *Principles of Electronic communication Systems*, McGnaw Higher Education 3rd Edition.
v. S. P Sh, *Basic Radio and Television*, 2nd Edition Tata McGraw –Hill Publishers

ECE 521E- ELECTRICAL MACHINE DESIGN (3 Units)

Pre-requisites: ECE 327 - Electric Machines III

Course Purpose:
To provide sound knowledge about constructional details and design of various electrical machines.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:
(i) carry out mmf calculation and thermal rating of various types of electrical machines;
(ii) design armature and field systems for d.c. machines;
(iii) design core, yoke, windings and cooling systems of transformers;
(iv) design stator and rotor of induction machines;
(v) design stator and rotor of synchronous machines and study their thermal behaviour.

Course Content:
Windings: Conductors, insulators, eddy currents, slot conductors, overhang conductors, transformer coils; permeable and conducting masses; electromotive force; transformer windings; D.C. field windings, a.c. armature windings: single layer windings; Double–layer windings; Fractional - slot windings; Types of double - layer winding; choice of winding, e.m.f. of windings, harmonics, magnetomotive force of windings.

Transformers: Design Frames, thermal rating; momentary load limitations; output equation; specific iron and copper losses; insulation; Types of windings and connections; Cooling and ratings Iron core dimensions. Rotating Machine Design: Output equation; specific copper and iron losses: power/weight ratio, salient pole and cylindrical rotor; Air gap flux distribution and saturation; Insulation, heating; ventilation and ratings. Computer Aided Electrical Machine Design.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Recommended Books:

(i) Sawhney, A.K., *A Course in Electrical Machine Design*, Dhanpat Rai & Sons, New Delhi, 1984.
(ii) Sen, S.K., *Principles of Electrical Machine Designs with Computer Programmes,* Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.
(iii) Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, *Design of Rotating Electrical Machines*, John Wiley & Sons.

ECE 522E – HIGH VOLTAGE TECHNOLOGY (3 Units)

Pre-requisites: ECE 421 - Power Systems IV

Course Purpose:

To give students an understanding of high voltage technologies including electric fields in dielectric systems, generation, insulating materials as well as ageing and breakdown mechanisms.

Expected Learning Outcomes:

Upon completion of this course, a student should be able to:

i. describe the principles of generating high dc-, ac- and impulse voltages;
ii. develop equivalent circuit models of the different high voltage generators;
iii. perform a dynamic response analysis of high voltage measurement systems;
iv. compute the breakdown strength of gas-filled insulation systems with simple geometries;
v. estimate the breakdown strength of contaminated liquids and solids;
vi. describe the principles for measurement of dielectric loss;
vii. discuss ageing of electrical insulation from measurements of complex permittivity;
viii. discuss the measurement principles of partial discharges.

Course Content:

Breakdown mechanisms in vacuum, gaseous, liquid and solid dielectrics, i.e. Streamer mechanism, corona, electronegative gases, arc discharge, arc (current) interruption techniques, intrinsic, electromechanical, thermal and particle initiated breakdown. Dielectrics: properties, effects of temperature, frequency, pressure, humidity and voltage. Ionisation process and decay. Flashover. Characteristics of liquid and plastic dielectrics. Corona; voltages, characteristics, gradient discharges and corona power loss. Generation of high voltages: transformer over-voltages, behaviour and distribution, oscillations and surges. Alternator under-voltage surges. Overhead lines: surges, wave propagation, terminations and surge energy. Lightning and surge protection: shielding, resistance, surge diverters, horn-gaps, arresters and surge modifiers, measurement of high voltages: sphere gaps. Cathode ray oscilloscope, rectifier condenser-current peak voltmeter, potential dividers and tesla coil. High voltage testing equipment: transformers, direct current testing equipment and impulse generator; Non-destructive insulation test techniques. Non-electric power engineering applications: e.g. sterilisation of liquid foods, weed control, ozone production, mechanical destruction, air treatment.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials

Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector

Course Assessment:

Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Lab Outline:
Students to carry out the following high-voltage lab experiments:

(i) Determine the flashover voltage of a pin type insulator;
(ii) Determine the flashover voltage of suspension type insulator and to observe the corona effects;
(iii) Compare the wet and dry flashover voltages for a typical outdoor insulator;
(iv) Investigate the voltage distribution over a suspension insulator string without guard ring;
(v) Investigate the voltage distribution over a suspension insulator string with guard ring.

Recommended books:

(i) Dieter Kind, *High-Voltage Insulation Technology: Textbook for Electrical Engineers*, Springer, ISBN-10: 3528085991
(ii) Ravindra Arora, Wolfgang Mosch, *High Voltage and Electrical Insulation Engineering*, John Wiley & Sons.
(iii) C. L. Wadhwa, *High Voltage Engineering*, New Age International.

ECE 523E – POWER SYSTEMS PROTECTION (3 Units)

Pre-requisites: ECE 511E - Power Systems Analysis
ECE 421 - Power systems IV

Course Purpose:
To enable students design a power protection system
Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. Explain the fundamentals of electrical power protection and applications;
ii. Recognise the different fault types;
iii. Perform simple fault and design calculations;
iv. Describe protection system components;
v. Perform simple relay settings;
vi. Choose appropriate protective devices for different equipment;
vii. Interpret the protection systems existing in your plant, understand their functions, detect any shortcoming and explain any undesired or uncoordinated relay operation;
viii. Make more informed decisions on electrical power system protection.

Course Content:
Review of symmetrical faults on synchronous machines and power systems. Relays: Operation, characteristics and testing. Types of relays. Over- current, directional, differential, distance, static and comparators. Circuit breakers: Operation, characteristics and testing. Types of circuit breakers: Oil, air, vacuum and gas. Alternator protection: differential protection, balanced earth- fault protection, stator inter – turn protection. Transformer protection: Buchholz devices, over – current relays, earth fault/leakage protection and differential system. Bus – bar protection: differential protection and fault - bus protection. Line protection: Time – graded over – current protection, differential pilot wire protection and distance protection. Protection against under and over – voltages: Causes and effects of over – voltages and under voltages. Protection against lightning.
Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Recommended books:

(i) J.D. Glover, M.S. Sama, and T.J. Overbye, *Power Systems Analysis and Design*, 4th ed., Thompson-Engineering.

