TEL - ELECTRONICS TECHNOLOGY

TEL 101 D C Analysis
This course is a core requirement in all Electronics programs. The course covers the basic principles of direct current circuits containing passive elements, including transient circuit analysis. Circuit theory and conversions will also be examined. Troubleshooting of basic resistive circuits with both a theoretical and a hands-on approach will be applied. Experiments are performed in conjunction with all major topics. Basic electronic testing equipment will be used in conjunction with all lab experiments, including the Digital Multimeter and the Analog Multimeter. NOTE: Prerequisites: An understanding of basic algebra.
Upon successful completion of this course, students should be able to:
Understand and use electric circuit terminology.
Analyze resistive circuits Follow necessary safety precautions in dealing with electrical equipment.
Connect simple circuits following schematic diagrams.
Use basic electrical measuring equipment.
Produce a readable, informative laboratory report.
Prerequisite: NONE New students should complete Placement Testing prior to registration. Visiting students may submit college transcript.
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 102 A C Analysis
This course extends the basic concepts introduced in DC Analysis (TEL 101) to incorporate time-varying voltages and currents. AC (Alternating Current) circuit analysis introduces the basic behavior of capacitors and inductors, as well as series/parallel circuits. Students also learn to analyze Power (real, reactive, apparent) in various AC circuit configurations, including series/parallel resonance.
Upon successful completion of this course, students should be able to:
Convert circuit elements from time domain to phasor (complex) representation and from phasor back to time domain.
Analyze currents and voltages in Rl, Rc, Rlc circuits using phasors.
Use software simulators to obtain various currents and voltages in Rl, Rc, Rlc circuits.
Calculate reactive, apparent, and real power in single phase and multiphase circuits.
Analyze series and parallel resonant circuits.
Analyze transformer circuits.
Demonstrate knowledge of safety in the use of various test equipment.
Produce an accurate and neat laboratory report.
Prerequisite: TEL 101.
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 110 Electronics I
This course utilizes an integrated approach to learning. A topic will be introduced and discussed, developed into a practical circuit, analyzed for faults, and evaluated with a prelab using a commonly accepted software package. The circuits are built, tested and reported in the lab experiments. The course covers basic semiconductor theory, Diode theory, Zener diodes, special use diodes and LEDs. Biopolar transistors to include biasing, D.C. load lines, transistor operation and data sheets are discussed. Power supply circuits and transistor amplifiers are analyzed. Experiments are performed in conjunction with all major topics to reinforce theory.
Upon successful completion of this course, students should be able to:
Define the properties, characteristics and applications of semiconductors and diodes.
Describe and demonstrate the concepts of biopolar transistors.
Evaluate the different characteristics and properties of transistor amplifiercircuits.
Define the characteristics and application of field effect transistors.
Describe the properties and demonstrate the concepts of power supplies.
Prerequisite: TEL 101.
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 111 Electronics II
This course covers differential amplifiers, operational amplifier operation, basic OP-AMP circuits, OP-AMP design considerations, components and timers as well as audio circuits to include audio amplifiers, power amplifiers and filters. Experiments are performed in conjunction with all major topics to reinforce theory.
Upon successful completion of this course, students should be able to:
Define the properties, characteristics and applications of operational amplifiers.
Recognize and describe the operation of basic OP-AMP circuits.
Describe the OP-AMP design concepts.
Describe the basic concept of the voltage regulator, voltage references and current reference.
Describe the concepts of audio circuits.
Prerequisite: TEL 110.
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 121 Digital Electronics
This course is a basic electronics course dealing with digital techniques and circuits. The operation of digital logic gates as well as integrated circuit families used in digital equipment are discussed. Boolean algebra is used to analyze, design and troubleshoot combinational digital circuits. Flip-flops, counters and shift registers are also considered. Practical applications of digital techniques are discussed and implemented in the weekly two-hour lab sessions. Lab design and measurements of the digital circuitry are also verified with computer simulation.
Upon successful completion of this course, students should be able to:
Discuss the applications and advantages of using digital techniques.
Implement logic functions using standard digital logic elements.
Discuss flip-flops, counters and registers.
Design and troubleshoot elementary digital circuits.
Prerequisite: TEL 101 and TEL 110* (*Course may be taken concurrently).
