Semester by Semester Structure/Schedule of Courses

YEAR ONE, SEMESTER ONE

- T - Teaching Hours
- P - Hours for Practicals, Tutorial and Laboratory Work (two practical hours is equal to one credit)
- C - Credit Hours

COURSE CODE	COURSE TITLE	T	P	C
ATU 103	Communication Skills I	1	2	2
BEE 101	Applied Electricity	1	2	2
BEE 103	Information Communication Technology	1	2	2
BEE 105	Mathematics for Engineers I (Algebra)	2	2	3
BEE 107	Thermodynamics	1	2	2
BEE 109	General Physics	1	2	2
BEE 111	Engineering Drawing	1	2	2
BEE 113	Engineering Ethics	1	2	2
ATU 107	Africa and World Development	1	2	2
BEE 115	Electrical Engineering Lab I	1	2	2
Totals		**16**	**20**	**21**
Cumulative Credit Hours		**21**		

YEAR ONE, SEMESTER TWO

COURSE CODE	COURSE TITLE	T	P	C
ATU 104	Communication Skills II	1	2	2
BEE 102	Measurements and Instrumentation	2	2	3
BEE 104	Engineering Computational Tools	2	2	3

BEE 106	Mathematics for Engineers II (Calculus I)	2	2	3
BEE 108	Basic Mechanics	1	2	2
BEE 110	Circuit Theory I	2	2	3
BEE 112	Basic Electronics	2	2	3
BEE 212	Analogue Electronics	2	2	3
Totals		**13**	**16**	**21**
Cumulative Credit Hours		**42**		

YEAR TWO, SEMESTER ONE

COURSE CODE	**COURSE TITLE**	**T**	**P**	**C**
BEE 201	Mathematics for Engineers III (Ordinary Differential Equations and Applications)	2	2	3
BEE 203	Electrical Engineering Lab III	1	4	3
BEE 205	Circuit Theory II	2	2	3
BEE 214	Digital Electronics	2	2	3
BEE 209	Electromagnetic Wave Theory	2	2	3
BEE 213	Electrical Machines	2	2	3
Totals		**13**	**16**	**18**
Cumulative Credit Hours		**63**		

YEAR TWO, SEMESTER TWO

COURSE CODE	**COURSE TITLE**	**T**	**P**	**C**
BEE 202	Control Engineering I	2	2	3
BEE 204	Mathematics for Engineers IV (Partial Differential Equations and Applications)	2	2	3
BEE 207	Computer Aided Electrical Design	2	2	3

BEE 208	Introduction to Computer Programming (C++)	1	2	2
BEE 210	Analogue and Digital Communication	1	2	2
BEE 212	Microprocessors and Microcontrollers	2	2	3
BEE 216	Electrical Engineering Lab. IV	1	2	2
Totals		**11**	**14**	**18**
Cumulative Credit Hours		**81**		

YEAR THREE, SEMESTER ONE

COURSE CODE	**COURSE TITLE**	**T**	**P**	**C**
	Signals and Systems	2	2	3
	CPLD/FPGA Design	2	2	3
	Digital Signal Processing	2	2	3
	High frequency electronic circuit	2	2	3
	Basics of Information Theory	2	2	3
	Principle and application of artificial intelligence	2	2	3
	Fundamentals of microwave technology	2	2	3
Totals		**14**	**14**	**21**
Cumulative Credit Hours		**102**		

YEAR THREE, SEMESTER TWO

COURSE CODE	**COURSE TITLE**	**T**	**P**	**C**
	Principle and application of sensor	2	2	3
	Principles of Radar	2	2	3

	Virtual instrument technology and Application	2	2	3
	Digital image processing	2	2	3
	Python programming and engineering practice	2	2	3
	Electromagnetic compatibility technology	2	2	3
	Comprehensive Design of CPLD/FPGA	1	4	3
Totals		**13**	**16**	**21**
Cumulative Credit Hours		**123**		

YEAR FOUR, SEMESTER ONE

COURSE CODE	**COURSE TITLE**	**T**	**P**	**C**
	Embedded System and Application	2	2	3
	Introduction to information security technology	2	2	3
	signal detection and estimation	2	2	3
	Internet of things technology and Application	2	2	3
	Principle and application of antenna	2	2	3
	Comprehensive Practice of Electronic Circuit Design	1	4	3
	Comprehensive practice of signal processing	1	4	3
Totals		**12**	**18**	**21**
Cumulative Credit Hours		**144**		

YEAR FOUR, SEMESTER TWO

COURSE CODE	**COURSE TITLE**	**T**	**P**	**C**

	Graduation Practice	0	8	4
	Graduation Design（Dissertation）	0	24	12
Totals		**0**	**32**	**16**
Cumulative Credit Hours		**160**		

1. **COURSE DESCRIPTION:**

YEAR ONE, SEMESTER ONE

ATU 103 COMMUNICATION SKILLS I (1,2,2)

Course Description

Communication is defined as the ability to convey or share ideas and feelings effectively. Several experts agree that communication skills include: Conveying messages without misinterpretation or misleading others. Effectively communicating with a range of people from all walks of life is essential for the success of the student. The student shall learn skills to improve the reading, listening, speaking and writing.

Objectives

- students will be able to develop functional skills in the use of English language.
- enhance student's communicative ability in English.
- equip students with skills in reading and writing, assist students pay attention to grammar accuracy and conventions of usage.

Contents

- **Concept and Process of Communication**: Process of communication; method of communication; medium of communication; levels of communication; body language in communication.
- **Barriers to Effective Communication**: Characteristics of effective communication; types of barriers to effective communication; miscommunication; noise; measures to overcome barriers of effective communication.
- **Listening Skills**: Listening as an active skill; types of listeners – listening for general content, listening to fill up information, listening for specific information; development of effective listening skills; barriers to effective listening skills.
- **Reading Skills**: Skimming and scanning as previewing techniques; technique of understanding the gist of an argument; coherence and sequencing of sentences.

Learning Outcomes

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

1. describe the process of communication and all methods of communication.
2. explain the barriers to effective communication.
3. develop good listening skills.
4. develop good writing skills.
5. write essay and summary correctly.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Reading Materials

1) Kumar, S., & Lata, P. (2011). Communication skills. Oxford University Press.
2) McKay, M., Davis, M., & Fanning, P. (2009). Messages: The communication skills book. New Harbinger Publications.
3) Sen, L. (2007). Communication skills. PHI Learning Pvt. Ltd.
4) Barker, A. (2006). Improve your communication skills (Vol. 118). Kogan Page Publisher.
5) Hargie, O. (2006). The Handbook of communication Skills, 3rd Edition. Routledge.
6) Hargie, O., Dickson, D., Tourish, D. (2004). Communication skills for Effective Management.
7) Worth, R. (2004). Communication Skills, 2nd Edition. Ferguson.

BEE 101 APPLIED ELECTRICITY (1,2,2)

Course Description

Applied Electricity provides students with broad understanding of electricity; charge, voltage, current, power and energy. The student shall apply the fundamental concepts to electricity supply by considering AC and DC voltages and currents. These concepts will be applied to calculate electricity billing.

Objectives

- This course enables students to acquire knowledge in the foundations of electricity concepts.

- Understand the basic laws and safety of electricity.

Contents

- **Foundations of electricity:** charge, voltage, current, power and energy, computation of power and energy for electrical gadgets and household, simple billing calculations.
- **Electricity supply:** definition and characteristics of AC and DC voltages and currents and their applications, calculation of Instantaneous, RMS and Average voltage and current values and their relevance.
- **Transformer:** definition and components of a transformer, principle of operation, ideal transformer and characteristics, transformer types and ratings used by utilities in Ghana.
- **AC circuit systems:** definition of 1-phase 2-phase and 3-phase circuit systems, voltage and current relationship between the circuit systems, sample voltage drop and line loss calculation for electricity supply from source to destination.
- **Electricity supply:** electricity utilities and functional roles, electricity generation sources, hydro power generation process, transmission process, distribution process to users in Ghana.
- **Power factor**: definition and relevance, active power, reactive power, and apparent power, calculation of power factor and correction.
- **Electric Motors:** components of an electric motor, basic principle of operation, motor types and applications.
- **Electrical Safety:** importance of electrical safety, shock current, common sources of hazards, safe practices.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given, take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1. explain the foundation principles of electricity.

2. explain AC and DC voltages and current.
3. describe the operation of transformers.
4. explain 1 phase, 2 phase and 3 phase power supply.
5. explain power factor

Reading Material

1) Williams, D. (2017). Electricity and magnetism. Anesthesia and Intensive Care Medicine.
2) Kranzl, L., Totschnig, G., Müller A., Bachner, G. and Bednar-Friedl, B. (2015). Electricity. Springer Climate.
3) Hudson, R. B. (2013). Electricity generation. Geothermal Energy: Utilization and Technology.
4) Hindmarsh, J. (2013). Worked Examples in Electrical Machines and Drives: Applied Electricity and Electronics. Elsevier.
5) Gussow, M. (2007). *Basic electricity*. McGraw-Hill.

BEE 103 INFORMATION COMMUNICATION TECHNOLOGY (2,2,3)

Course Description

Information and Communication Technologies (ICTs) is a broader term for Information Technology (IT), which refers to all computer-based document processing including word processing, spreadsheet application and presentation application.

Objectives

- Students will apply computer hardware and software, word processing, spreadsheet and presentation applications.
- Students will demonstrate knowledge in the internet of things.

Contents

- **Computer Hardware and Software:** Introduction to computer system and parts. hardware and software.
- **Word Processing Application**: Editing, Formatting of Text, Insertion of Tables and Symbols, Creating Business Documents. Merging of Data, and Printing of Word

Processing **Document. Spreadsheet Application:** Introduction to Spreadsheet Applications, application of Formula and functions, formatting, editing and printing of worksheets.

- **Presentation Application:** Introduction to Presentation Application, Creation, Editing and Formatting of Presentations, Managing Slides, working with Objects, Images and Pictures in a Presentation, running a Slide Show and Developing Presentation on a Topic
- **Internet of Things**: Introduction to the world wide web, the internet as means of communication and as a search engine.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. The use of the computer lab facilities is necessary for hands on practice. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

Upon completion of this course, students will able to

1. develop applications related to spreadsheet
2. develop applications related to databases
3. explain how a computer programme works
4. describe how to search information on the internet

Reading Materials

1. Arshdeep B., Vijay M. (2015). Internet of Things: A Hand-on Approach Universities. Press (India).
2. Arzen, K.E. (2014). Computer Software Structure. Elsevier, 1483297616, 9781483297613.
3. Alan C. (2006). Principles of Computer Hardware. OUP Oxford.
4. Iris B. (2003). Performing with Word Processing Applications. Course Technology.
5. Syed, M. R. (2001). Multimedia Networking: Technology: Management and Applications: Technology, Management and Applications. Idea Group Inc (IGI).

BEE 105 MATHEMATICS FOR ENGINEERS I (ALGEBRA) (2,2,3)

Course Description

In this course students shall learn about complex numbers and algebra. The course serves as foundation course which shall be important for developing the requisite mathematical discipline needed by the electrical engineer.