ECE 524E – MICROWAVE ENGINEERING (3 Units)

Pre-requisites: ECE 312 - Electromagnetics I, ECE 322 - Electromagnetics II, MAT 202 - Engineering Mathematics II, ECE 514: Transmission Lines
Course Purpose:
To introduce students to microwave components and circuits in terms of scattering parameters, electrical characteristics of waveguides through electromagnetic field analysis, and basics of microwave amplifiers.

Students are expected to analyse microwave network through application to impedance matching and tuning, design of microwave resonators, passive components, filters, and microwave antennas.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

viii. discuss the operation of components and devices used in RF & Microwave systems;
ix. describe the principles of design and operation of devices for generation & processing of RF signals at different power levels;
x. discuss the applications of RF & microwave systems in communication, control and instrumentation;
xi. discuss recent developments in broadband communications for voice, data and video communication requirements and their relationship with microwaves;
xii. design microwave antenna;
xiii. explain the basic structures of RF / microwave transmission lines (microstrip, strip);
xiv. identify TEM, TE, and TM waves;
xv. explain operation of rectangular waveguide;
xvi. describe the lumped element circuit model for a transmission line;
xvii. design impedance matching networks for microwave circuits;

Course Content:
Introduction: Components of RF and microwave design, Behaviour of passive components, Propagation of guided waves. Micro-stripline circuits; Evaluation of attenuation constant for the rectangular waveguide. Waveguides and Components: Review of electromagnetic (EM) spectrum. Rectangular waveguides, Circular Waveguides, Microwave cavities. Microwave antennas: electromagnetic horns; reflector antennas; micro-strip antennas; phased arrays. Micro Strip Antenna. Directional couplers. Circulators, isolators. Wave guide couplings, bends and twists, Transitions, hybrid couplers, Matched load, Attenuators and phase shifters, E-plane, H-plane and Hybrid Tees, Hybrid ring. Waveguide discontinuities: Windows, Irises and Tuning screws, Detectors, wave meters. Strip Lines: Microstrip lines. Parallel strip lines. Coplanar strip lines. Shielded strip lines. Microwave Active circuits: Microwave transistors and tunnel diodes. Microwave FETs. Transferred electron devices: Avalanche transit time devices. Microwave linear beam tubes. Microwave crossed-field tubes. Microwave Communication Systems. Effect of Biological Exposure to microwave radiation. Microwave tubes: Klystron, Reflex Klystron, Magnetron, TWT, BWO: Their schematic, Principle of operation, performance characteristics and application. Microwave semiconductor devices: PIN diode, Tunnel diode, LSA diode, varactor diode, Gunn Devices, IMPATT and TRAPATT, their Principal of operation, characteristics and applications. Microwave Relays: Line-of-site path characteristics, FM radio stations and repeaters, FM microwave systems, analogue FM/AM, analogue versus digital switching arrangements.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:
Strip line and Slot line practical demonstration. Practicals on waveguides and microwave detectors. Smith chart computation.
Recommended books:

(i) Liao, S.Y. *Microwave Devices & Circuits*, Publisher: Prentice Hall, 3rd ed, ISBN10: 0135832047
(ii) Collin, R.E. *Foundations for Microwave Engineering;* TMH 2nd Ed. ISBN-10: 0780360311
(iii) Rizzi P. A., *Microwave Engineering: Passive Circuits*; PHI. ISBN-10: 0135867029
(iv) Pozar D. M., *Microwave Engineering*, Wiley, 2012. ISBN-10: 0471448788

ECE 525E – WIRELESS AND MOBILE COMMUNICATION (3 Units)

Pre-requisites: ECE 416 - Digital Communication, ECE 328 - Principles of Communication Systems

Course Purpose:
To introduce the students to engineering principles and technologies used in wireless and mobile communication.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

(i) define the components of mobile and wireless communication;
(ii) explain basic principles behind radio resource management techniques such as power control, channel allocation and handoffs;
(iii) explain technologies used in Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA) and Wi-Fi Networks;
(iv) compare different types of mobile and wireless networks;
(v) design systems that effectively share spectrum through multiple access;
(vi) design simple mobile and wireless systems.

Course Content:
Introduction to Mobile Communication: Evolution of Mobile and Radio Communication; Packet Radio; Pure Aloha and Slotted Aloha; and Multiple Access Techniques, Cellular Concept; Frequency Re-use and Channel Assignment Strategies; Mobile Radio propagation; PCS Architecture, Mobility management, signaling in PCS Networks. Wireless channel models: Path loss; Shadowing; Multipath fading; Wideband channel models; Capacity of wireless channels; Diversity (time, frequency, space); Equalization; Multicarrier modulation; Cellular concept; Frequency reuse. Global System for Mobile Communication (GSM): system overview: GSM Architecture, Mobility management and signaling; Number portability. Third and Fourth Generation Mobile Services: International Mobile Telecommunications 2000 (IMT 2000); Wideband Code Division Multiple Access (WCDMA); CDMA 2000; Quality of service in 3G; 4G Networks: Layering architecture and Protocols; LTE. Mobile Satellite Communication Systems: Transmission techniques; receiver antenna design; propagation and interference; Case studies of the IRIDIUM and GLOBALSTAR. Wireless Data Networks: HSCPD, General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes; Wireless Local Loop (WLL); WiMax; Bluetooth and IEEE 802.15; Billing Systems. Mobile Communication: Analogue and Digital Cellular Systems; Advanced Mobile Phone Systems (AMPS); Global Systems for Mobile Communication (GSM): Architecture, Mobile Data Communication: HSCPD, GPRS Architecture, GPRS Network Nodes, Billing Systems, WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP-based systems.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector, Computer with simulation software

Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)

Recommended book:

(i) Theodore S. Rappaport, *Wireless Communications*, Latest Edition,
(ii) Tse and P. Viswanath, *Fundamentals of Wireless Communication*, Cambridge University Press; ISBN-10: 0521845270
(iii) William Stallings, *Wireless Communications and Networks*, Pearson, ISBN-10: 0131918354
(iv) William Lee, Wireless and Cellular Communications, McGraw-Hill, Latest Ed.
(v) Stojce Dimov Ilcev; Global Mobile Satellite Communications; Springer; ISBN: 978-1-4020-7767-8

ECE 526E – TELECOMMUNICATION SWITCHING AND NETWORKS (3 Units)

Pre-requisites: ECE 416 - Digital Communication Systems

Course Purpose:
To introduce students to switching, network planning and transmission as applied within the telecommunications infrastructure.