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 124 Microprocessor I
This covers the basics of microprocessor architecture and programming. Technical terms and conventions, program execution and addressing modes, and computer arithmetic and logical operations are covered in detail. Intel's 8085 microprocessor is used to illustrate programming and architecture concepts incorporated in Intel's more advanced microprocessors. Programming exercises are performed on the Hewlett Packard trainer in weekly 2 hour lab sessions.
Upon successful completion of this course, students should be able to:
Interpret binary, octal, hexadecimal, and ASCII codes and number systems.
Define basic microprocessor terminology.
Describe the operation of a microprocessor.
Define basic programming terminology.
Describe the features of the 8085 microprocessor.
Write assembly programs using proper syntax.
Use basic flowchart techniques to clarify and troubleshoot program execution.
Execute programs and verify results using the Hewlett-Packard microprocessor trainer.
Prerequisite: TEL 101 and TEL 121* (*Course may be taken concurrently).
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 126 Microprocessor II
This course is a continuation of the study of microprocessors. Hardware and software concepts covered in Microprocessors I (TEL 124) are integrated into a study of the interfacing of various I/O devices. Hardware and software experiments are performed using the Hewlett-Packard trainer.
Upon successful completion of this course, students should be able to:
Describe how to interface to the 8085 MPU.
Describe and program various programmable devices, such as the 8155, 8255A, 8254 and 8251A.
Interface D/A and A/D converters to the 8085 MPU.
Describe serial I/O and data communications.
Describe the use of interrupts in interfacing with I/O devices.
Prerequisite: TEL 124.
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 128 Computer System Electronics
The fundamentals of various components used in microcomputer systems and their hardware/software support are discussed. Methods of determining system faults at the system, unit, board and component levels are studied. Typical computer/digital systems and test equipment are introduced in the weekly laboratory session.
Upon successful completion of this course, students should be able to:
Diagnose and troubleshoot hardware and software problems.
Analyze signal flow at systems level.
Differentiate between software and hardware problems.
Construct hardware prototypes.
Generate software.
Perform system calibration and testing.
Interface various computer devices and accessories.
Prerequisite: TEL 126.
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 190 Electronics Internship (1 credit)
College-Sponsored Experiential Learning (CSEL) is designed to integrate on-the-job learning experiences with classroom studies. These experiences are structured either to explore career options or to prepare for a specific occupation. Students participating in the Cooperative Education and Internship Program gain college credit and are graded for their learning/work experience by the appropriate faculty. Students participating in this 60 hour internship will earn 1 college credit for this experience. Upon successful completion of this hands-on work experience, the student should be able to satisfy instructionally selected competencies from those below according to the number of credits to be awarded. NOTE To be eligible for an internship, students must: Have completed a minimum of 18 or more credits within the last 5 years. Have begun course work in their major (at least 9 credits). Have an overall grade point average (GPA) of 2.5. Obtain a written recommendation by a DCCC faculty within the discipline of the internship. Submit a current resume to the Office of Student Employment Services.
Upon successful completion of this course, students should be able to:
Explain three program-related concepts that have been applied during the work experience.
Describe the ways that technology is utilized in the work experience.
Analyze the culture of the host organization.
Analyze an operational process within the work experience.
Demonstrate how assigned tasks depend on successful communication.
Describe how time and activity are managed to meet work-imposed deadlines.
Describe an instance where problem-solving skills were needed to analyze a situation in the work experience.
Formulate a self-assessment for career growth and personal satisfaction.
Satisfy the competencies of the chosen CSEL placement (to be developed in consultation with the CSEL instructor).
Work closely with a faculty mentor in the student's program/major to complete a project which articulates how the experience helps the student achieve program outcomes.
1 Credit

TEL 194 Electronics Internship (2 credits)
College-Sponsored Experiential Learning (CSEL) is designed to integrate on-the-job learning experiences with classroom studies. These experiences are structured either to explore career options or to prepare for a specific occupation. Students participating in the Cooperative Education and Internship Program gain college credit and are graded for their learning/work experience by the appropriate faculty. Students participating in this 120 hour internship will earn 2 college credits for this experience. Upon successful completion of this hands-on work experience, the student should be able to satisfy instructionally selected competencies from those below according to the number of credits to be awarded. NOTE To be eligible for an internship, students must: Have completed a minimum of 18 or more credits within the last 5 years. Have begun course work in their major (at least 9 credits). Have an overall grade point average (GPA) of 2.5. Obtain a written recommendation by a DCCC faculty within the discipline of the internship. Submit a current resume to the Office of Student Employment Services.