Objectives

- equip students with basic mathematical tools that will prepare them to understand advanced Engineering courses.
- Students will be introduced to complex numbers, linear, quadratic, radical, exponential, logarithmic, polynomial and rational equations and inequalities.
- Students will also be introduced to vector algebra and vector matrix.

Contents

- **Complex Numbers**: Cartesian complex numbers, Argand diagram, addition and subtract, multiplication and division, complex equation, polar form, De Moivre's theorem.
- **Vector Algebra**: vector space, linear independence, geometric vectors and Cartesian basis, scalar product, triple product, solve problems using vector algebra.
- **Matrix algebra**: matrix operations and properties, determinant, inverse matrix, solution of simultaneous equations by matrices, Cramer's rule, Gaussian elimination.

Mode of Delivery

1. The course consists of classroom instruction including lectures using classical lecture style, power point slides.
2. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1. explain complex numbers.
2. solve mathematical problems involving complex numbers.

3. apply algebra of matrices.
4. Solve problems using matrices.
5. apply the concepts of vectors and scalars to mathematical problems.

Reading Materials

1. Beezer, R. A. (2012). A First Course in Linear Algebra. Congruent Press.
2. David, C.L. (2012). Linear Algebra and Its Applications 4th edition. Pearson.
3. Attenborough M. (2003). Mathematics for Electrical Engineering and Computing. Newnes Publications. UK.
4. Stroud K. A. and Booth D. J. (2003). Advanced Engineering Mathematics, 4th Edition. Palgrave Macmillan, UK.
5. Blyth, T. S. and Robertson, E. F. (2002). Basic Linear Algebra. Springer Undergraduate Mathematics Series.

BEE 107 THERMODYNAMICS (1,2,2)

Course Description

Thermodynamics is the study of the relations between heat, work, temperature and energy. The laws of thermodynamics describe how the energy in a system change and whether the system can perform useful work on its surroundings. From thermodynamics, the student will understand the behaviour of related phenomenon of electric devices as air conditioners ad fans.

Objective

- demonstrate knowledge in the basic concept and definitions of thermodynamics.
- apply the knowledge to refrigeration cycle and systems.

Content

- **Concept and Definitions**: Explain the energy conversion efficiencies system, Explain the energy conversion and efficiencies property, Explain the energy conversion and efficiencies state, Definition of thermal equilibrium, State the Zero law of thermodynamics.
- **First Law of Thermodynamics:** State the first law of thermodynamics, Explain the concept of adiabatic process, Explain the conversion of energy principles for open systems,

Calculate the work for different process of expansion of gases, Demonstrate the cooling of electronics device.

- **Second law of thermodynamics**: Equilibrium with respect of the second law, heat engines, definition of Kelvin Plank statement, reversible and irreversible process, Carnot principles.
- **Refrigeration Cycle and Systems**: Coefficient of performance, vapour compression cycle, refrigeration cycle, absorption in refrigeration system, process of liquefaction and solidification of gas.
- **Cooling Devices**: Importance of cooling devices, Design cooling device for specific applications, assemble cooling device on specific applications, Test the effectiveness of cooling device, Test the effectiveness of cooling device.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcome

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

1) explain the elements of thermodynamics as simple as possible.
2) distinguish principles from application.
3) explain the operating principle of internal combustion engines.
4) explain cooling of electrical devices

Reading Material

1. Singh, O. (2003). Applied thermodynamics. New Age International.
2. Novikov, I. I., & Voskresenskiĭ, K. D. (1963). Applied Thermodynamics and Heat Transfer. Foreign Technology Division, Air Force Systems Command.
3. Li, K. (2018). Applied thermodynamics: availability method and energy conversion. Routledge.

4. Lucas, K. (2013). Applied statistical thermodynamics. Springer Science & Business Media.
5. Tassios, D. P. (2013). Applied chemical engineering thermodynamics. Springer.

BEE 109 GENERAL PHYSICS (1,2,2)

Course Description

The course is structured to enable students gain insight into the basic principles of physics and their possible application. It also explains physics principles and tools to students as a foundation for innovative engineering approaches to solving real life problems.

Objectives

- Equip students with a thorough understanding of the basic concepts of physics and the methods scientists use to explore natural phenomena.
- apply mathematical analysis to physics.
- explain the fundamental laws of physics and the application of scientific data, concepts, and models for use in the natural sciences and real-world situations.

Contents

- **MECHANICS**

  Multiparticle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.

- **ELECTROMAGNETIC WAVES**

  The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves -

Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

- **OSCILLATIONS, OPTICS AND LASERS**

  Simple harmonic motion - resonance –analoguey between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference – Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry**.**

- **BASIC QUANTUM MECHANICS**

  Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes-Normalization, probabilities and the correspondence principle.

- **APPLIED QUANTUM MECHANICS**

  The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1. explain the basic physical laws, principles and formalism
2. apply basic physical laws, principles and formalism
3. apply basic error analysis and some phenomenological experiments.
4. explain the basic physical laws, principles and formalisms learnt.

Reading Materials

1) Awrejcewicz, J. (2012). Classical mechanics: kinematics and statics. Springer Science & Business Media.
2) Craster, R. V., & Guenneau, S. (Eds.). (2012). Acoustic metamaterials: Negative refraction, imaging, lensing and cloaking. Springer. Science & Business Media.
3) Sadiku, M. N. (2014). Elements of electromagnetics. Oxford university press.
4) Li, C. (2016). Nonlinear optics: principles and applications. Springer. Thouless, D. J. (2014). The quantum mechanics of many-body systems. Courier Corporation.
5) Callister, W. D., & Rethwisch, D. G. (2011). Materials science and engineering. NY: John wiley & sons.

BEE 111 ENGINEERING DRAWING (1,2,2,)

Course Description

Course Description The course focuses on enabling students to understand, draw and read drawing as an engineer's language and to provide information on various aspects of engineering as well as abstracting concepts.

Objectives

- The students shall learn the knowledge in basic engineering drawing which includes drawing standards, geometrical construction, axonometric projection, orthographic projection.

Content

- **Drawing Standards**: Paper sizes, manipulation of scales, lettering, title blocks and part list.
- **Geometrical Construction**: Polygon, Tangency, Blending of lines and curves, application of blending of lines and curves, truncation of solid prisms and development.
- **Axonometric Projection**: Dimetric projection and Isometric projection.
- **Orthographic Projection**: First and third angle projections, sections, auxiliary projections, functional dimension, non-functional dimension and auxiliary dimension, assembly and detail drawings, CAD.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1. Design simple electrical circuits and understand through nodal, mesh analysis about constructing series and parallel configuration of circuits with sources and variable loads.
2. Get knowledge on electrical machines and its efficient operating principle.
3. Understand metering principles, safety measures while working with electrical circuits.
4. Analyse existing power distribution and hence apply technology in electrical applications.

Reading Materials

1. Dhawan ER. R. K. (2011), Fundamentals of Engineering Drawing, S. Chand Publishing.
2. Morling K. (2010), Geometric and Engineering Drawing, 3rd Edition, Elsevier Insights.
3. Simons C., Maguire D., Phelps N. (2009), Manual of Engineering Drawing; Technical Product Specification and Documentation to British and International Standards, Butterworth-Heinemann, UK.
4. Venkata R. K. (2008), Textbook of Engineering Drawing, 2nd Edition, BS Publications.
5. Simons C. and Maguire D. (2004), Manual of Engineering Drawing, 2nd Edition, Newnes.

BEE 113 ENGINEERING ETHICS (1,2,2)

Course Description

Engineering is a professional career that impact lives. Engineering Ethics is the set of rules and guidelines that engineers adhere to as a moral obligation to their profession and to the world.

Objective

- The student will demonstrate knowledge in understanding; Morality and Philosophy of Ethics, relationships in the work place, risk and safety, global ethics.

Contents

- **Introduction**: Definition of ethics in general, Compare ethics in general and engineering ethics, Description of ethics at a personal level, importance of ethics in science and engineering, the role of codes of ethics.
- **Morality and Philosophy of Ethics**: Moral dilemmas of ethics, hierarchy of moral values, factors affecting moral responsibility, difference between internal and external morality, descriptive and prescriptive claims of philosophical theory, Utilitarian theory and Kantian theory.
- **Relationships in the work place:** personal and social responsibilities, rights and responsibilities in workplace relationships, importance of intention, role of engineers in organizations, whistle blowing in the workplace, effects of deception, withholding truth and spreading truth.
- **Risk and Safety:** Reliability, risk and safety, risk management. ethics of risk and safety.
- **Global ethics**: Internet ethics, responsible conduct of research, intellectual property and privacy issues, environmental ethics, globalization and cultural ethics.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

On completion of the course the student is expected to:

1) explain the nature of professional responsibility and be able to identify the ethical elements in decisions.
2) resolve problems arising from questionable practice.
3) develop critical thinking skills and professional judgement and understand practical difficulties of bringing about change.
4) develop a professional ethical identity to carry forward in their working life.

Reading Materials

1. Whitbeck, C. (2011). Ethics in Engineering – Practice and Research: 2nd edition. Cambridge: Cambridge University Press.
2. Harris Jr., C.E., Pritchard, M.S., Rabins, M.J. (2009). Engineering Ethics, Concepts, and Cases: 4th edition. California: Wadsworth Learning.
3. Martin, M.W. and Schinzinger R. (2005). Ethics in Engineering, 4th Edition. McGraw Hill, Inc.
4. Seebauer, E.G. and Barry, R.L. (2001). Fundamental of Ethics for Scientists and Engineers. New York: Oxford University Press.
5. Vesilind, P. A., & Gunn, A. S. (1998). *Engineering, ethics, and the environment*. Cambridge University Press.

ATU 107: AFRICA AND WORLD DEVELOPMENT (2, 2, 3)

Course Description

The field includes the study of Africa's history (pre-colonial, colonial, post-colonial), demography (ethnic groups), culture, politics, economy, languages, and religion (Islam, Christianity, traditional religions). By the year 2050, at least 25% of the world's population will be in Africa. Now more than ever is the time to incorporate long-ignored African knowledge into our worldview. Studying African history and politics gives us a deeper understanding of world history and especially of current events.

Objective

- Students shall gain broad knowledge of Africa traditions, culture, history socio-economic development and religions.

Contents

- **AFRICA:** Etymology; historical and socio-economic background; social economic history; social structure of Africa; early African civilization and trade politics and government; the African time concept; economic activities of pre-colonial Africa (Agric, hunting, salt, gold, craft industries).
- **Traditional African Family Structure:** Traditional family structure; effects of modernization and urbanization on the family structure.
- **African Traditional Religion**: an ancestor in African Traditional Religion; Crime and African Traditional Religion; the meaning of Peace in African Traditional Religion and Culture.
- **Indigenous African Knowledge Systems**: Medicine, Mathematics, Food Processing, Metallurgy, Building Technology.
- **COLONIAL AFRICA - Global Encroachment into Africa:** The Atlantic Slave Trade, the end of the Atlantic Slave Trade and its impact on Africa, Colonial Exploration and conquest in Africa, types of colonial rule; the practice and legacy of colonialism; the African Resistance to the establishment of Colonia Rule.
- **POST-COLONIAL AFRICA-Africa**: African and Modern technology; conflicts in Africa; the causes of conflicts; impact of conflicts on African; new colonialism; Democracy and Africa's second liberation**.**
- **SOCIAL TOPICS:** Sexual abuse and violence in Africa; female genital mutilation (FGM); culture (definition, characteristics and components, basis of difference in cultures).

