GENERAL INFORMATION, RULES AND REGULATIONS FOR UNDERGRADUATE PROGRAMME IN ELECTRONICS AND COMMUNICATION ENGINEERING

1. Introduction:

National University pursues a policy of continuous updating and improving the four-year course curriculum having 8 (eight) semesters and carrying 147 credits for bachelor's degree in Electronics and Communication Engineering (B.Sc. Eng.). This is to take into account the modern developments in the field of Electronics and Communication Engineering, where ideas and concepts move too fast. Detailed syllabuses for all the courses have been framed keeping in view the objectives of National University in this regard. Electronics and communication Engineering discipline is to be considered in a special way, as it has got a professional backing and, a large employer group needs the services of its graduates.

2. Admission:

Students will be admitted in the first semester, first year of Electronics and Communication Engineering (ECE) in affiliated colleges/Institutes as per rules of the National University.
Students passing HSC in the current year or one year ago with minimum GPA 2.0 in SSC and HSC (Science/Diploma in Engineering/Equivalent) examination and having al least "C" grade in Physics and Mathematic can apply. Students passing General Certificate Examination (GCE) in at least 3 subjects in "O" level and 2 in "A" level and having at least "C" grade in Physics and Mathematics can apply. A one year break of study is acceptable.

3. Duration of Each Semester:

The duration of each will be 19 weeks whose breakdown is as follows:

Classes		15 weeks
Recess before semester final Examination	2 weeks	
Semester Final examination (approximately)	2 weeks	
Total		19 weeks

4. Course Designation System:

Each course is designated by a three-letter code identifying the department offering it, followed by a three-digit number having the following interpretation:

The first digit indicates years.
The second and third digits indicate courses.

5. Assignment of Credits:

The assignment of credits to a theoretical course follows a different rule from that of a practical course.

Theoretical Courses: One lecture of 1-hour duration per week per semester is equivalent to 1.0 credit.

Practical Courses: One lab session of 3-hour duration per week per semester is equivalent to 1.5 credits. 1 credit is equivalent to two hours of lab work per semester per week.

Project: The project work must be initiated in 7^{th} Semester.

6. Types of courses:

In ECE there are two types of courses: (i) core courses, which from the nucleus of the B.Sc. degree program and (ii) General Education (GED) Courses, the study of which will be useful for the students to grow as a good citizen with social values and norms. A student has to complete the entire designated course for the award of degree.

7. The Grading System:

The total performance of a student in a given course in based on a scheme of continuous assessment. For theory courses, continuous assessment in made through a set of quizzes, class evaluation, class participation, homework assignment and a semester final examination. The assessment in laboratory/practical courses is made through observation of the student at work during the class, viva-voce during laboratory hours and quizzes.
Each course has a certain number of credits, which describes its corresponding weight. A letter grade with a specified number of grade points is awarded to each course. A student's performance is measured both by the number of credits completed satisfactorily and by the weighted average of the grade points earned. A minimum grade point average (GPA) is essential for satisfactory progress. A minimum number of credits have to be earned in order to qualify for the degree requirements. Letter grades and corresponding grade points (as approved by the University Grants

Communication of Bangladesh) will be awarded in accordance with the provision shown below:

Letter Grade	Grade Point	Numerical Grade
A+	4.00	80% and above
A	3.75	75% to less than 80%
A-	3.50	70% to less than 75%
B+	3.25	65% to less than 70%
B	3.00	60% to less than 65%
B-	2.75	55% to less than 60%
C+	2.50	50% to less than 55%
C	2.25	45% to less than 50%
D	2.00	40% to less than 45%
F*	0.00	Less than 40%
* Subject in which the student gets F grades shall not be counted towards credit hours requirements and for the calculation of Grade Point Average (GPA) or Cumulative GPA (CGPA).		

8. Examination Rules:

There will be at least two in-course examinations to be conducted by the college/Institute for each course and marks along with the grades be submitted to the controller of examinations of the National University before the final examination. Semester final examinations will be conducted by the National University on a six months basis for each semester. Semester final examination of each theoretical course will be held for 3 hours and there will be 7 questions in which 5 questions must be answered. Each question carrying 16 marks should contain two or more parts (e.g. 1(a), 1(b), 1(c), etc.). Two examiners will evaluate the semester final examination scripts separately. If the variation of marks of the two examiners is 20% or more, a third examiner will be appointed to reexamine the scripts. The marks will be finalized by averaging of minimum variation of two examiners.