Expected Learning Outcomes:
Upon completion of this course, a student should be able to:

i. describe and relate fundamentals of telecommunication networks and associated technologies;
ii. apply the principles of queuing theory in evaluating the performance of telecommunication networks;
iii. solve problems and design simple systems related to telecommunications networks;

iv. appreciate the reasons for switching, and the relative merits of the possible switching modes, e.g. packet and circuit switching;
v. understand the principles of the internal design and operation of communication switches.
vi. develop a performance model of a telecommunication system based on a description of its functionality and associated parameters;
vii. determine a methodology for planning a telecommunication system to meet performance and reliability constraints and to apply standard solution techniques to obtain the desired capacity and routing;
viii. determine the factors required to plan a communication network when given the subscriber densities and performance objectives;
ix. apply standard algorithms to solving performance and planning problems in communication networks.

Course Content:
Introduction to Switching and Networks: the structure of switching centers, selectors and cross point matrices, blocking and none blocking networks, Local and trunk switching. Public Switch Telephone Network (PSTN): Definitions and basic concepts, PSTN Infrastructure, Local Networks, Switching, Line Circuit Functions, Signaling Systems. Distributed Packet Switching for Local Computer Networks; Queuing in Networks; Single Stage Switching Systems, Multistage Switching Systems with Dynamic Routing, Multicast Switch Architectures with Dynamic routing (Asynchronous Transfer Mode-ATM Switch), Multistage Switching Systems with Static Routing, Unbuffered Switching Networks. Principles of traffic for switching systems, Queuing theorems for circuit switching centres. Time division switching centres. Digital Subscriber Lines (xDSL): Asymmetric DSL(ADSL); High-data-rate DSL (HDSL); Symmetric DSL (SDSL);Very High Speed DSL (VDSL); Integrated Services Data Network - ISDN and PABX, capacity of PSTN. Converged Networks: Applications: VoIP, FoIP. Protocols: Packet Transport: IPv4, Ipv6, ICMP; Packet Routing: RIP, OSPF, BGP; End-to End Reliability: TCP, UDP. WAN Transport: IP over Serial Lines; IP over Frame Relay; IP over ATM; Voice over ATM. Traffic management and scheduling in a switch; Optical switching: wavelength division multiplexing (WDM). Teletraffic models: Poisson model, Erlang model; Binomial model. teletraffic measurements. Network planning and dimensioning, Traffic and congestion control in ATM and internet: Connection Admission Control; Usage Parameter Control; Flow control. QoS architectures in the Internet.

Mode of Delivery

Lectures, Class discussions, e-learning and laboratory tests

Instructional Materials
Handouts, textbooks, lecture notes, e-materials, Chalkboard, Whiteboard, LCD/Overhead Projector
Course Assessment:
Continuous Assessment Tests (20%), Practicals 10%, End of semester Examination (70%)
Lab Outline:

Poisson source properties and their characterization; Simulation study on queueing properties; Design of an N-trunk telephone switch.
Recommended books:

i. John Bellamy, *Digital Telephony*, 3rd Edition, Wiley Interscience, 2000, ISBN 0471345717
ii. Leon-Garcia, Widjaja, *Communication Networks, Fundamental Concepts and Key Architectures*, McGraw-Hill, 2006.
iii. R.L. Freeman, *Fundamentals of Telecommunications*, John Wiley, 1999.
iv. W. Goralski, SONET/SDH, McGraw-Hill, 2002.
v. M. Cole, *Introduction to Telecommunications: Voice, Data and the Internet*, Prentice-Hall, 2002.
vi. J. Salrand, *High-performance Communication Networks*, Morgan Kaufmann, 2000.
vii. Villy B. Iversen, *Teletraffic Engineering Handbook*, ITU,
viii. http://www.tele.dtu.dk/teletraffic

LIST OF APPENDICES

APPENDIX 1: BACKGROUND INFORMATION

Preamble
Softcore University(MMUST) is situated in Kakamega Town along the Kakamega – Webuye Road. The University is an offshoot of the former Western College of Arts and Applied Sciences (WECO), which was founded on 5th January 1972. The University was established through an Act of Parliament on 30th December 2006 as the seventh Public University in Kenya. It was first established as Western University College of Science and Technology (WUCST) by the Legal Notice No.373, which appeared in Kenya gazette supplement No. 119 of 5th December, 2002, thus succeeding the defunct Western College of Arts and Applied Science (WECO). According to the legal notice, WUCST was established as a constituent college of Moi University. The legal notice mandated WUCST to provide directly or in collaboration with other institutions of higher learning, facilities for University education including technology, science and professional education.

MMUST Motto
The University of Choice

MMUST Vision
To be a centre of excellence in science and technology, responsive to development needs of society through engagement in dynamic knowledge creation and application.

MMUST Mission
To generate, preserve and disseminate knowledge by integrating Science and Technology into quality programmes covering a wide variety of disciplines while engaging in innovative research, teaching and consultancy.

MMUST Core Values
The University activities and decisions are guided by the following core values; passion for excellence, devotion to duty, academic freedom, professionalism, quality service, integrity, respect, social fairness, innovation and social responsibility.

APPENDIX 2: ACADEMIC RESOURCES

1. Lecture, tutorial and seminar rooms for the program

MMUST has adequate lecture rooms, and conference halls to accommodate all the students of the program. The computer laboratory will be equipped with computers and internet access to online research and learning resources.

2. Library

The MMUST library accommodates several volumes. The University has acquired integrated library service software (KOHA), which enables efficiency in access of resources from the library. The library is equipped with books; journals for various programmes offered at the University and the library has on-going plans to strengthen the teaching and learning resources by providing more books, e-books, journals, e-journals, CDs and DVDs, as well as linkages with other institutions for access to other libraries worldwide.