Mode of Delivery

Lectures, tutorials, hands-on practical demonstrations, laboratory experiments, exercises, assignments and group project work.

Learning Outcomes

At the end of the course, students should demonstrate knowledge in:

- Africa Ethnology
- History
- Socio-Economic Background
- Traditional African Family Structure
- Africa Religions

Reading Material

1. Kingsley, M. (2013). *West african studies*. Routledge.
2. Curtin, P. D., Feierman, S., Thompson, L., & Vansina, J. (1964). *African history* (No. 56). New York: Macmillan.
3. Young, C. (2002). *Ethnicity and politics in Africa*. Boston University, African Studies Center.
4. Gulliver, P. H. (2013). *Tradition and transition in East Africa: Studies of the tribal factor in the modern era*. Routledge.
5. Falola, T. (2022). *Decolonizing African studies: knowledge production, agency, and voice* (Vol. 93). Boydell & Brewer.

BEE 115: ELECTRICAL ENGINEERING LAB I (1,2,2)

Course Description

Electrical Engineering Lab. I introduce the student basic laboratory practices which translates the principles of Physics into practical engineering experimental phenomenon. The course as the first engineering laboratory course is important to be acquainted with laboratory equipment, how to collect data from observatory laboratory experiment and vitally to learn the problem-solving skills from theoretical concepts.

Objectives:

- To learn the proper use of various kinds of engineering laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to engineering principles and interpretation of experimental data.

- To determine error in experimental measurements and techniques used to minimize such error.

Content

- Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
- Simple harmonic oscillations of cantilever.
- Non-uniform bending - Determination of Young's modulus
- Uniform bending – Determination of Young's modulus
- Laser- Determination of the wave length of the laser using grating
- Air wedge - Determination of thickness of a thin sheet/wire
- Optical fibre -Determination of Numerical Aperture and acceptance angle b) Compact disc- Determination of width of the groove using laser.
- Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
- Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
- Post office box -Determination of Band gap of a semiconductor.
- Photoelectric effect
- Michelson Interferometer.
- Melde's string experiment
- Experiment with lattice dynamics kit.

Learning Outcomes:

Upon completion of the course, the students should be able to:

1. describe the functioning of various physics laboratory equipment.
2. use graphical models to analyze laboratory data.
3. use mathematical models as a medium for quantitative reasoning and describing physical reality.
4. access, process and analyze scientific information.
5. solve problems individually and collaboratively.

Reading Materials

1) Awrejcewicz, J. (2012). Classical mechanics: kinematics and statics. Springer Science & Business Media.
2) Craster, R. V., & Guenneau, S. (Eds.). (2012). Acoustic metamaterials: Negative refraction, imaging, lensing and cloaking. Springer. Science & Business Media.
3) Sadiku, M. N. (2014). Elements of electromagnetics. Oxford university press.
4) Li, C. (2016). Nonlinear optics: principles and applications. Springer. Thouless, D. J. (2014). The quantum mechanics of many-body systems. Courier Corporation.

YEAR ONE, SEMESTER TWO

ATU 104 COMMUNICATION SKILLS II (2,1,2)

Course Description

This course aim at consolidating students' understanding of communication and presentation Skills. It is a follow up to Communication Skills I. It will equip students with the language skills that will enable them to read, write, and speak effectively. Students will be taken through fundamental issues in grammar and composition to strengthen their language skills in these areas. The course also focuses on effective communication and presentation skills at individual, group and organizational levels.

Objectives

- To learn advanced communication skills.
- To gain improved techniques in writing, speaking, presentation and listening of the English language**.**

Contents

- **Writing**: Use of appropriate diction, coherence and cohesion in sentence formation, technical and literary writing, types of letters, CV and Resumes, technical report writing.
- **Speaking**: Use of phonetics, voice modulation, falling and rising tones, fluency and pace of delivery, influence of mother tongue on pronunciation.
- **Presentation**: Art of oral presentation, etiquettes of public speaking.
- **World of works**: Importance of developing employable skills, interview via phone, group interview, face-to-face interview, mannerism and etiquettes during interview.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides**.** Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1. Organize their ideas coherently and clearly in paragraphs.
2. Summarize a given passage by extracting the relevant information.
3. Revise information for content, language, and purpose for diverse audiences.
4. Plan appropriate speech for targeted audience.
5. Support ideas with information to compose written, spoken and visual messages

Reading Materials

1) Hargie, O. (2006). The Handbook of communication Skills, 3rd Edition. Routledge.
2) Hargie, O., Dickson, D., Tourish, D. (2004). Communication skills for Effective Management.
3) Worth, R. (2004). Communication Skills, 2nd Edition. Ferguson.
4) Sen, L. (2007). *Communication skills*. PHI Learning Pvt. Ltd.
5) Kumar, S., & Lata, P. (2011). *Communication skills*. Oxford University Press.
6) McKay, M., Davis, M., & Fanning, P. (2009). *Messages: The communication skills book*. New Harbinger Publications.
7) Barker, A. (2006). *Improve your communication skills* (Vol. 118). Kogan Page Publisher.

BEE 102 MEASUREMENTS AND INSTRUMENTATION (2, 2, 3)

Course Description

Instrument is a device for determining the value or magnitude of a quantity or variable. Electronic instrument is based on electrical or electronic principles for its measurement functions. Instrumentation is the variety of measuring instruments to monitor and control a process. The student shall be acquainted with AC and DC instruments for measurement.

Objectives

To impart knowledge on the following topics:

- Basic functional elements of instrumentation
- Fundamentals of electrical and electronic instruments
- Comparison between various measurement techniques

- Various storage and display devices
- Various transducers and the data acquisition systems

Contents

- **INTRODUCTION** Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration Principle and types of analogue and digital voltmeters, ammeters.
- **ELECTRICAL AND ELECTRONIC INSTRUMENTS 9** Principle and types of multi meters – Single and three phase watt meters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.
- **COMPARATIVE METHODS OF MEASUREMENTS** D.C potentiometers, D.C (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic Interference – Grounding techniques.
- **STORAGE AND DISPLAY DEVICES** Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.
- **TRANSDUCERS AND DATA ACQUISITION SYSTEMS** Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors-Thermal Imagers.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning outcomes

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

1) acquire knowledge on basic functional elements of instrumentation
2) explain fundamentals of electrical and electronic instruments
3) compare the various measurement techniques
4) acquire knowledge in Various storage and display devices
5) explain the concepts various transducers and the data acquisition systems
6) analyse electrical and electronic Instruments
7) explain the operational features of display Devices and Data Acquisition System.

Reading Material

1. Northrop, R. B. (2018). *Introduction to instrumentation and measurements*. CRC press.
2. Webster, J. G., & Eren, H. (Eds.). (2018). *Measurement, Instrumentation, and Sensors Handbook: Two-Volume Set*. CRC press.
3. Morris, A. S., & Langari, R. (2011). *Measurement and instrumentation: theory and application*. Academic Press.
4. Boyes, W. (Ed.). (2009). *Instrumentation reference book*. Butterworth-Heinemann.
5. Klaassen, K. B. (1996). *Electronic measurement and instrumentation*. Cambridge University Press.

BEE 104 ENGINEERING COMPUTATIONAL TOOLS (2,2,3)

Course Description

Computational engineering in this context refers to the study and development of computer algorithms that translate mathematical and physical descriptions of engineering problems into languages and software that computers can process. The student shall use MATLAB to apply and analyse various engineering concepts.

Objectives

- To gain understanding of computing systems.
- Learn the use of spreadsheet, basic and advanced MATLAB programming.

Content

- **Introduction**: Role of computer hardware components and Organization, computer software (operating system, types of computer languages, and concept for executing a computer program), Engineering problem solving methodology (algorithm and flowchart), Disassemble and re-assemble a computer, Installation of computer software on a new machine.
- **Spreadsheet**: Characteristics of spreadsheet (arithmetic operations, common engineering functions and operations, logical operations, plotting capabilities), Installation of spreadsheet applications on a computer, Solving simple engineering model application with spreadsheet.
- **MATLAB**: MATLAB programming environment (versions of MATLAB, user interface, characteristics of MATLAB programming (normal programming based and models under Simulink)), Installation of MATLAB Software, Manipulation of Variables under MATLAB (creating variables, data import from external sources, data entry, scalars, vector and matrix data, vector and matrix arithmetic, plotting and visualization), Manipulation of MATLAB file (M-file, Function files etc.)
- **Manipulation of MATLAB functions: (**Basic mathematical functions, data analysis functions, random functions, logical functions, relational and logical operators, if statements, loop).

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1. write computer programs to solve engineering problems with MATLAB and Microsoft Excel.
2. apply basic control and data structures to construct simple programs.
3. plot curves in two (2) or three (3) dimensions and interpret them.
4. apply testing and debugging techniques to identify and correct errors in programs.

5. implement basic algorithms, including numerical methods.

Reading Materials

1. Moore, H. (2012). MATLAB for Engineers (3rd ed). Pearson.
2. Jambrina, P. G., & Aldegunde, J. (2016). Computational tools for the study of biomolecules. In *Computer Aided Chemical Engineering* (Vol. 39, pp. 583-648). Elsevier
3. Barth, T. J., Griebel, M., Keyes, D. E., Nieminen, R. M., Roose, D., & Schlick, T. (2005). *Lecture notes in computational science and engineering* (Vol. 49, p. 125). New York: Springer.
4. Ashlock, D. (2006). *Evolutionary computation for modeling and optimization* (Vol. 571). New York: Springer.
5. Abraham, A., & Hassanien, A. E. (Eds.). (2012). *Computational social networks: Tools, perspectives and applications*. Springer Science & Business Media.

BEE 106 MATHEMATICS FOR ENGINEERS II (CALCULUS) (2,2,3)

Course Description

In this course students shall learn about ordinary and partial differential equations and integral calculus to solve problems as determining the maxima and minima as well as finding areas and volumes. This course serves as foundation calculus which shall be important for developing the requisite mathematical discipline needed by the electrical engineer.

Objectives

- Apply calculus to engineering problems.
- The student shall be familiarized with real numbers and Bolzano-Weierstrass theorem, sequence, series function, coordinate geometry, differentiation and integration.

Contents

- Real number operations, Bolzano-Weierstrass theorem, limit of sequence, limit theorems.
- Types of functions and their graphs, convergence of series of real number, test for convergence, series of functions and power series, conic section in rectangular coordinates.
- Parametric equations of conic sections, polar curve in a plane polar coordinates.