Upon successful completion of this course, students should be able to:
Explain three program-related concepts that have been applied during the work experience.
Describe the ways that technology is utilized in the work experience.
Analyze the culture of the host organization.
Analyze an operational process within the work experience.
Demonstrate how assigned tasks depend on successful communication.
Describe how time and activity are managed to meet work-imposed deadlines.
Describe an instance where problem-solving skills were needed to analyze a situation in the work experience.
Formulate a self-assessment for career growth and personal satisfaction.
Satisfy the competencies of the chosen CSEL placement (to be developed in consultation with the CSEL instructor).
Work closely with a faculty mentor in the student's program/major to complete a project which articulates how the experience helps the student achieve program outcomes.
2 Credits

TEL 199 Electronics Internship (3 credits)
College-Sponsored Experiential Learning (CSEL) is designed to integrate on-the-job learning experiences with classroom studies. These experiences are structured either to explore career options or to prepare for a specific occupation. Students participating in the Cooperative Education and Internship Program gain college credit and are graded for their learning/work experience by the appropriate faculty. Students participating in this 180 hour internship will earn 3 college credits for this experience. Upon successful completion of this hands-on work experience, the student should be able to satisfy instructionally selected competencies from those below according to the number of credits to be awarded. NOTE To be eligible for an internship, students must: Have completed a minimum of 18 or more credits within the last 5 years. Have begun course work in their major (at least 9 credits). Have an overall grade point average (GPA) of 2.5. Obtain a written recommendation by a DCCC faculty within the discipline of the internship. Submit a current resume to the Office of Student Employment Services.
Upon successful completion of this course, students should be able to:
Explain three program-related concepts that have been applied during the work experience.
Describe the ways that technology is utilized in the work experience.
Analyze the culture of the host organization.
Analyze an operational process within the work experience.
Demonstrate how assigned tasks depend on successful communication.
Describe how time and activity are managed to meet work-imposed deadlines.
Describe an instance where problem-solving skills were needed to analyze a situation in the work experience.
Formulate a self-assessment for career growth and personal satisfaction.
Satisfy the competencies of the chosen CSEL placement (to be developed in consultation with the CSEL instructor).
Work closely with a faculty mentor in the student's program/major to complete a project which articulates how the experience helps the student achieve program outcomes.
3 Credits

TEL 200 Electro and Mechanical Systems
This course examines the behavior of electrical and mechanical components used in interfacing the machine environment to the outside world. The course concentrates on the behavior of input and output devices used to detect, measure and control mechanical, thermal, fluid, optical and electrical processes.
Upon successful completion of this course, students should be able to:
Analyze the characteristics and behavior of various input devices and transducers.
Analyze the characteristics and behavior of various output devices.
Describe various methods of modifying analog output signals of devices using amplification and filtering.
Describe various methods of modifying digital output signals of devices using digital techniques and devices including analog-digital/digital-analog converters.
Describe various feedback techniques (from detection, modification and control) used to control various processes.
Develop skills to troubleshoot input sensors, output devices and controllers.
Be able to use various test equipment to localize probable faults in a control system.
Prerequisite: TEL 110.
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 202 Biomedical Instrumentation
This course provides a perspective on the essential aspects of biomedical equipment. It covers practical matters such as operation, calibration, maintenance and troubleshooting of medical equipment. Topics covered by this course include an overview of the human body, the heart and the circulatory system. It also covers electrodes and transducers, bioelectric amplifiers, electrocardiographs, intensive care units, electro-optics, computers in biomedical equipment and electrical safety in the medical environment. Experiments are performed in conjunction with all major topics to reinforce theory.
Upon successful completion of this course, students should be able to:
Define major systems, characteristics and principle functions of the human body.
Describe the characteristics and properties of electrodes, transducers and bioelectric amplifiers.