3. Online Research Resources

Additional research support for the program is provided through MMUST library, which provides additional access to a variety of online scholarly and peer reviewed journals through online databases.

4. Information and Communication Technology

The IT Department and support sections have been established to provide Information and Technology services to the entire fraternity. Under Kenya Education Network Trust (KENET) initiative, the university website is now operational. The wide area network (WAN) link facilitates easier sharing of data and information across the university. MMUST has provisions for multi-media facilities for teaching and learning.

5. Academic Staff for the Programme

In addition to the qualifications required by the Commission for Higher Education, the proposed program adheres to the internationally recognized qualifications for degree teaching. The program teaching staff are:

Laboratories and Workshops

Name of Programme: Bsc. in Electrical and Communications Engineering

Name of Departmental Laboratory, Workshop, ICT , Area m^2	Description of Equipment	Manufacturer	Number
Electrical Workshop	Mechatronics work cell (Robot, AGV, CNC, PLC, Microcontrollers, PCB Fabrication and Computer Interface		**1 (supplied by ADB)**
	Basic Electricity Engineering Module – Mod. CBE-1/EV	Electronica Veneta	**1**
	Digital and Analogue Multimeters		
	Function Generators		**5**
	Cathode Ray Oscilloscopes (CROs)		**5**
	Power Supply (0-30V, 2.5A DC) P005B	Eagle	**3**
	Power Supply (0-30V, 2.5A DC) PSI-PSU/EV	Electronica Veneta	**2**
	Bench Top Power Supply Mod. PSI-PSU/EV	Electronica Veneta	**4**
	Three Phase Asynchronous Motor Mod M5/EV220/380V	Electronica Veneta	**1**
	Machine DC Motor/Generator M1-2/EV	Electronica Veneta	**1**
	Three Phase Induction Motor 2.2kW Y90L-2	STCL China	**2**
	Three Phase Transformer Mod M-14/EV	Electronica Veneta	**1**
	Three Phase Synchronous Generator M-3/EV	Electronica Veneta	**1**
	Inductive Load 1L-1E/V	Electronica Veneta	**1**
	Resistive Load (three-Phase) 5000Ω×3, 0.32A Mod. RC-1a	Electronica Veneta	**3**
	Resistive Load(single-Phase) 50Ω, 16A	Electronica Veneta	**1**
	Electric Drive controller (DC and AC)	Electronica Veneta	**1**
Telecommunication Laboratory	Transmission lines mod.LA/EV	Electronica Venneta	**1**
	Analogue Signal Generator	Gwin Steck	**2**
	Antenna Engineering Mod.LA/EV	Electronica Veneta	**1**
	Insertion Fault Module Mod. SISL/EV	Electronica Veneta	**2**
	Trunk Network Training Sytem Mod PCM /EV	Electronica Veneta	**1**
	Digital Modulation Training Module,Mod.MCM/3 1/EV	Electronica Veneta	**1**

	Digital Communication Module Mod. PCM/EV	Electronica Veneta	**1**
	PCM Switching and Transmission Systems – Mod PCM/EV	Electronica Veneta	**1**
	Colored TV Trainer Model, CTVT Supplied by Bytronic Educational Technology		**1 (supplied by ADB)**
	Fiber Optic Communication Training Kit Mod. MCM/40	Electronica Veneta	**1**
	Telephone Training Module E18/EV	Electronica Veneta	**1**
	Satellite Synchronized Clock SEL-2401		**1**
	Parabolic Dish Antenna 4.9GHz-5.8GHz Mod. HDDA5W-29		**2**
	Computers Pentium III	Fujistu	**5**
Power and Machines Laboratory	Electromechanical Training Set	Electronica Veneta	**1**
	Power Electronics Training Module mod MCM11/EVElectronica Venneta	Electronica Veneta	**1**
	Universal Variable Load	Electronica Veneta	**1**
	Tacho-Generator M1-16/EV	Electronica Veneta	**1**
	DC Motor Driver Mod CV-1/EV	Electronica Veneta	**1**
	Variable Line 0-43V ac Three Phase 3A/0-500V DC 4A Three Phase Power Supply AAVV-1/EV	Electronica Veneta	**1**
	Torque Measurement Unit BP CLASS C3	Electronica Veneta	**1**
	Three Phase Motor Driver ModVSD-1/EV	Electronica Veneta	**1**
	DC ElectroDynamometer Mod. TM-1/EV	Electronica Veneta	**1**
	Single Phase Motor Mod-M-8/EV	Electronica Veneta	**1**
	Machine Meters Panel AZ67	Electronica Veneta	**1**
	Three Phase Synchronous Motor Mod-M-5/EV	Electronica Veneta	**2**
	RPM Digital Meter Mod. CED-2/EV	Electronica Veneta	**1**
	Motor Relay SEL-749M Serial: 111125385		**1**
	System Computing Platform SEL-3351 Serial: 2005298300		**1**
	Directional Overcurrent Relay SEL-351 Serial: 2004211231		**1**
	Current Differential Voltage Protection Relay SEL-378E		**1**
Microprocessor Laboratory	Digital Converter AD-DA: Mod MCM8A/EV	Electronica Veneta	**1**
	8-Bit Microprocessor Mod Z1/EV, Z3/EV	Electronica Veneta	**2**