- Techniques of standard differentiation and integration.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

At the end of module, the student should be able to:

1. solve first-order differential equations
2. solve differential equations with constant coefficients.
3. Interpret solutions of differential equations.
4. develop differential equations to model electrical systems

Reading Materials

1. Beezer, R. A. (2012), A First Course in Linear Algebra, Congruent Press.
2. David, C.L (2012), Linear Algebra and Its Applications 4th edition, Pearson.
3. Attenborough M. (2003), Mathematics for Electrical Engineering and Computing, Newnes Publications, UK.
4. Stroud K. A. and Booth D. J (2003), Advanced Engineering Mathematics, 4th Edition, Palgrave Macmillan, UK.
5. Blyth, T. S. and Robertson, E. F. (2002), Basic Linear Algebra, Springer Undergraduate Mathematics Series.

BEE 108 BASIC MECHANICS (1,2,2)

Course Description

The branch of physics that deals with the action of force on matter is referred to as mechanics. All considerations of motion are addressed by mechanics, as well as the transmission of forces through the use of simple machines.

Objectives

- To equip the students with knowledge in basic engineering mechanics.
- Students will have knowledge on static equilibrium of particles and rigid bodies.
- They would also understand the principle of work and energy; comprehend on the effect of friction on equilibrium, the laws of motion, the kinematic of motion and the interrelationship.

Content

- **Fundamental Concept**: Newton's laws of motion; force systems and characteristics of forces; moment of a force; vector representation of forces and moments.
- **Basic statics**: Equilibrium of rigid bodies in two and three dimensions, Structural analysis: The method of joints and the method of sections, Friction, Simple machines.
- **Basic dynamics of particles:** Basic dynamics of rigid bodies, Simple harmonic motion.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given, take-home style to increase students' practical skills using digital devices.

Learning outcomes

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

1. perform calculations on statics.
2. solve questions on dynamics in mechanics.

Reading Materials

1. Marsden, J. E., & Ratiu, T. S. (2013). *Introduction to mechanics and symmetry: a basic exposition of classical mechanical systems* (Vol. 17). Springer Science & Business Media.
2. Cengel, Y., & Cimbala, J. (2013). Ebook: Fluid mechanics fundamentals and applications (si units). McGraw Hill.
3. Gross, D., & Hauger, W. (2011). *Engineering mechanics 2 Mechanics of materials*. springer publication.

4. Truesdell, C., & Rajagopal, K. R. (2000). *An introduction to the mechanics of fluids*. Springer Science & Business Media.
5. Truesdell, C., & Rajagopal, K. R. (2000). *An introduction to the mechanics of fluids*. Springer Science & Business Media.

BEE 110 CIRCUIT THEORY I (2, 2, 3)

Course Description

This course introduces students to resonance in circuits, and the relevant parameters and methods used their designs; network theorems and applications, how to apply graph theory in estimating electrical parameters in circuits; as well as Laplace and inverse Laplace transforms and their applications and use in analysing circuits.

Objectives

- Introducing students to Basic Circuit elements and DC circuit analysis.
- To prepare students for methods in solving DC circuits, appreciate the concept of signal waveform and characteristics.

Content

- **Basic circuit elements**: Electric quantities (charges, voltage, current, power, energy), sources of power in a circuit (Voltage and current sources), the operation of basic electrical components (resistor, inductor and capacitor).
- **Ohm's law**: Apply Ohm's law to calculate voltage, current and resistance power and energy. Kirchhoff's Laws with mathematical equations to solve electrical circuits problem.
- **Signal waveforms:** D.C. step, impulse, square pulse, sinusoidal, triangular and exponential.
- **Signal characteristics**: time constant, RMS value, duty cycle, crest factor, form factor. Experiments and Simulation on signal parameters measurement.

Learning Outcomes

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

1) design series and parallel RLC circuits

2) Solve series and parallel RLC circuits related problems
3) Analyse circuits using Node Voltage & Mesh Current Analysis in electrical networks and solve related problems.
4) Apply Network Theorems to electrical networks to evaluate network parameters in simplified ways. 77
5) Analyse Graph and Trees for a given network and build network matrices and solve related problems
6) Analyze and design Coupled (Magnetic and Electromagnetic) Circuits and solve related problems
7) Analyze the transients in electrical networks and solve related problems 8. Apply Laplace Transform and form Transfer Function for different kinds of electrical networks.

Reading Material

1) Bird, J. (2013a), Electrical and Electronic Principles and Technology, 5th edition, Routledge, Great Britain, 464 pp.

2) Bird, J. (2013b), Electrical Circuit Theory and Technology, 5th edition, Routledge, Great Britain, 784 pp.

3) Bird, J. (2014). Electrical circuit theory and technology. Routledge. Arora, N. D. (2012). MOSFET models for VLSI circuit simulation: theory and practice.

4) Springer Science & Business Media. Anderson, B. D., & Vongpanitlerd, S. (2013). Network analysis and synthesis: a modern systems theory approach. Courier Corporation.

5) Svoboda, James A., and Richard C. Dorf. Introduction to electric circuits. John Wiley & Sons, 2013. Suresh, K. K. (2010). Electric Circuits and Networks (for Gtu). Pearson Education India.

6) Zhang, T. (Ed.). (2012). Instrumentation, Measurement, Circuits and Systems. Springer Science & Business Media.

BEE 112 BASIC ELECTRONICS (2, 2, 3)

Course Description

This course focuses on building up the student's fundamental idea based on semiconducting devices and their associated electrical properties and characteristics as well as their applications to

various equipment designs. The course equips the student with the basic understanding of electronics.

Objectives

- The student shall learn about basic physics and applications of diodes, transistors, and thyristors.
- The student shall learn the concepts of the various types of amplifiers, switching device and power supplies.

Content

- **Semi–conductor materials**: Intrinsic and extrinsic semi – conductors, p-n junction. Current / voltage (V-I) characteristics junction barrier, junction break – down, applications of p-n diode, rectifiers.
- **Transistors:** The junction transistor, Current / Voltage (V-I) characteristics of CE, CB and CC configuration, FET transistors.
- **Transistors as amplifiers**: Introduction to electronic amplifiers, biasing, stability, load line techniques for transistor amplifiers. Design considerations for an AC/DC coupled amplifier.
- **Power Supply**: Rectifiers, power suppliers, filters, multipliers, voltage regulation, thyristors- operation and characteristics, single- phase controlled rectifiers.

Learning Outcome

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

1. explain the fundamentals of the operation of semiconductor devices and their electrical characteristics.
2. develop the skills of selecting the right semi conducting devices for an engineering design.
3. demonstrate how semi conducting devices function and work in designed systems
4. demonstrate an understanding of the working principles and configurations of given semi-conducting devices

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Reading Material

1. Sedra, A. S., Smith, K. C., Carusone, T. C., & Gaudet, V. (2016). Microelectronic circuits. New York: Oxford University Press.
2. Bird, J. (2014). Electrical circuit theory and technology. Routledge.
3. Coldren, L. A., Corzine, S. W., & Mashanovitch, M. L. (2012). Diode lasers and photonic integrated circuits. John Wiley & Sons.
4. Klauk, H. (Ed.). (2012). Organic electronics II: more materials and applications. John Wiley & Sons.
5. Bimbhra, P. S., & Kaur, S. (2012). Power electronics. Khanna publishers.
6. Li, S. S. (2012). Semiconductor physical electronics. Springer Science & Business Media.

BEE 114 ELECTRICAL ENGINEERING LAB II (1, 2, 2)

Course Description

It is a practical course aimed at getting the students familiarise themselves with the behavioural characteristics and properties of known electronic components – resistors, inductors, capacitors, diodes, transistors, measuring and testing of equipment like signal generators, CRO, etc.

Objectives

- The student shall know about both passive and active electronic components.
- The laboratory sessions shall also reinforce the concepts discussed in class with a hands-on approach and allow the students to develop skills and experience with electronic equipment.
- To gain knowledge in hand-on activities as soldering.

Content

- **Use of lab equipment**: Electronic components (resistors, capacitors, inductors, diodes). Use of multimeters and oscilloscopes. Construction and debugging of simple electronic circuits.
- **Practical characteristics of passive components**: Resistors, capacitors, inductors.
- **Practical characteristic verification of active components**: LEDs, bipolar junction transistors, MOSFETs, optical isolators, op amps.
- **Use of electromechanical actuators**: DC Motors.

Mode of delivery

The course consists of laboratory work and experiments. Hands-on assignments.

Learning Outcomes

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

1. explain the basics of electronics and perform experiments.
2. explain the behaviour of different active components like Diodes, Transistors, FETs etc., and know their application.

Reading Materials

1) Sedra, A. S., Smith, K. C., Carusone, T. C., & Gaudet, V. (2016). Microelectronic circuits. New York: Oxford University Press.
2) Bird, J. (2014). Electrical circuit theory and technology. Routledge.
3) Coldren, L. A., Corzine, S. W., & Mashanovitch, M. L. (2012). Diode lasers and photonic integrated circuits. John Wiley & Sons.
4) Klauk, H. (Ed.). (2012). Organic electronics II: more materials and applications (Vol. 2). John Wiley & Sons.
5) Bimbhra, P. S., & Kaur, S. (2012). Power electronics. Khanna publishers.
6) Li, S. S. (2012). Semiconductor physical electronics. Springer Science & Business Media.

YEAR TWO, SEMESTER ONE

BEE 201 MATHEMATICS FOR ENGINEERS III (ORDINARY DIFFERENTIAL EQUATION) (2,2,3)

Course Description

The objective of this course is to equip students with basic mathematical tools that will prepare them to understand advanced Engineering courses. Students will be introduced to functions, differentiation and integral calculation and others.

Objectives

- The student shall learn about advanced calculus in engineering problems.
- The student shall be acquainted with ordinary differential equations, second order differential equation, Laplace transformation.

Contents

- **Ordinary Differential Equation:** Classification of ordinary differential equations, first order differential equation, application of ordinary differential equation.
- **Linear Second Order Differential Equation:** Difference between first and second order differential equations, homogenous and non-homogenous second order differential equations, application of homogenous and non-homogenous second order differential equations, vibrating spring mass systems.
- **Laplace Transformation:** Proper and improper integrals, evaluation of improper integral, use of Laplace transformation to solve ordinary differential equations.
- **Z-Transfrom:** Proper and improper integrals, evaluation of improper integral, use of Laplace transformation to solve ordinary differential equations.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

At the completion of the module, students should be able to:

1) explain the concept of differential equation.
2) classify the differential equations with respect to their order and linearity.
3) explain the meaning of solution of a differential equation.
4) express the existence-uniqueness theorem of differential equations.
5) solve first-order ordinary differential equations.
6) solve exact differential equations.

Reading Materials

1. Beezer, R. A. (2012), A First Course in Linear Algebra, Congruent Press.
2. David, C.L (2012), Linear Algebra and Its Applications 4th edition, Pearson.
3. Attenborough M. (2003), Mathematics for Electrical Engineering and Computing, Newnes Publications, UK.
4. Stroud K. A. and Booth D. J (2003), Advanced Engineering Mathematics, 4th Edition, Palgrave Macmillan, UK.
5. Blyth, T. S. and Robertson, E. F. (2002), Basic Linear Algebra, Springer Undergraduate Mathematics Series.