Describe the fundamentals and properties of electro-cardiographs, the intensive care unit and operating rooms.
Define electrical safety as applied to medical institutions.
Define the characteristics and the properties of electro-optics in the biomedical field.
Describe the operation and the characteristics of computers used in Biomedical Equipment.
Prerequisite: TEL 101 and TEL 110 and TEL 111*. (*Courses may be taken concurrently.)
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 210 Troubleshooting and Repair
This course is an applied course in Electronics, which aims to provide the student with clear and concise instruction on how to repair consumer electronic equipment. Students will discuss the operation of basic electronic systems such as amplifiers, power supplies, stereo receivers and CD players. Schematic diagrams and block diagrams will be studied for call type of device. The techniques utilized in this course are universally applicable in all types of electronic equipment regardless of their application. Theory and applications acquired in pre-requisite electronic courses will be applied to Troubleshooting and Repair.
Upon successful completion of this course, students should be able to:
Demonstrate a process for finding fault in electronic circuits.
Demonstrate the techniques used to locate various faults in a basic guide amplifier system.
Demonstrate the ability to solder and desolder components in a PC board.
Analyze and define the operation of a basic split DC power supply.
Utilize the manufacturers' service manual for repair and adjustments for pioneer models SX-251R and PD-102.
Demonstrate the ability to repair a stereo receiver Pioneer Model Sx-251R and a CD player Pioneer Model PD-102.
Prerequisite: TEL 110.
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 260 Materials, Safety, Health Issues and Equipment
This course provides an overview of basic nanofabrication processing equipment and material chemistry and handling procedures. The focus is on cleanroom protocol, safety, environmental and health issues in equipment operation and materials handling. Safety and health issues will be covered for the following topics: cleanroom operation; vacuum pump systems operation; furnace operation; chemical vapor deposition system operation; and vacuum deposition/etching system operation. Specific materials handling issues will include deionization water, solvents, cleaners, ion implantation sources, diffusion sources, photoresists, developers, metals, dielectrics, and toxic, flammable, corrosive, and high purity gases as well as packaging materials.
Upon successful completion of this course, students should be able to:
Identify the basic nanofabrication processing equipment.
Describe the uses and applications of the basic nanofabrication processing equipment.
Identify safety hazards associated with nanofabrication.
Explain the fundamentals of vacuum technology including pumps, components, and metrology.
Identify materials used in nanofabrication manufacturing.
Operate material metrology equipment.
Associate the material handling issues with each identified nanofabrication material.
Explain basic chemical properties of materials.
Summarize basic cleanroom operation and protocol.
Demonstrate an understanding of basic cleanroom operation and protocol.
Prerequisite: TEL 111 and TEL 121 and TEL 210 and MAT 210 and ENG 112 and TEL 261* (*May be taken concurrently.)
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 261 Basic Nanofabrication Process
This course provides an overview of basic processing steps in Nanofabrication (contact lithography, basic etching and deposition techniques). The majority of the course details a step-by-step description of the equipment and processes needed to fabricate devices and structures. Processing flow will be examined for structures such as microelectronic devices including diode and the MOS capacitor. Students receive an in depth introduction to basic lithography from wafer preparation to final inspection. Contamination issues in nanofabrication are discussed in detail. Students will learn the similarities and differences in both equipment and process flows for each configuration by undertaking "hands-on" processing.
Upon successful completion of this course, students should be able to:
Perform basic lithography processes.
Operate contact lithography equipment.
Operate optical microscopes and imaging software.
Operate metrology equipment.
Explain electrical characterization equipment.
Describe the basic steps in p-n junction diode process flow.
Identify the equipment in p-n junction diode process flow.
Explain the complete p-n diode manufacturing process in a class 10 cleanroom.
Describe the basic steps in a MOS capacitor process flow.
Identify the equipment in a MOS capacitor process flow.
Compare the similarities and differences in equipment and process flow for the process flows listed above.
Prerequisite: TEL 260* (*May be taken concurrently.)