	Computer Based Electronics Training Systems		**1 (supplied by ADB)**
Control Laboratory	Transducer Fundamental Training Model Mod FLTP/EV	Electronica Veneta	**1**
	Industrial Control Trainer Model (EV)		**1 (supplied by ADB)**
High Voltage Laboratory	Comprehensive Engineering Training Equipment for Power Systems		**1 (supplied by ADB)**
Laboratory Equipment Accessed in other Universities (JKUAT, MULTIMEDIA and TUK)			
Course	**Equipment**	**University**	
ECE 514E: Radar and Satellite Engineering	Radar Training System - Electronica Venetta/UniTrain Satellite Communication Trainer - Electronica venneta/Unitrain	Multimedia	
ECE 524E: Microwave Engineering	Microwave Engineering Training Module	Multimedia	
ECE 522E: High Voltage Technology	High Voltage Training and Testing System	JKUAT	
ECE 511E: Power System Analysis	-Power World Computer Simulation Hardware (Power Analysis) - Computer Sever : Intel Processor 6 GHZ or more Brand: HP power edge 860 Mini Tower Windows 2010 sever 8 GB Ram or Greater 1TGB HDD 17" colour monitor LCD TFT 128x1024 32- bit colour video display adopter 128 MB or Greater open GL- capable workstation class graphics card 2 NIC cards 10/100/1000 Gbps - HP Pavillion PC computers: Intel Processor 3.0 GHZ or more Windows 2010 professional 8 GB RAM or Greater IT GB Hard disc space available or more 17" LCDTFT colour Monitor 128x1024 64- bit colour video display adopter 128 MB or Greater open G In- capable workstation class graphics card 10/100/1000 NIC single port	JKUAT	
ECE 515E: Optoelectronics and Photonics	Optoelectronic Devices Training System – Electronica venneta SISl,SIS2andSISl modules are used - electronicavenetta	Multimedia	
ECE 524: Electro-acoustics	Electro Acoustic Training System- Electronica venneta/Unitrain	TUK	

ECE 523E: Power System Protection	Power Systems Training kit- UniTrain/Electronica venneta	JKUAT	
ECE 413: Instrumentation	The following parts : PLC - 5A/EV, PLC-8/EV, PLC-9/EV,PLC-9-10/EV, PLC-7/EV, PLC- E/EV, API-3/EV, API- 4/EV, Plus software for the same. The following items are to operate Multivariable process control system already procured(FLTP/EV) - Electronicavenetta	JKUAT	

Note: The Department of Electrical and Communications Engineering has its laboratories housed in Laboratory and Tuition Block B (LBB) Building, Rooms LBB 211, LBB B004 and LBB B005

Laboratory /Practical Exercises

Name of Programme: Bsc. in Electrical and Communications Engineering

Level and Unit Code	Title of Course	Title of Laboratory/Practical
Year One		
ECE 212	Electric Circuit Theory and Analysis I	1. Kirchoff's voltage and current laws 2. Using network theorems for the solution of ac/dc networks ➢ Mesh theorem ➢ Nodal theorem ➢ Superposition ➢ Thevenin's theorem ➢ Norton's theorem 3. Demonstration of Maximum Power Transfer Theorem graphically 4. Simple RLC circuits
ECE 211	Physical Electronics	1. *characteristics of pn* junction 2. The forward and reverse characteristics of a diode 3. Design of half- and full wave rectifiers 4. Design of Wave Shaping circuits(clipper and clamper circuits) 5. Demonstration of Bipolar Junction Transistor (BJT) and Field-Effect Transistor (FET) characteristics 6. Design of RC differentiating and integrating filter circuits
Year Two		
ECE 221	Basic Electronics	1. The hybrid model of a transistor 2. Design of different types of amplifiers ➢ transistor amplifiers ➢ RC-coupled amplifier ➢ Audio-frequency amplifier ➢ Radio-frequency amplifier ➢ Tuned amplifiers ➢ Feedback amplifiers 3. Design of oscillators: Colpitt oscillator, Hartley oscillator, Wein Bridge oscillator, Clapp oscillator 4. Design of Silicon Controlled Rectifiers (SCR), 5. Demonstration of the operation of UJT, triacs, diacs
ECE 226	Electric Circuit Theory and Analysis II	1. Design and Analysis of RLC Resonant circuits 2. Analysis of sinusoidal steady-state of dc/ac circuits 3. AC power circuit analysis 4. Polyphase circuits 5. Frequency domain analysis, Bode plots, network analysis in the s-domain, 6. Demonstration of mutual inductance in a coil 7. Simulation of circuits in PSPICE, Multisim, Circuit Lab or NL5

ECE 225	Electrical Machines I	1. Characteristics of DC series and shunt motors 2. Characteristics DC series and shunt generators 3. Exploring different parts and operation characteristics of AC induction motor, Synchronous generator, Induction generator, Universal motor, Brushless DC motor , Switched reluctance motor 4. Testing methods of a transformer
ECE 213	Power Systems I	1. Primary and secondary constants of transmission lines and cables 2. Simulation Three-phase transmission system 3. Determination of power in nominal T and π networks 4. Determination of single line equivalent circuit of star-and delta-connected loads 5. The Bus Admittance and Impedance Matrices using MATLAB
ECE 224	Electrical Measurements	1. Static and dynamic characteristics of instruments 2. Errors in Measurements: classification of measurement error and elimination of errors in measurements. 3. Sensors and Transducers: potentiometer; pressure gauges; Linear viable Differential Transformers (LVDT) for measurement of pressure and displacement 4. Measurement of resistance-Wheatstone bridge 5. Measurement of capacitance – Schering bridge; Q-meter; energy meter; power meter. 6. Cathode Ray Oscilloscope: CRO measurement of voltage, frequency, phase difference; use of Lissajous figures in the detection of frequency and phase 7. Wave Analyzers: Distortion and Harmonic analyzers.
ECE 220	Workshop Practice	1. Cold and Hot tests of electronic components 2. Design simple electronic projects and assembly of amplifiers, small power supplies, alarm circuits; 3. Electrical installation and cabling 4. Motor starting control practice 5. Computer applications; 6. Machining, welding and metal works using machining tools and equipment 7. Surveying, Laying out procedures 8. Motor and transformer rewinding 9. Chemical engineering and textile plants demonstration and observation
Year Three		
ECE 312	Electromagnetics I	1. Vector analysis methods in electromagnetic fields using MATLAB 2. Electric field determination using MATLAB 3. Electrostatic boundary value problems solution using Simulation software 4. Biot-Savart Law and Electromotive force determination using MATLAB 5. Simulation of electromagnetic fields using either of the following simulation softwares • MagNet 2D/3D • SoNNET • RemCon • emGine Simulator • EMS simulation software