BEE 203 ELECTRICAL ENGINEERING LAB III (1,4,3)

Course Description

In this course the student shall learn to build basic electrical/electronic circuits. The aim of the course is to help students to learn the design of common and applicable electrical/electronic circuit.

Objectives

- The student shall gain skills in circuit simulation.
- The student learns to develop skills in PCB design and construction.

Contents

- Verifications of KVL & KCL.
- Verifications of Thevenin & Norton theorem.
- Verification of Superposition Theorem.
- Verification of maximum power transfer Theorem
- Determination of Resonance Frequency of Series & Parallel RLC Circuits.
- Transient analysis of RL and RC circuits.

- **Circuit Simulation**: Build an application circuit with a circuit design software, Simulate the circuit, Transfer the circuit onto a PCB layout design software.
- **PCB design and construction**: Perform routing with constraint of PCB size, wire thickness and components layout, Print out PCB design layout, Perform etching, Solder components and PCB, Test final application, Adhere to safe work to others, self and environment.

Mode of Delivery

The course consists of laboratory work and experiments. Hands-on assignments.

Learning Outcomes

At the completion of the module, students should be able to:

1) explain the concept of basic electronic circuits.
2) explain common components of electronic circuits.
3) design and simulate basic circuits.
4) use bread board.
5) translate a circuit onto PCB board.
6) solder and test circuits.

Reading Materials

1. Dorf, R. C. (Ed.). (2018). The Electrical Engineering Handbook-Six Volume Set. CRC press.
2. Tadej T., Árpád B. (2009), Circuit Simulation with SPICE OPUS: Theory and Practice (Modeling and Simulation in Science, Engineering and Technology), 2009 edition, Birkhäuser.
3. Baker R. J. (2004), CMOS Circuit Design, Layout, and Simulation, 2nd Edition, Wiley-IEEE Press.
4. Norb M. (1995), Electronic Circuits Analysis Simulation and Design, 1st Edition, Simon & Schuster Books.
5. Smith, R. J., & Dorf, R. C. (1992). *Circuits, devices and systems: a first course in electrical engineering*. John Wiley & Sons.

BEE 205 CIRCUIT THEORY II (2, 2, 3)

Course Description

This course shall introduce students to the laws of circuits. Circuit theory is a linear analysis; Thus, the voltage-current relationships for R, L, and C are linear relationships, as R, L, and C are considered to be constants over a large range of voltage and currents. These laws are translated into understanding electrical systems.

Objectives

- The objective of this course is to introduce students to circuit laws and theorems.
- Learn about a.c circuits, both single and three phase circuits.

Content

- **Circuit laws:** Kirchoff's Laws, mesh and nodal analysis, Superposition Theorem, Thevenin's and Norton's theorems, Reciprocity theorems, Delta- star and star- delta transformations.

- **Alternating Voltage and Current**: Average and r.m.s. values of alternating currents and voltages, harmonics, representation of a smusoidal alternating quantities by phasors, addition and subtraction of sinusoidal quantities.

- **Single and Three Phase circuits**: A.C. R-L-C circuits, resonance and q factor, complex power factor, active and reactive current. Solving single phase R-C-L- circuits using j operator. Three phase circuits.

- **Transient analysis:** Analyze first order circuits (LR and RC) subjected to different excitations (D.C., square pulse, sinusoidal sources and exponential sources, analyze second order RLC circuit subjected to different input (step input and sinusoidal input), experiment on transient circuits, elementary work topology and network constraints and network.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

At the end of this course, students will be able to:

1) identify linear systems and represent those systems in schematic forms.
2) apply Kirchhoff's current and voltage laws and Ohm's law to circuit problems.
3) simplify circuits using series and parallel equivalents and using Thevenin and Norton equivalents.

Reading Material

1. Bird, J. (2013a), Electrical and Electronic Principles and Technology, 5th edition, Routledge, Great Britain, 464 pp.

2. Bird, J. (2013b), Electrical Circuit Theory and Technology, 5th edition, Routledge, Great Britain, 784 pp.

3. Nahvi, M. and Edminister, J. A. (2003), Theory and Problems of Electric Circuits, 4th edition, McGraw-Hill Companies, Inc., USA, 469 pp.

4. Hebert, W. J. (2012), Introduction to Electric Circuits, Prentice Hall, India, 411 pp. c) Theraja, B. L. and Theraja, A. K. (2008)

BEE 207 COMPUTER AIDED ELECTRICAL DESIGN (2, 2, 3)

Course Description

The course discusses modern techniques used in computer-aided design of analogue, digital and mixed- signal circuits and systems, including CAD for layout design, circuit sizing, topology generation and modeling.

Objectives

- Students shall learn about the basics of AutoCAD Electrical Software.
- Apply simple electrical designs and their use with other software such as Dialux.

Contents

- Introduction to AutoCAD Design Software Environment, Identification of Electrical Components and Wires in AutoCAD, Creation of Drawings and Project File Management.
- Construction of single wire circuits, multiple wire circuits, Single phase & 3ϕ component insertion.
- Component Editing & Catalogue Manipulation. Editing of footprint, Terminal Manipulation (Terminal Strip Editor) & Drawing of PLC based diagrams.

- Manipulation of Catalog Databases, Symbol Creation, Report Creation, Project Export & Import.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

Upon successful completion of this course, students will be able to:

1. install auto cad successfully
2. distinguish electrical components
3. draw electrical circuits with auto cad
4. manage project with different files and understand their hierarchy
5. performs schematic diagrams using auto cad
6. draw diagram including PLC and their connections
7. create symbols and generate report

Reading Materials

1. Marques, G., Saini, J., & Dutta, M. (Eds.). (2023). IoT Enabled Computer-Aided Systems for Smart Buildings. Springer Nature.

2. Su, R., & Hu, Y. (2020). Medical imaging and computer-aided diagnosis. Springer Singapore.

3. Santhanagopalan, S. (Ed.). (2023). Computer Aided Engineering of Batteries (Vol. 62). Springer Nature.

4. Murthy, K. V. (2008). Computer-aided design of electrical machines (pp. 223-276). Hyderabad, India: BS Publications.

5. Stojkovic, Z. (2012). Computer-aided design in power engineering: Application of software tools. Springer Science & Business Media.

BEE 209 ELECTROMAGNETIC WAVE THEORY (2, 2,3)

Course Description

Electromagnetic fields are a combination of invisible electric and magnetic fields of force. They are generated by natural phenomena like the Earth's magnetic field but also by human activities, mainly through the use of electricity. Mobile phones, power lines and computer screens are examples of equipment that generates electromagnetic field. The course imparts knowledge on the concepts of electrostatics, electric potential, energy density and their applications.

Objectives

- Equip the students with knowledge on the concepts of electromagnetic wave theory.
- Understand the working principle, design and analysis of Electrical machines and Systems.

Contents

- **Introduction**: Review of vector analysis, scalar and vector product, gradient, divergence and curl of a vector and their physical interpretation, transformation amongst rectangular, cylindrical and spherical co-ordinate system.
- **Electrostatic Field**: Coulomb's law, electric field intensity from point charges, Electric field due to continuous field distribution of charges, gauss's law, electric displacement and displacement density, potential functions, potential field of a charge, Laplace's and Poisson's equation, capacitance and electrostatic energy.
- **Steady Magnetic Fields**: Faraday Induction law, Ampere's Work law in the differential vector form, Ampere's law for a current element, magnetic field due to volume distribution of current. Ampere 's Force Law, vector potential (Alternative derivation), equation of continuity.
- **Time Varying Fields**: Equation of continuity for time varying fields, inconsistency of Ampere 's law, Maxwell's field equations and their interpretation; solution for free space conditions, electromagnetic waves in a homogeneous medium, propagation of uniform plane wave, relation between E & H in a uniform plane- wave, wave equations for conducting medium, Maxwell's equations using phasor notation, wave propagation in a conducting medium, conductors, dielectrics, wave propagation in good conductor and good dielectric.
- **Reflection and Refraction of EM Waves**: Reflection and refraction of plane at the surface of a perfect conductor & perfect dielectric (both normal incidence as well as oblique incidence), Brewster 's angle and total internal reflection, reflection at the surfaces

of a conductive medium, surface impedance, transmission- Line analoguey, pointing theorem.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

At the completion of the subject, students should be able to:

1. explain the concepts of scalar and vector quantities.
2. apply vector methods in two and three dimensional space based on cartesian, cylindrical and spherical coordinate systems.
3. explain the of laws of electrostatics and its applications in electrical engineering such as inductance calculation.
4. explain the concepts of laws of magneto statics and its applications in electrical engineering such as inductance calculation.
5. explain the basics of magnetic circuits and magnetic materials.
6. perform laboratory experiments to measure dielectric constant of materials, capacitance and inductance of electrical circuits.

Reading Materials

1. Jackson J. D. (1999), Classical Electrodynamics, John Wiley.

2. Millford W. Greiner (1998), Classical Electrodynamics, Springer.

3. Landau L. D. and Lifshitz E. M. (1995), Electrodynamics of Continuous Media, Butterworth Heinemann.

4. David G. (1995), Introduction to Electrodynamics, 3rd Edition., Prentice-Hall.

5. Reitz J. R. and F. J. (1986), Foundation of Electromagnetic Theory, Narosa.

BEE 212 ANALOGUE ELECTRONICS (2, 2, 3)

Course Description

The student is introduced to various electronic components and systems used in modern industry. Operational amplifier principles and applications including comparators (zero and non-zero crossing detectors), voltage followers, inverting and non-inverting amplifiers. Subtraction,

summing (mixer), difference and compound amplifiers and active filters. Operational amplifiers circuits are configured to make up complex analogue circuits.

Objectives

- To provide students with knowledge in various amplifiers, noise and distortion.
- Acquaint students to analogue systems, signal generators and AC/DC convertors.

Contents

- **Amplifiers:** Small signal amplifiers, frequency compensation, noise and distortion, tuned amplifiers, wideband video amplifiers.
- **Feedback:** Positive and negative feedback.
- **Analogue Systems**: Operational amplifiers, summers, multipliers, integrators, differentiators and integrators, active filters, applications to control systems.
- **Signal Generation and Conditioning**: Sine wave, ramp and square wave oscillators, comparator circuits, Schmitt trigger, modulation, PLI, sample and hold, analogue multiplexer.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1) acquire knowledge in IC fabrication procedure
2) analyse the characteristics of Op-Amp
3) explain the importance of Signal analysis using Op-amp based circuits.
4) Explain functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
5) explain the applications of Op-amp
6) analyse linear integrated circuits; their fabrication and application.

Reading Material

1) Hart, D. W., & Hart, D. W. (2011). Power electronics (Vol. 166). New York: McGraw-Hill.
2) Hart, D. W., & Hart, D. W. (2011). Power electronics (Vol. 166). New York: McGraw-Hill.
3) Roy, D. C. (2003). Linear integrated circuits. New Age International.
4) Irwin, J. D. (1997). The industrial electronics handbook. CRC press.
5) Kissell, T. E. (1997). Industrial electronics (pp. 524-540). Prentice Hall.