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 262 Thin Film in Nanofabrication
This course covers advanced thin film deposition and etching practices in nanofabrication. Advanced deposition techniques covered in the first part of the course include atmosphere, low-pressure and plasma enhanced chemical vapor deposition, sputtering, thermal and electron beam evaporation. The study of materials includes dielectrics, polysilicon and metals. The second part of the course focuses on advanced etching practices and techniques emphasizing reactive ion etching, high-density plasma systems, ion beam etching, and wet chemical etching. Students will receive hands-on experience in depositing and etching dielectric, semiconductor, and metallic materials using state-of-the-art tools and practicing many of the steps critical to nanofabrication of semiconductor devices including microelectronics, MEMs devices, display structures, and structures used in the biotechnology fields.
Upon successful completion of this course, students should be able to:
Explain all chemical vapor deposition (CVD) processes used in nanofabrication.
Explain the operation of CVD equipment.
Describe the uses of different CVD thin films in nanofabrication.
Explain all physical vapor deposition (PVD) processes used in nanofabrication.
Set up and operate equipment to perform PVD.
Describe the uses of different PVD thin films in nanofabrication.
Explain the processes in wet chemical etching techniques.
Set up and operate equipment to perform wet chemical etching.
Describe the uses of wet chemical etching techniques.
Explain the processes in plasma etching techniques used in nanofabrication.
Set up and operate equipment to perform plasma etching.
Describe the uses of plasma etching techniques.
Operate a scanning electron microscope for materials characterization.
Prerequisite: TEL 260 and TEL 261.
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 263 Lithography for Nanofabrication
This course covers all aspects of advanced lithography from design and mask fabrication to pattern transfer and inspection. The course is divided into three major sections. The first section describes the advanced lithographic process from substrate preparation to exposure. Most of the emphasis is on understanding the nature and behavior of photoresist materials. The second section examines systems and techniques that define patterns. This section will introduce specialized optical masks and reticles, aligners, steppers and scanners. In addition, critical dimension (CD) control and profile control of photoresist will be investigated. The last section will discuss advanced optical lithographic techniques such as phase shifting masks and illumination schemes as well as e-beam, e-ray, EUV, and ion beam lithography. A section about engineering dielectrics is also discussed.
Upon successful completion of this course, students should be able to:
Explain the process steps necessary to produce a photolithographic pattern in positive, negative and chemically amplified resists.
Describe the nature and behavior of photoactive materials such as BCB.
Describe all lithographic techniques in nanofabrication.
Explain mask layout and fabrication for photolithography.
Describe and perform alignment and registration in photolithography.
Identify the equipment used in photolithography.
Set up and operate equipment used in photolithography.
Modify profiles in photoresist for liftoff applications.
Prerequisite: TEL 260 and TEL 261.
3 Credits3 Weekly Lecture Hours

TEL 264 Materials Modification in Nanofabrication
This course will cover in detail the processing steps used in modifying material properties in nanofabrication. An intensive study of metals used in nanotechnology aids the student in understanding the various methods of metalization such as CVD, evaporation, and sputtering. Metal applications for interconnect technologies will be examined. Aluminum, refactory metals and copper deposition techniques and characterization will be discussed in detail along with topics such as diffusion barriers, contact resistance, electromigration, corrosion, stress effects, and adhesion. Other modification technologies such as ion implementation, diffusion and surface preparation and treatment are integrated as well. An intensive study of dielectric properties and materials including dielectric constant engineering, mechanical, optical, and electrical characteristics, poly, BSG, PSG, SOG, and BPSG gives the student further insight into advanced device fabrication. Material properties and basic device structures will be discussed for the optoelectronic market.
Upon successful completion of this course, students should be able to:
Contrast thermally grown oxides with spin on dielectrics.
Identify the processing equipment for slicing, etching and polishing.
Describe the procedures for slicing, etching, polishing, and epitaxial growth.
Perform advanced fabrication techniques.
Determine the processing parameters of dielectric materials.
Explain the concept of engineering dielectric constants for different nanofabrication applications.
Explain metalization techniques and processing equipment.
Select appropriate materials to match the design needs of nanofabricated devices.
Describe the process of direct bandgap photonic emission.
Examine common materials and properties for the optoelectronic market.
Describe the need for optoelectronic devices.
Prerequisite: TEL 260 and TEL 261 and TEL 262 and TEL 263.