ECE 313	Electrical Machines II	1. Determination of Single Phase Transformer characteristics 2. Three-Phase Induction Motor: Effect of slip on rotor circuit (current and current frequency, e.m.f., and reactance), speed/torque/load/slip characteristics using MATLAB 3. Torque and power experiment, power balance equations using MATLAB 4. Determination of circuit parameters, starting currents and starting methods, 5. Speed control, braking and overload protection, rating, heating, losses and efficiency, applications of induction motors. 6. Synchronous Machine: System dynamics and basic power flow 7. Design electric motors using Infolytica Motor Solve Software
ECE 327	Electrical Machines III	1. Quadrature field theory, double revolving field theory using MATLAB 2. Locked rotor torque 3. Synchronous machines (steady state performance characteristics 4. Synchronous motor starting and use for power factor correction and dynamic braking, rating, heating, losses and efficiency of synchronous machines. 5. Synchronous machine transients, transformation to direct and quadrature axis variables, basic machine relations in direct quadrature zero (*dqo*) variables.
ECE 314	Analogue Electronics I	1. Determination of h-parameters of BJTs for various configurations 2. Characterization and design of AC variable-gain amplifier 3. Design of test circuits for BJTs and FETs 4. Design of FET ring oscillators 5. Design and characterization of emitter-coupled transistor pairs, tuned amplifier and oscillator 6. Determination of frequency response curves for BJT amplifiers 7. Design of oscillators. 8. Transistor curve tracer using PSPICE
ECE 328	Principles of Communication Systems	1. Modulation: AM, DSB-SC, SSB-SC; Frequency modulation (FM); 2. Demodulation: AM and FM 3. AM and FM transmitters and receivers 4. Noise performance in various modulation schemes 5. Fourier transform; signal transmission through a linear system; numerical computation of the Fourier transform using MATLAB

ECE 316	Digital Electronics I	1. Verification of the truth table of logic gates realize AND, OR, NOT gates; 2. Realize AND, OR gates using diodes and resistors; 3. verify the Boolean algebra function using digital IC gates (consensus theorem) only; 4. Rrealize the function F (A, B, C, D) =(C+D) (A+B) (B+D) using NOR gates only; 5. Design a half/full adder circuit using FF for 2 bits; 6. Design a half/full sub tractor circuit using FF for 2 bits; 7. Design a binary to gray code converter; design a function using K-map 8. Verify its performance using SOP and POS form; 9. Design BCD to seven-segment display using 7447 IC; implement F (A, B, C) =E (1, 3, 4, 5, 6) with a multiplexer; 10. Design a modulus N counter and a ring counter; 11. Design a shift register using flip-flops.
ECE 321	Control Systems I	1. Simulation of step response and impulse response with unity feedback using MATLAB; 2. Determination of root locus, Bode plot, and Nyquist plot using MATLAB; 3. Determination of PI, PD and PID controller action of first-order simulated process using Process Control training module mod. FLTP-U/EV 4. Frequency response design examples using MATLAB.
ECE 322	Electromagnetics II	1. Maxwell's equations: conservation of electric charge 2. Transmission line equations solutions using MATLAB 3. Per-unit-length parameters, Distributed model equivalent circuit, Propagation constant, Characteristic impedance, Lossless line, Distortion less line, 4. Transmission line circuit, Transmission line input impedance 5. Power flow on transmission lines, Transients on transmission lines, Correction for transmission loss using computer simulation. 6. Simulation of transmission lines using MATLAB 7. Impedance matching networks 8. Use MMTL (multilayer multiconductor transmission line) and Arbitrary Transmission line calculator to simulate transmission lines
ECE 323	Network Analysis and Synthesis	1. Time and Frequency Domain Analysis 2. Transient response of RL, RC and RLC Circuits to DC excitation 3. Network Functions: Concept of complex frequency, poles and zeros using MATLAB 4. Network functions for single-port and two-port, Restrictions on poles and zero locations for driving point & transfer functions. 5. Characterization of LTI two port networks, reciprocity and 6. Network synthesis techniques for 2-terminal network: Foster and Cauer forms; Transmission Zeroes, Synthesis of transfer functions: Properties of transfer functions. 7. Filter Design 8. Butterworth and Chebyshev approximation using MATLAB 9. Low pass filter design

ECE 324	Digital Electronics II	1. Design of basic logic gates 2. Verilog simulation and hardware implementation of combinational circuits such as MUX/DEMUX, encoder/decoder 3. Arithmetic logic unit (ALU); 4. Verilog simulation and hardware implementation of sequential circuits such as flip-flops, registers, shift registers, counters; implementation of logic circuits using SPLDs; project solving a real-life problem. 5. FPGA design of filters
ECE 325	Signals and Systems	1. Simulation of different types of using MATLAB 2. Simulation of singularity functions: Unit step function, unit impulse function, derivate of singularity function. 3. Harmonic analysis of periodic signals: 4. Plotting of power density spectra for various signal systems 5. Convolution theorems and deterministic 6. Continuous-time and discrete-time systems 7. Fourier transform of Linear systems, Time-invariant systems, Linear time–invariant systems, impulse response 8. Filter characteristics of linear systems 9. Random signals 10. Design of filter using windowing method
ECE 317	Power Systems II	1. Derivation of power systems parameter equations 2. Overhead lines standard parameters, generalised circuit constants and equivalent circuits 3. Switch-gear; Fuses, Circuit breakers, isolators, insulators, bushing, reactors; 4. Faults in Power systems: Symmetrical fault calculations on three phase systems. 5. Unsymmetrical fault calculations on three phase systems 6. Simulation of symmetrical and unsymmetrical faults in power systems 7. Harmonic analysis of power systems
ECE 320	Industrial Attachment I	1. Engineering technical skills 2. Engineering and management: responsibilities and daily routines of an engineer/technologist and administrative duties 3. Human relations: working with people to get things done 4. Computer applications: using the computer as an aid in planning, designing and analysis of engineering projects and work processes 5. Costing: awareness of cost effectiveness in engineering proposals/designs 6. Safety: awareness of importance of safety in the organization 7. Quality control: awareness of quality in all jobs done 8. Productivity: awareness of measures taken to improve the productivity at the workplace 9. Marketing: awareness of methods of product promotion.
Year Four		
ECE 411	Control Systems II	1. Design of lead/lag/lead-lag compensators using MATLAB both in frequency and time domain. 2. Frequency response of differentiators and integrators 3. Develop state space equations and matrices and determine controllability and observability of system in MATLAB 4. Simulation of compensators in MATLAB