BEE 214 DIGITAL ELECTRONICS (2, 2, 3)

Course Description

Digital electronics is the study of electronic circuits that are used to process and control digital signals. In contrast to analogue electronics, where information is represented by a continuously varying voltage, digital signals are represented by two discrete voltages or logic levels. Digital electronics is used in a wide range of applications, including computer systems, communication systems and control systems. Some of the key concepts in digital electronics include Boolean algebra, logic gates, digital filters, and flip-flops.

Objective

- To provide students with a fundamental understanding of digital system concepts.
- Learn about the logic gates for combinatorial logic circuit design; Higher level logic element such us counters and multiplexers.
- To provide practical skills required for the implementation of digital electronic circuits.

Content

- History and overview of digital logic including reasons for studying digital circuits, important areas of application, role of digital circuits in computer engineering.
- Switching theory: number systems and codes, binary arithmetic and logical operations, Boolean and switching algebra, representation and manipulations of functions, minimization of functions.
- Combinational Logic: truth tables, basic logic gates, realization of switching functions with networks of logic gates, relations between electronic circuits and Boolean functions.

- Design of Combinational Circuits: multiplexers, arithmetic functions - half and full adders, subtractors, multipliers and dividers, arithmetic and logic units.
- Memory Elements: basic circuits for latches, clocked and unclocked memory devices, basic Flip-Flops (RS, D and JK), asynchronous flip-flop inputs (preset, clear), timing constraints (setup time, hold time), data registers (selection, clocking timing), random access memory.
- Sequential Logic Circuit: finite state machines (FSM), Mealy and Moore models of FSM, modeling FSM behavior (state diagram, table, timing diagram, algorithm state, machine chart), synchronous and asynchronous circuits and analysis, design of synchronous sequential circuits (state minimization, assignment, next state, output realization), sequential functional units (data registers, shift registers, counters, sequence detectors, synchronizers, debouncers)

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1) use digital electronics in the present contemporary world
2) design various combinational digital circuits using logic gates
3) analyse and design synchronous and asynchronous sequential circuits
4) use the semiconductor memories and related technology
5) use electronic circuits involved in the design of logic gates

Reading Material

1) Luo, F. L., Ye, H., & Rashid, M. H. (2010). Digital power electronics and applications. Elsevier.
2) Pedroni, V. A. (2008). Digital electronics and design with VHDL. Morgan Kaufmann.
3) Maini, A. K. (2007). Digital electronics: principles, devices and applications. John Wiley & Sons.
4) Jain, R. P. (2003). *Modern digital electronics* (Vol. 1, No. 10, p. 5V). Tata McGraw-Hill Education, New Delhi.

5) Gothmann, W. H. (1977). *Digital electronics: an introduction to theory and practice* (Vol. 1, No. 1, p. 1). Prentice Hall Of India Pvt. Ltd., New Delhi.

EEE 213 ELECTRICAL MACHINES (2, 2, 3)

Course Description

A electro-mechanical system converts electrical energy into mechanical energy or vice versa. A armature-controlled DC motor represents such a system, where the input is the armature voltage, and the output is motor speed, or angular position. This course shall guide the student to the design of DC devices including DC transformers founded on electromagnetism.

Objective

- The objective of this course is to equip students with the understanding of magnetic circuits, force carrying conductor.
- The course also aims to familiarize the students to DC generators and motors.

Contents

- **Magnetic Circuit:** Magneto-motive force – Magnetic field strength – Permeability – B-H curve of materials' reluctance – Electric and magnetic circuit – Kirchhoff's law on magnetic circuit.
- **Force on Current Carrying Conductor:** Faraday's law and motional emf – Concentrated winding emf – phase winding for AC machines – flux density distribution – Chord distribution and winding factors – Machine rating, losses, cooling and temperature rise and duty cycle.
- **DC Generator:** Construction of DG generator – Types of winding – Armature reaction – DC generator characteristics – Machine losses and efficiency.
- **DC Motor:** Construction of DC motors – Operation of DC motor.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

The students should be able to:

1. explain magnetic circuit
2. explain electromechanical energy conversion
3. demonstrate understanding of transformer

Reading Materials

1. Furlani, E. P. (2001). *Permanent magnet and electromechanical devices: materials, analysis, and applications*. Academic press.
2. Krause, P. C., Wasynczuk, O., & Pekarek, S. D. (2012). *Electromechanical motion devices* (Vol. 90). John Wiley & Sons.
3. Kumar, K. M. (2004). *Dc Machines And Transformers 2Ed*. Vikas Publishing House.
4. Turowski, J., & Turowski, M. (2017). *Engineering electrodynamics: electric machine, transformer, and power equipment design*. Crc Press.
5. Begamudre, R. D. (2007). *Electromechanical energy conversion with dynamics of machines*. New Age International.

YEAR TWO, SEMESTER TWO

BEE 202 CONTROL ENGINEERING I (2, 2, 3)

Course Description

A control system is a set of mechanical or electronic devices that regulate other devices or systems by way of control loops. Typically, control systems are computerized. Control systems are a central part of production and distribution in many industries. Automation technology plays a big role in these systems. The student shall be introduced to the principles of control systems.

Objectives

- The student shall gain knowledge in block diagram representation of a control system, transducers, amplifiers and actuators.

Contents

- Importance of Transfer Function which is analogue to efficiency.
- Block diagram application to obtain Transfer Function.
- Maison's Rule application in solving Transfer Function.
- Frequencies response by graphical applications.
- Introduction to Control Systems - Equation of physical power systems.
- Block diagram: representation of control system.
- Transfer function; Open loop and close loop. Schematic, representation of a Control System.
- Transducers for the measurement of displacement, velocity, force, temperature and heat flow.
- Amplifiers and actuators: operation of electronic, pneumatic, hydraulic, rotating and electrical performance and use of DC, AC and hydraulic motors.
- Nyquist – rough stability criteria and bode plots.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcome

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

1. explain the importance of Transfer Function which is analoguey to efficiency.

2. use Block diagram application to obtain Transfer Function.
3. apply Maison's Rule in solving Transfer Function.
4. obtain Frequencies response by graphical applications.

Reading Material

1. Flood, J. E. (Ed.). (1997). Telecommunication networks. IET.
2. Van Bosse, J. G., & Devetak, F. U. (2006). Signaling in telecommunication networks. John Wiley & Sons.
3. Carne, E. B. (2012). Modern telecommunication. Springer Science & Business Media.
4. Lindsey, W. C., & Simon, M. K. (1991). Telecommunication systems engineering. Courier Corporation.
5. Dodd, A. Z. (2002). The essential guide to telecommunications. Prentice Hall Professional.

BEE 204 MATHEMATICS FOR ENGINEERS IV (PARTIAL DIFFERENTIAL EQUATION) (2, 2, 3)

Course Description

This course is a continuation of ordinary differential equations. Partial Differential equations will build upon ordinary differential equations to solve advanced problems related to engineering. Advanced calculus approaches will apply vector calculus and functions to engineering problems.

Objectives

- Learn to be acquainted with advanced calculus to engineering problems.
- The student shall learn the application of differentiation and integration, vector calculus and functions of several variables.

Contents

- **Application of Differentiation and Integration:** Application of double integrals in Cartesian and polar coordinates, application of triple integrals in Cartesian, cylindrical and spherical coordinates.
- **Application of Differentiation in Vector Algebra:** Scalar product of vectors, vector product of vectors, scalar and vector triple product of vectors, implicit functions, solve simple problems of complex variables.

- **Functions of several variables**: Limits of continuity of function, differentiability, extreme, gamma and beta function.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

At the completion of the module, students should be able to:

1) explain the concept of partial differential equation.
2) explains the meaning of solution of a partial differential equation.
3) express the existence-uniqueness theorem of partial differential equations.
4) solve partial differential equations.
5) apply differential equations to basic engineering problems.

Reading Materials

1. Beezer, R. A. (2012), A First Course in Linear Algebra, Congruent Press.

2. David, C.L (2012), Linear Algebra and Its Applications 4th edition, Pearson.

3. Attenborough M. (2003), Mathematics for Electrical Engineering and Computing, Newnes Publications, UK.

4. Stroud K. A. and Booth D. J (2003), Advanced Engineering Mathematics, 4th Edition, Palgrave Macmillan, UK.

5. Blyth, T. S. and Robertson, E. F. (2002), Basic Linear Algebra, Springer Undergraduate Mathematics Series.

BEE 208 INTRODUCTION TO COMPUTER PROGRAMMING (C++) I (2, 2, 3)

Course Description

Computer programming is the process of designing and writing computer programs. As a skill set, it includes a wide variety of different tasks and techniques; this course shall teach the important tenets and help you to develop and interpretate common computer programs in C++ and FORTRAN. Its focus is to help the student to develop skills in these languages to apply to engineering problems.

Objectives

- The student shall learn the concepts of programming.
- Students shall be acquainted with the tenets of high-level programming language such as C++, FORTRAN.
- The course equips student with engineering computational tools and prepare them to solve basic algorithm or problem encountered in everyday life with the approach of software.

Content

- Computer Hardware, Computer organization: CPU function, memory devices and organization, Executing a stored program, interrupt, Input /Output (I/O) devices.
- Computer Software: System Software, Application Software, Licensing Schemes, High level programming with C++, Basics of C++.
- Control structures: Arrays, Strings, Functions, GUI programming with Visual Studio.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

1) design algorithms to solve simple problems,
2) use algorithms in the processing programming environment,
3) correct, test and debug processing programs.
4) explain how algorithms and processing programs work.

Reading Material

1. Kjell Backman. (2012). ***Structured Programming with C++***. www.bookboon.com
2. Douglas A Downing, Michael A. Covington, Melodi Mauldin, Catherine Anne Covington. (2009). ***Dictionary of Computer and Internet terms***. Barrons, 10th Editions.
3. Knuth, D. E. (2007). Computer programming as an art. In ACM Turing award lectures (p. 1974).
4. Stephen Randi Davis. (2004). C++ ***For Dummies. 5th Edition***. Wiley Publishing, Inc.
5. Bruce Eckel. (2000). ***Thinking in C++***. Vol 1, 2nd Edition, Prentice Hall.

BEE 210 ANALOGUE AND DIGITAL COMMUNICATION (2, 2, 3)

Course Description

This course introduces you to the basic principles and techniques used in analogue and digital communications. You will learn analogue and digital modulation techniques, communication receiver and transmitter design, baseband and bandpass communication techniques, line coding techniques, and noise analysis in various transmission environments. After completing the course, you will be able to use analytical techniques to evaluate the performance of analogue and digital communication systems.

Objectives

- To provide a modern treatment of communication system.
- To gain knowledge in the statistical underpinnings of communication theory with applications.

Content

- **Signal and Spectra:** Detailed treatment of random, or stochastic processes with particular emphasis on their partial characterization. The correlation properties and power spectra of random processes are described in detail**.**
- **Continuous wave modulation:** An outline of integrated treatment of continuous wave modulation (analogue modulation) techniques are presented here.
- **The various types of modulation schemes discussed are listed as:** Full amplitude modulation**,** Double sideband-suppressed carrier modulation**,** Quadrature amplitude modulation**,** Single side band modulation**,** Vestigial side band modulation**,** Angle modulation consisting of both phase modulation and frequency modulation.
- **The time domain and spectral characteristics of these modulated wave:** methods for their generation and detection, and the effect of channel noise on their performances are discussed.
- **Pulse Modulation:** The processes of sampling, quantization, and coding that are fundamental to the digital transmission of analogue signal will be discussed. This section may be viewed as the transition from analogue to digital communications. Specifically, the

following types of pulse modulation techniques are discussed: PAM, PWM, PPM, PCM, DM and DPCM.