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 265 Characterization, Packaging and Testing of Nanofabrication Structures
This course examines a variety of techniques and measurements essential for controlling device fabrication and final packaging. Students will revisit concepts such as residual gas analysis introduced in TEL 261, optical emission spectroscopy (OES) and end point detection as introduced in TEL 263. Characterization techniques such as surface profilometry, advanced optical microscopy, optical thin film measurements, ellipsometry, and resistivity/conductivity measurement will be implemented on nanofabricated samples. Basic electrical measurements on device structures for yield analysis and process control will also be stressed. These will include breakdown measurements, junction testing, and C-V and I-V tests and simple transistor characterization. In addition, students will examine mechanical as well as electrical characterizations of nanostructures for biological/biomedical applications. The students will perform DNA analysis by learning and performing the polymerase chain reaction for DNA replication. They will also study and manufacture microfluid channels for biological analysis. An extensive overview of biology will be given with emphasis on biocompatible materials. The students will also learn about the manufacturing issues involved in subjects such as interconnects, isolation, and final device assembly. The importance of planarization techniques such as deposition/etchback and chemical/mechanical polishing will be emphasized. Lastly, packaging procedures such as die separation, inspection bonding, sealing and final test for both conventional IC's and novel MEM and biomedical devices will be examined.
Upon successful completion of this course, students should be able to:
Describe various process monitoring techniques used in nanofabrication.
Design a process flow for a NMOS transistor from wafer preparation to packaging.
Present the NMOS transistor overflow in power point format, with emphasis on process interrelationships.
Describe various material characterization techniques used in nanofabrication.
Use the C/V and I/V testing techniques utilizing devices made using the process flows of TEL 262.
Identify the equipment employed for final assembly.
Explain the processes of final assembly.
Describe the importance of nanofabricated biocompatible materials.
Replicate and quantify DNA fragments utilizing the polymerarase chain reaction and gel electrophoresis.
Describe the issues associated with metalization and planarization.
Identify the equipment associated with metalization and planarization.
Operate equipment for metalization.
Describe the test procedures associated with packaging.
Describe the issues associated with packaging.
Identify the equipment associated with packaging.
Prerequisite: TEL 260 and TEL 261 and TEL 262 and TEL 263.
3 Credits2 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 301 Basic Telecommunications
This course presents an overall view of the telecommunication industry with emphasis on the systems approach. Seven major areas are discussed: basic telecommunication, television, the telephone system, satellite communication, fiber optics, fiber-optic systems and cellular radio.
Upon successful completion of this course, students should be able to:
Discuss the Federal Communication Commission (FCC) and the scope of their justification.
Describe telecommunication systems and network.
Discuss the services of the telecommunication industry.
Discuss the telephone system.
Discuss the future of the telecommunication industry.
Prerequisite: TEL 110.
3 Credits3 Weekly Lecture Hours

TEL 302 Radio Frequency Communication Systems
RF communications, noise and special communication circuits are introduced first. Various modulation techniques are then discussed in depth. Discussion of radio receivers and transmitters, wave propagation, antennas and transmission lines forms an integral part of this course.
Upon successful completion of this course, students should be able to:
Define the basic communications system.
Demonstrate a fundamental knowledge of electromagnetic waves.
Understand a variety of transmission lines and their characteristics.
Define the properties, characteristics and applications of antennas.
Distinguish the difference between time and frequency domain.
Define the concept of noise and how noise affects communications systems.

Evaluate the properties of components that make up communications systems.
Describe the properties and demonstrate the concepts and applications of phase-locked loops and synthesizers in communications systems.
Define the properties, characteristics and applications of amplitude modulation.
Define the properties and characteristics of frequency modulation.
Discuss the advantages of using single sideband transmission.
Prerequisite: TEL 301.
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours

TEL 303 Digital and Data Communications
This course provides a clear and comprehensive introduction into what makes up a data communications system. Topics such as LANS, Packet Switching and ISDN are introduced.
Upon successful completion of this course, students should be able to:
Define the properties and the characteristics of various types of carriers and services.
Distinguish the difference between various code sets.
Define the characteristics of synchronous and asynchronous transmission.
Discuss modems and interface.
Describe system networks and architectures.
Prerequisite: TEL 301.
4 Credits3 Weekly Lecture Hours
2 Weekly Lab Hours