ECE 412	Electronic Circuit Design	1. Integrated Circuit OPamps 2. Design of circuit systems: waveform generators, precision rectifier systems, automatic gain amplifiers, four quadrant multipliers. 3. Chopper-stabilized opamp 4. Design of bridge and thermocouple 5. Design of function generators and frequency modulators. 6. Audio pre- and power amplifier Integrated Circuits 7. Design of an op amp instrumentation, antilog and logarithmic amplifiers
ECE 413	Instrumentation	1. Design, construction, and analysis of measurement circuits 2. Data acquisition circuits, instrumentation devices, and automatic testing; 3. Measurement of electrical parameters using different lab instruments; 4. Analogue to digital and digital to analogue conversion 5. Calibration of measurement instruments; 6. Use of data acquisition systems for presentation and interpretation of data; 7. Use of microcomputers to acquire and process data; 8. Use of simulation and instrumentation languages (LabVIEW). 9.
ECE 414	Microprocessors	1. Data transfer schemes 2. Hardware Architecture of 8086 and 8051 3. 8086 and 8051 system configuration 4. 16-Bit Microprocessor Instruction Set and Assembly Language Programming: Programmer's model of 8086 and 8051 5. Addressing methods in 8086 and 8051 6. Programmable Peripheral Interface (PPI)-Intel 8255, Sample-and-Hold Circuit and Multiplexer 7. I/O Interfacing: Memory Interfacing in 8086 and 8051 8. Design of simple electronic projects controlled by a computer such as traffic lights
ECE 415	Power Electronics I	1. Characteristics of Power Diodes, power transistor (BJT), Power metal oxide semiconductor field effect transistor (MOSFET) 2. Insulated Gate Bipolar Transistor (IGTBT). Thyristor (SCR 3. DIAC, TRIAC, Gate-Turn-Off thyristor (GTO), MOS-Controlled thyristor (MCT). Unijunction Transistor (UJT). 4. Single-phase and three-phase diode bridge rectifiers with: R load, RL load, CR load 5. Single-phase and three-phase half and bridge thyristor converters with RL load.

ECE 416	Digital Communication Systems	1. Signal digitization: Pulse Amplitude Modulation (PAM), 2. Sampling theorems and sampling circuits 3. Pulse code modulation (PCM). 4. Differential Pulse Code Modulation (DPCM), M-ary encoding. 5. MATLAB Simulation of digital communication systems ➢ Amplitude shift keying (ASK) ➢ Frequency Shift Keying (FSK), ➢ Phase Shift Keying (PSK), ➢ Quadrature Amplitude Modulation (QAM) ➢ Differential Phase Shift Keying (DPSK). ➢ Signal recovery in ASK, FSK and PSK; ➢ Gaussian Minimum Shift Keying (GMSK) 6. Performance analysis of wireless communication systems based on bit error rates 7. Implementation of error control coding techniques or channel coding; 8. Simulation of interference patterns in wireless communication systems 9. Data transmission: Local data transmission protocols (Ethernet, token ring); 10. Modems; high Asymmetric Digital subscriber line (ADSL); Very–high Speed Digital subscriber line (VDSL), integrated services digital network (ISDN).
ECE 422	Data Communication and Computer Networks	1. Data Communications and Networking. Physical Layer 2. Analog Signals, Digital Signals 3. Digital Transmission: Line coding, Block coding, Sampling, Transmission mode. Analog Transmission: Modulation of Digital Data; 4. Telephone modems, modulation of Analog signals. 5. Routing Network Layer Protocols 6. Domain Name System (DNS) 7. Determination of IP addresses for computers, gateways and routers
ECE 417	Power Systems III	1. Derivation of power systems parameter equations 2. Faults in Power systems 3. Load forecasting and Load flow analysis
ECE 423	Microprocessor Systems Design	1. Design and write programs using 80x86 assembly language (instructions, directives, addressing modes); 2. Design and write programs using 80x86 interruptions; 3. Use the low-level development and debugging environment; 4. Use the BIOS interruptions; 5. Use the DOS interruptions;
ECE 424	Power Electronics II	1. Design of converters 2. Single-phase and three-phase uncontrolled rectifiers 3. Half-controlled and fully-controlled inverters; 4. Buck, and boost converters 5. Design of Choppers 6. Simulation of power electronics systems using GeckoCIRCUITS simulator
ECE 425	State Space Design and Digital Control	1. Design of compensators using MATLAB both in frequency and time domain. 2. Design of a digital system using z-transform in MATLAB
ECE 421	Power Systems IV	1. Mechanical design of transmission lines 2. The stability problem. 3. Synchronous machine characteristics using a synchroscope 4. Automatic voltage regulator in improving stability

ECE 512E	Special Electrical Machines	1. Machines with special applications. methods of speed control, dynamic characteristics and applications 2. Tachogenerators: Direct current Tachogenerators, A.C induction Tachogenerator; A.C.Synchronous 3. Universal commutator motor, servo motors 4. Programming and uses stepper motor
ECE 516E	Antenna and Radio Wave Propagation	1. Types on antennas and application 2. Design and simulation of antennas using FEKO or HFSS or EMCOS Antenna Vlab or Antenna Scatterers Analysis Program (ASAP) or Finite Differences Time Domain (FDTD) Antenna Simulator 3. Use ANS-OF to simulate patch or microstrip antennas and wire antennas 4. Radiation patterns for different types of antennas 5. Smart Antennas design 6. Design of log periodic antennas for a given frequency of operation 7. Use ASAP simulation software to automatically optimize wire antennas
ECE 515E	Optoelectronics & Photonics	1. Photo-detectors, LEDs, photo diodes and photo transistors, opto isolators 2. Design simple optoelectronic systems such as fiber optic and free space communication channels, interferometers, simple imaging systems; 3. Measure several parameters of optoelectronic systems such as attenuation, bit error rate, frequency dispersion, and relate these to the system designs 4. Design an optic fiber link for any mobile/data communication system.
ECE 514E	Radar and Satellite Engineering	1. Operation of radar and navigation systems; 2. Measure and identify the parameters which determine the performance of radar systems; 3. Satellite navigation using Doppler's effect 4. Determination of range using radar principle Investigate function of satellite subsystems; 5. Apply orbital mechanics formula and tools to spacecraft mission design; 6. Select appropriate launch systems and understand their effect on satellite and payload design and performance; 7. Design and analyse satellite links; 8. Evaluate satellite subsystem performance. 9. Simulation of satellite systems
ECE 420	Industrial Attachment II	1. Apply theoretical knowledge in industrial application; 2. Acquire skills in communication, management and team-work; 3. Practice ethical and professional work culture; 4. Implement Health Safety Environment (HSE) practices at workplace
Year Five		