- **Digital Modulation Techniques:** This part deals with the theories and MATLAB modelling of various digital modulation techniques including: BPSK, QPSK, OQPSK, M-PSK, π/4-QPSK, MSK and GMSK.

Learning Outcomes

At the end of the course, student will be able to:

a) explain analogue and digital communication processes.
b) distinguish between different type of communication systems.
c) explain pulse modulation techniques.
d) explain digital modulation techniques.
e) develop engineering models for simulation and analysis.

Mode of Delivery

Lectures, tutorials, seminars, written, oral presentations, class quizzes and practical assignment.

Reading Materials

Sklar, B. (2021). Digital communications: fundamentals and applications. Pearson.

Chitode, J. S. (2020). Digital communications. Technical Publications.

Fitz, M. P. (2007). Fundamentals of Communications Systems.

Hsu, H. (2003). Analogue and Digital Communications, 2nd Ed. McGraw Hill.

Couch, L.W. (2001). Digital and Analogue Communication Systems, 6th Ed. Prentice Hall, NJ. Oxford

Lathi, B. P. (1998). Modern Digital and Analogue Telecommunication Systems. 3rd Ed.,

BEE 212 ANALOGUE ELECTRONICS (2, 2, 3)

Course Description

The student is introduced to various electronic components and systems used in modern industry. Operational amplifier principles and applications including comparators (zero and non-zero crossing detectors), voltage followers, inverting and non-inverting amplifiers. Subtraction,

summing (mixer), difference and compound amplifiers and active filters. Operational amplifiers circuits are configured to make up complex analogue circuits.

Objectives

- To provide students with knowledge in various amplifiers, noise and distortion.
- Acquaint students to analogue systems, signal generators and AC/DC convertors.

Contents

- **Amplifiers:** Small signal amplifiers, frequency compensation, noise and distortion, tuned amplifiers, wideband video amplifiers.
- **Feedback:** Positive and negative feedback.
- **Analogue Systems**: Operational amplifiers, summers, multipliers, integrators, differentiators and integrators, active filters, applications to control systems.
- **Signal Generation and Conditioning**: Sine wave, ramp and square wave oscillators, comparator circuits, Schmitt trigger, modulation, PLI, sample and hold, analogue multiplexer.

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

7) acquire knowledge in IC fabrication procedure
8) analyse the characteristics of Op-Amp
9) explain the importance of Signal analysis using Op-amp based circuits.
10) Explain functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
11) explain the applications of Op-amp
12) analyse linear integrated circuits; their fabrication and application.

Reading Material

6) Hart, D. W., & Hart, D. W. (2011). Power electronics (Vol. 166). New York: McGraw-Hill.
7) Hart, D. W., & Hart, D. W. (2011). Power electronics (Vol. 166). New York: McGraw-Hill.
8) Roy, D. C. (2003). Linear integrated circuits. New Age International.
9) Irwin, J. D. (1997). The industrial electronics handbook. CRC press.
10) Kissell, T. E. (1997). Industrial electronics (pp. 524-540). Prentice Hall.

BEE 214 DIGITAL ELECTRONICS (2, 2, 3)

Course Description

Digital electronics is the study of electronic circuits that are used to process and control digital signals. In contrast to analogue electronics, where information is represented by a continuously varying voltage, digital signals are represented by two discrete voltages or logic levels. Digital electronics is used in a wide range of applications, including computer systems, communication systems and control systems. Some of the key concepts in digital electronics include Boolean algebra, logic gates, digital filters, and flip-flops.

Objective

- To provide students with a fundamental understanding of digital system concepts.
- Learn about the logic gates for combinatorial logic circuit design; Higher level logic element such us counters and multiplexers.
- To provide practical skills required for the implementation of digital electronic circuits.

Content

- History and overview of digital logic including reasons for studying digital circuits, important areas of application, role of digital circuits in computer engineering.
- Switching theory: number systems and codes, binary arithmetic and logical operations, Boolean and switching algebra, representation and manipulations of functions, minimization of functions.

- Combinational Logic: truth tables, basic logic gates, realization of switching functions with networks of logic gates, relations between electronic circuits and Boolean functions.
- Design of Combinational Circuits: multiplexers, arithmetic functions - half and full adders, subtractors, multipliers and dividers, arithmetic and logic units.
- Memory Elements: basic circuits for latches, clocked and unclocked memory devices, basic Flip-Flops (RS, D and JK), asynchronous flip-flop inputs (preset, clear), timing constraints (setup time, hold time), data registers (selection, clocking timing), random access memory.
- Sequential Logic Circuit: finite state machines (FSM), Mealy and Moore models of FSM, modeling FSM behavior (state diagram, table, timing diagram, algorithm state, machine chart), synchronous and asynchronous circuits and analysis, design of synchronous sequential circuits (state minimization, assignment, next state, output realization), sequential functional units (data registers, shift registers, counters, sequence detectors, synchronizers, debouncers)

Mode of Delivery

The course consists of classroom instruction including lectures using classical lecture style, power point slides. Home-works are given take-home style to increase students' practical skills using digital devices.

Learning Outcomes

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

6) use digital electronics in the present contemporary world
7) design various combinational digital circuits using logic gates
8) analyse and design synchronous and asynchronous sequential circuits
9) use the semiconductor memories and related technology
10) use electronic circuits involved in the design of logic gates

Reading Material

6) Luo, F. L., Ye, H., & Rashid, M. H. (2010). Digital power electronics and applications. Elsevier.

7) Pedroni, V. A. (2008). Digital electronics and design with VHDL. Morgan Kaufmann.
8) Maini, A. K. (2007). Digital electronics: principles, devices and applications. John Wiley & Sons.
9) Jain, R. P. (2003). *Modern digital electronics* (Vol. 1, No. 10, p. 5V). Tata McGraw-Hill Education, New Delhi.
10) Gothmann, W. H. (1977). *Digital electronics: an introduction to theory and practice* (Vol. 1, No. 1, p. 1). Prentice Hall Of India Pvt. Ltd., New Delhi.

BEE 216 ELECTRICAL ENGINEERING LAB. IV (2, 2, 3)

Course Description

This course is designed for the practical realization of the concepts typically in Analogue Circuits and also Digital Electronics. They shall therefore perform experiments to verify behaviors of OPAMPS, decoders, multiplexers and logic gates.

Objectives

- To learn design, testing and characterizing of circuit behavior with combinational logic gate ICs.
- To learn design, testing and characterizing of circuit behavior with register/ counter and sequential logic ICs.
- To learn design, testing and characterizing of circuit behavior with OPAMP ICs.
- To learn design, testing and characterizing of circuit behavior with digital ICs like decoders, multiplexers.

List of Experiments

- Implementation of Boolean Functions, Adder and Subtractor circuits.
- Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
- Parity generator and parity checking.
- Encoders and Decoders.
- Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
- Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
- Study of multiplexer and de multiplexer.

- Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
- Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
- Voltage to frequency characteristics of NE/ SE 566 IC. 11. Variability Voltage Regulator using IC LM317.

Learning Outcomes

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

1) implement Boolean Functions.
2) explain the importance of code conversion.
3) design and implement circuits with digital ICs like decoders, multiplexers, register.
4) explain application of Op-Amp.
5) design and implement counters using analogue ICs like timers, VCOs and digital ICs like Flip-flops and counters.

Mode of Delivery

The course consists of laboratory work and experiments. Hands-on assignments.

Reading Materials

1) Luo, F. L., Ye, H., & Rashid, M. H. (2010). Digital power electronics and applications. Elsevier.
2) Pedroni, V. A. (2008). Digital electronics and design with VHDL. Morgan Kaufmann.
3) Maini, A. K. (2007). Digital electronics: principles, devices and applications. John Wiley & Sons.
4) Jain, R. P. (2003). *Modern digital electronics* (Vol. 1, No. 10, p. 5V). Tata McGraw-Hill Education, New Delhi.
5) Gothmann, W. H. (1977). *Digital electronics: an introduction to theory and practice* (Vol. 1, No. 1, p. 1). Prentice Hall Of India Pvt. Ltd., New Delhi.

YEAR THREE, SEMESTER ONE

Signals and Systems

Chapter 1 introduces knowledge points such as time-domain transformation and operation of continuous time signals; Chapter 2 discusses the step response and impulse response of continuous systems; Chapter 3 introduces knowledge points such as Fourier transform of periodic signals, spectrum of power and energy signals, etc; Chapter 4 discusses the conditions for signals to pass through linear systems without distortion, etc; Chapter 5 introduces knowledge points such as continuous signal Laplace transform; Chapter 6 describes the system simulation block diagram and signal flow diagram, etc; Chapter 7 introduces knowledge points such as time-domain operation and transformation of discrete signals; Chapter 8 discusses the Z-domain analysis and simulation of discrete systems; Chapter 9 introduces knowledge points such as pole analysis of system functions.

CPLD/FPGA Design

This course mainly includes the development process, basic principles, basic structure of CPLD and FPGA devices, basic overview of hardware description languages, sentence rules, the use of commonly used design software, the main application directions and application systems of CPLD/FPGA. The teaching objective of this course is to enable students to understand the basic principles and main application directions of CPLD and EPGA, understand the basic structure of hardware description languages, proficiently master the sentence structure of a hardware description language, and combine specific design software to write digital logic circuit systems. On this basis, it is possible to achieve commonly used digital logic circuit systems by combining CPLD and FPGA with peripheral basic circuits. The course focuses on the sentence structure of hardware description languages and the application system of CPLD/FPGA.

Digital Signal Processing

This course focuses on time-domain discrete signals as the research object, teaching the definitions of time-domain discrete signals and time-domain discrete signals, frequency domain analysis, discrete Fourier transform, fast discrete Fourier transform, network structure of time-domain discrete systems, infinite pulse response digital filter design, and limited pulse response digital filter design. Through the study of this course, students will understand the general process and

methods of signal processing, and master frequency domain analysis methods; Understand the physical meaning and implementation of discrete Fourier transform, master the principles and implementation of fast Fourier transform; Understand the meaning and application of network structure, master the design principles and methods of digital filters, and enable students to have preliminary abilities in signal analysis.

High Frequency Electronic Circuit

Chapter 1 introduces knowledge points such as the composition of transmitters and receivers; Chapter 2 discusses the basics of nonlinear circuit analysis and other related topics; Chapter 3 introduces knowledge points such as centralized frequency selective amplifiers; Chapter 4 discusses the working principle of Class C resonant power amplifier and other related content; Chapter 5 introduces knowledge points such as quartz crystal oscillators and voltage controlled oscillators; Chapter 6 discusses the demodulation circuit of amplitude modulation signals and other related content; Chapter 7 introduces knowledge points such as the generation circuit of frequency modulation signals; Chapter 8 discusses topics such as automatic frequency control circuits.