ECE 511	Engineering Product Design	1. Design printed circuit boards; 2. Demonstrate individual skill using selected manufacturing techniques, including drilling, pressing, tapping, and rapid prototyping; 3. Employ engineering, scientific, and mathematical principles to execute a design from concept to finished product; 4. Fabricate an electromechanical assembly from engineering drawings; 5. Work collaboratively on a team to successfully complete a design project; 6. Documentation for an engineering designed product 7. Product packaging
ECE 510	Engineering Project II	1. Demonstrate practical skills in the design of engineering components, assemblies and/or systems; 2. Demonstrate knowledge of creativity, innovation, safety, ergonomics and good engineering practice in the design process; 3. Design project plan making best use of information technology 4. Produce and present technical designs accompanied with detailed analysis, calculations, manual and/or computer-generated engineering drawings or source codes and any other relevant information.
ECE 512	Software Engineering	1. Design, implement, and evaluate software-based systems, components, 2. Modelling and designing of software systems and in the analysis of tradeoffs inherent in design decisions; 3. Author a software requirements document, formal specifications and software testing plans 4. Demonstrate knowledge of the distinction between critical and non-critical software systems; 5. Demonstrate the ability to manage a project including planning, scheduling and risk assessment/management.
ECE 513	Non-Linear and Multivariable Control	1. Analyze stability of non – linear system in MATLAB. 2. Design multivariable system and analyze their stability in MATLAB
ECE 513E	Electrical Machine Drives and Industrial Applications	1. Characteristics of loads and operating requirements to be satisfied by the drive; 2. Electrical machines: d.c. machine: transfer function, operation fed by SCR rectifier 3. Power converters: Static power converters: principle of operation and external characteristics 4. Basic operation and PWM control of voltage and frequency (triangular carrier PWM) 5. Current-Source Inverter Drive with regeneration. 6. A.C. current control: Control of the currents of a three-phase system (i.e. motor) in different reference systems (abc, αβ, dq); 7. PI regulators; Hysteresis regulators; predictive control; compensation of dq coupling terms. Space Vector PWM: 8. Inverter configurations
ECE 521E	Electrical Machine Design	1. Design armature and field systems for d.c. machines; 2. Design core, yoke, windings and cooling systems of transformers; 3. Design stator and rotor of induction machines; 4. Design stator and rotor of synchronous machines and study their thermal behaviour.

ECE 522E	High Voltage Technology	1. Determine the flashover voltage of a pin type insulator; 2. Determine the flashover voltage of suspension type insulator and to observe the corona effects; 3. Compare the wet and dry flashover voltages for a typical outdoor insulator; 4. Investigate the voltage distribution over a suspension insulator string without guard ring; 5. Investigate the voltage distribution over a suspension insulator string with guard ring.
ECE 524E	Microwave Engineering	1. Strip line and Slot line practical demonstration. 2. Waveguides and microwave detectors. 3. Smith chart computation. 4. Impedance matching networks 5. Design of an antenna for a particular application 6. Installation of microwave antennas 7. CST Microwave Studio for EMC/EMI and cable bundle analysis
ECE 511E	Power Systems Analysis	1. Investigate a wide-variety of per-unit conversion; 2. Determine symmetrical and unsymmetrical fault current; 3. Apply the equal area criterion to calculate the critical clearing time of a faulted network; 4. Investigate the dynamic principle of power systems and generators. 5. Solve the economic dispatch problem for a lossless power system with generator minimum/maximum MW constraints; 6. Determination of system losses, including the penalty factor values; 7. Analyse current issues associated with restructuring in the electricity industry.
ECE 525	Electroacoutics	1. Investigate loudspeaker and microphone performance in terms of frequency response, directivity and distortion; 2. Investigate the principles of pressure and pressure gradient microphones; 3. Calibrate microphones with standard calibration methods; 4. Recognise and select appropriate techniques for the analysis of electroacoustic problems; 5. Develop specifications for electroacoustic transducers; 6. Materials used in studio design 7. Design of a Radio/TV studio
ECE 525E	Wireless and Mobile Communication	1. Investigate the components of mobile and wireless communication; 2. Principles of optimization and planning of cellular networks 3. Design of network systems based on 1G, 2G, 3G, 4G technologies; 4. Design of simple mobile and wireless systems.
ECE 521	Digital Signal Processing	1. Design, implementation and testing of digital filters; 2. Analysis of linear and adaptive filter equalizers and spectrum estimation; 3. Apply mathematical tools and computation methods for signal processing; 4. Design of audio and video systems incorporating digital signal processing algorithms.

ECE 523	Industrial Electronics	1. Single-phase full-wave bridge rectifier and linear regulator; 2. Traffic Light Control System for an Intersection using S7-300 PLC; 3. Power control in AC circuits using an AC chopper: Lamp Dimmer; 4. Switched-mode DC-DC conversion using buck converter; 5. Controlling a squirrel-cage induction motor with Simatic S7-300 PLC; 6. Closed-loop temperature control of an electrical heater.
ECE 523E	Power Systems Protection	1. Investigate the fundamentals components of electrical power protection and applications; 2. Recognize the different fault types; 3. Perform simple fault and design calculations; 4. Design power protection system; 5. Choice of appropriate protective devices for different equipment; 6. Interpret the protection systems existing in your plant
ECE 526E	Telecommunication Switching and Networks	1. Poisson source properties and their characterization; 2. Simulation study on queueing properties; 3. Design of an N-trunk telephone switch.