Basics of Information Theory

The foundation of information theory is the theoretical foundation of modern communication and information engineering, which mainly includes the definition and measurement of information; Various discrete sources and information entropy; Remainder degree; Channel and mutual information; Average mutual information and channel capacity; Data processing and information measurement theory; Information rate distortion function and data compression principle; Discrete source coding theory and coding methods for distortion free and limited sources; Discrete noisy channel coding theory and coding principles.

Principle and Application of Artificial Intelligence

This course introduces the basic principles, methods, and application technologies of artificial intelligence, including knowledge representation, deterministic reasoning, and search strategies, as well as uncertainty reasoning methods, machine learning, and computational intelligence. It also introduces the application research and latest research progress of artificial intelligence.

Fundamentals of Microwave Technology

This course includes 5 chapters: Introduction, Transmission Line Theory, Microwave Transmission Lines, Microwave Networks, and Common Microwave Components. This course covers the basic principles of engineering science such as linear circuits, electronic circuits, electromagnetic fields, and electromagnetic waves, as well as microwave technology knowledge, structural characteristics of waveguide matching double T, and working principles.

YEAR THREE, SEMESTER TWO

Principle and Application of Sensor

Chapter 1 introduces the general processing methods for system errors and other knowledge points; Chapter 2 discusses sensor applications, sensor dynamic characteristics, and other related topics; Chapter 3 introduces knowledge points such as temperature error and compensation of metal strain gauges; Chapter 4 discusses the basic characteristics and measurement circuits of differential transformers; Chapter 5 introduces knowledge points such as the equivalent circuit and measurement circuit of capacitive sensors; Chapter 6 discusses the piezoelectric effect and piezoelectric materials; Chapter 7 introduces knowledge points such as Hall switch integrated sensors; Chapter 8 discusses the basic principles of fiber optic waveguides and other related content; Chapter 9 introduces knowledge points such as the structure of semiconductor gas sensors; Chapter 10 discusses the compensation of cold junction temperature of thermocouples and other related content; Chapter 11 introduces the performance characteristics, working principles, and other knowledge points of the digital temperature sensor DS1820.

Principles of Radar

This course introduces the basic principles of radar target detection, ranging, azimuth, and velocity measurement, the composition principles of radar microwave transmission and antenna, transmission, reception, display, and intermediate frequency power supply, the performance and technical performance of radar and their corresponding relationships, the principles of radar information processing and ARPA system composition, and introduce the development of new technologies in radar.

Virtual Instrument Technology and Application

1. Basic Theory of Measurement and Control Technology
2. The concept of virtual instruments and their software and hardware systems
3. Introduction to LabVIEW Virtual Instruments
4. Create, edit, and debug VI
5. Data types and data operations
6. Program structure
7. Graphical display of data and HMI design

8. Signal processing and file operations
9. Data collection methods and applications
10. Application Programming Interface
11. Advanced Applications of LabVIEW
12. Actual design cases

Digital Image Processing

The first part of this course is the foundation of digital image processing, consisting of three chapters: introduction, basic concepts of digital image processing, and image transformation; The second part is the theory, methods, and examples of digital image processing, including three chapters: image enhancement, image restoration and reconstruction, and image encoding and compression; The third part is the basic theory, methods, and examples of image feature extraction and analysis, including image segmentation, binary image processing and shape analysis, texture analysis, template matching, and pattern recognition.

Python Programming and Engineering Practice

"Python Programming" is a required course of general education for students in all fields. The course covers basic methods of programming, Python syntax, and the use of common libraries. The course adopts the teaching concept of "understanding and applying the computing ecology" to help students learn Python quickly, easily and systematically, master the basic methods of programming, understand the whole programming process from problem analysis to program maintenance, and initially have the ability to solve various practical problems with Python language. The course train students in rigorous and realistic scientific style and improves their scientific literacy.

Electromagnetic Compatibility Technology

This course introduces electromagnetic compatibility engineering methods, mainly including basic methods and specific applications of grounding, overlap, shielding, and filtering; Introduced the application of electrical compatibility, suppression techniques for transient interference, including PCB (printed circuit board) design, biological electromagnetic effects, and electromagnetic radiation protection; Introduced spectrum management and frequency allocation, including

frequency division and usage, frequency allocation techniques, methods, and evaluation of allocation effectiveness; Introduced electromagnetic compatibility measurement methods, electromagnetic compatibility measurement sites and equipment, as well as the implementation of electromagnetic compatibility measurement.

Comprehensive Design of CPLD/FPGA

Goal 1: Master the types and reasons for choosing FPGA in the comprehensive practice of the course; Master the design process of complex digital systems, be able to generate schematic diagrams through software and compare them.

Goal 2: Master the design methods of digital circuits on FPGA; Master the method of designing TEST BENCH to verify the correctness of the model; Master the precautions for safe use of FPGA.

Goal 3: Master the simulation design method of ModelSim; Master the simulation design method of Quatus2; Understand the principles of simulation software; Master the usage methods of ISE and Vivado design software; Being able to distinguish the differences between these software and make choices.

Goal 4: Master the principle of designing driver programs through FPGA; Master transmitting data streams through FPGA and communicating with microcontrollers accordingly.

YEAR FOUR, SEMESTER ONE

Embedded System and Application

1. Overview of embedded systems

Introducing the definition, characteristics, classification, and application fields of embedded systems, and cultivate students' overall understanding of embedded systems.

2. Hardware Design of Embedded Systems

Covering the hardware fundamentals, circuit design, microcontroller system design, and other content of embedded systems, allowing students to master the basic principles and technologies of embedded system hardware design,

3 Embedded System Software Design

Including embedded operating systems, driver program design, real-time operating systems, and other content, to enable students to understand the key technologies and methods of embedded system software design.

4 Analysis of Embedded System Application Cases

Through case analysis, guiding students to apply their acquired knowledge to solve practical problems and improve their practical application abilities.

Introduction to Information Security Technology

It is essential for students to master the necessary information security management and security prevention technologies. Through the study of this course, students can master the basic principles of computer information security, popular information security settings, security vulnerabilities, firewall strategies and implementation, hacker principles and prevention, so as to enable them to be competent in the implementation, operation, management, and maintenance of information systems.

Signal Detection and Estimation

This course introduces the basic theory of signal detection and estimation. Firstly, explain the basic theory, random signal analysis, and statistical description of this course. Secondly, introduce basic detection theories and methods such as classical detection theory, detection of deterministic signals, detection of random parameter signals, detection of multiple signals, and sequential detection. Finally, introduce basic estimation theories and methods such as classical estimation,

signal parameter estimation, signal waveform estimation (Wiener filtering, Kalman filtering, and adaptive filtering), as well as power spectrum estimation.

Internet of Things Technology and Application

Chapter 1 introduces the concept, current situation, basic architecture, and industrial chain of Internet of Things technology, as well as the development trends of Internet of Things technology both domestically and internationally; Chapters 2 to 5 use the widely recognized hierarchical division method of the Internet of Things in the industry, respectively elaborating on the perception and recognition layer, network construction layer and communication technology, data management layer and comprehensive application, while incorporating relevant key technologies, striving for complete content and clear hierarchy; Chapter 6: Trends and Prospects for the Future Development of the Internet of Things.

Principle and Application of Antenna

Understanding the position and role of antennas in wireless communication engineering: Proficient in describing the electrical parameters of antennas, understanding the physical meaning and calculation methods of each parameter; Master the description of the spatial radiation field of the current element and the analysis method of the radiation characteristics of symmetric oscillator antennas; Understand the product theorem of directional graphs; Master the radiation characteristic analysis methods and measures to improve radiation characteristics of commonly used forms of antennas such as simple line antennas, traveling wave antennas, and non frequency varying antennas; Master the analysis method of radiation characteristics of planar antennas, describe the radiation characteristics of horn antennas and rotating parabolic antennas, and their relationship with antenna geometric parameters: understand the basic working principle of smart antennas, and understand new technologies and development trends in the field of antennas.

Comprehensive Practice of Electronic Circuit Design

This course is designed to provide students with practical experience in designing and building electronic circuits. It covers the fundamentals of electronic components, circuit theory, and simulation techniques. Students will engage in hands-on projects that involve the assembly and testing of various circuits, such as amplifiers, oscillators, and power supplies. The course also

introduces advanced topics such as digital electronics, microcontroller integration, and circuit optimization.

Throughout the semester, emphasis is placed on problem-solving skills, teamwork, and the ability to adapt theoretical knowledge to practical applications. Students will use modern tools and software for circuit design and analysis, gaining proficiency that prepares them for challenges in the electronics field. The capstone project will require students to design a complete electronic system, demonstrating their cumulative learning and technical skills.

Comprehensive Practice of Signal Processing

This course will set up engineering practice projects such as digital filter design, digital audio equalization, sound source localization, adaptive howling suppression, digital watermark embedding and extraction. Students will work together in groups to complete the entire project process, including researching project requirements and related physical constraints, establishing mathematical models, researching signal processing methods, writing simulation programs and debugging to achieve signal acquisition, processing, and analysis, in order to verify the theoretical derivation and compare the advantages and disadvantages of different solutions.

YEAR FOUR, SEMESTER TWO

Graduation Practice

Graduation fieldwork is an important practical part to complete the education objectives teaching plans. It is an important step to train students to analyze and solve problems independently by comprehensively using the theoretical knowledge and professional skills they have learned. It contains also the basic training contents for training students to engage in safety design and scientific research in the future. The graduation fieldwork of safety engineering major is mainly on-site practice. Through on-site labor, hands-on operation, investigation and research, listening to the technical explanation of field engineering and technical personnel, collect data and complete the internship report. In the process of practice, attention should be paid to the collection of information, data and relevant materials of enterprise safety management and production safety, so as to make full preparation for graduation project (Thesis). Through the graduation fieldwork, we can test the students' flexible use of the knowledge they have learned, strengthen their further understanding of the professional knowledge, so as to complete the transition from school to work, and lay a solid foundation for the relevant industry post work after graduation. At the same time, students' sense of social responsibility will be enhanced and their comprehensive quality will be improved in the process of graduation fieldwork.

Graduation Design（Dissertation）

The graduation project is an important practical teaching link in the entire teaching plan, and its basic task is to cultivate students to comprehensively apply the basic theories and professional knowledge they have learned, improve their ability to analyze and solve practical engineering problems, and provide them with a comprehensive training in raising, analyzing, and solving problems before embarking on a job. Therefore, it is required that in the implementation of the graduation project, attention should be paid to cultivating students' ability to work independently. Starting from problem posing, through research, literature search and reading, scheme design and comparison, data analysis and processing calculation, computer application, comprehensive analysis and graduation project report, etc., students should be trained to independently analyze and solve problems, and rigorous scientific awareness should be cultivated; The correct way of thinking; A serious and responsible attitude; A down-to-earth and hardworking style; The courage

to face difficulties and tackle challenges, as well as the team spirit of mutual assistance and unity, can enhance the comprehensive quality of adapting to society.