9. Distribution of Marks for Theoretical Courses:

Twenty percent (20%) of marks of all theoretical courses shall be allotted to two in-course examinations each for 7.5%. The answer scripts of in-course examinations may be sent to the Controller of Examination of the National University if required. The rest of the marks (80%) for each theoretical course will be allotted to the semester final examination, which will be conducted centrally by the National University. There are internal and external examiners for each course in the Semester final examination. Distribution of marks for a given theoretical course is as follows:

In the case of in-course assessment 5% marks out of the allocated 20% will be awarded on the basis of attendance as follows:

90% and above		5%
85% to less than 90%		4%
80% to less than 85%		3%
75% to less than 80%		2%
60% to less than 75%		1%
Less than 60%		0%
In-course examination	7.5%+7.5%+5% = 20%	
Semester final examination (3 hour duration)	= 80%	
Total Marks		= 100%

10. Distribution of Marks for Practical Courses:

The practical semester final examinations have to be conducted by internal and external examiners. The practical final examination that is conducted centrally by the National University will be held on 60 marks for each course. Marks distribution of each practical course is stated below:

In-course examinations (Practical)	= 40%
Semester Final Examination (3 hours)	= 60%
Total	= 100%

Distribution of 60% practical marks:

Electronics/ Hardware/ Communication/ Equivalent Other Labs	**Percentage of total**	**Programming/ Software/ Equivalent Other Labs**	**Percentage of Total**
Design	15%	Algorithm	15%
Circuit Implementation	20%	Coding	20%
Result	15%	Result	15%
Experiment Related Viva	10%	Experiment Related Viva	10%

11. Evaluation of Project work:

The project work will convey 200 marks. The evaluation of the project work, for grading will be as follows:

Project Defense	50% Marks
Project Report	50% Marks

A panel of examiners appointed by the National University will conduct the project defense and also examine the project report. The project evaluation can be conducted by one or more centers, selected by the National University. At least two members for the panel of examiners must be present for project defense and evaluation.

12. Calculation of GPA and CGPA:

Grade point average (GPA) is the weighted average of the points obtained in all the courses passed/completed by a student. For example, if a student passes/completes courses in a semester having credits of C_1, C_2 .....C_n and his/her grade points in these courses are G_1, G_2, ...,G_n respectively then

$$GPA = \frac{\sum_{i=1}^{n} C_i * G_i}{\sum_{i=1}^{n} C_i}$$

The cumulative Grade point average (CGPA) is the weighted average of the GPA obtained in all the semesters passed/completed by a student. For example, if a student passes/completes n semester having total credits of TC_1, TC_2, ...TC_n and his/her GPA in these semester are GPA_1, GPA_2, ...GPA_n respectively then

$$CGPA = \frac{\sum_{i=1}^{n} TC_1 * GPA_i}{\sum_{i-1}^{n} TC_i}$$

Please note that the grades earned for viva-voce (4^{th} semester) will not be taken into account for CGPA calculation. However, the grades must be shown in the transcript.

13. Numerical Example of Computing GPA and CGPA:

13.1 Example for Computing GPA:

Suppose a student has completed eight courses in a term and obtained the following grades:

Course	Credits, C_i	Grade	Grade Points, G_i	C_i*G_i
ECE-101	2.00	A+	4.00	8.000
ECE-102	3.00	A+	4.00	12.000
ECE-103	1.50	A	3.75	5.625
ECE-104	3.00	B	3.00	9.000
ECE-105	1.50	A-	3.50	5.250
ECE-106	3.00	A+	4.00	12.000
ECE-107	4.00	A	3.75	15.000
ECE-108	1.50	A-	3.50	5.250
Total	4.00			**72.125**

GPA= 72.125/19.50=3.7

13.2 Example for Computing CGPA:

Suppose a student has completed four semesters and obtained the following GPA:

Semester	Credit hours Earned, TC_1	GPA Earned, GPA_i	GPA_i*TC_i
I	19.50	3.70	72.150
II	20.50	3.93	80.565
III	21.25	3.96	84.150
IV	20.25	4.00	81.000
Total	**81.50**		**317.865**

CGPA= 317.865/81.50=3.90

14. Promotion to the Next Year:

A student has to take the required courses for a particular year, appear at the annual examination and score a minimum specified GPA/CGPA to be promoted to the next year.
Promotion to the next year will be given if a student scores minimum GPA as follows:
1st year to 2nd year: GPA 2.00 (D)
2nd year to 3rd year: CGPA 2.00 (D)
3rd year to 4th Year: CGPA 2.00 (D)

15. Minimum Earned Credit and CGPA Requirement for the degree:

The minimum CGPA requirement for the Bachelor Degree in Electronics and Communication Engineering is 2.00 and having no F grade in any course (except viva-voce).
A student must attend the viva-voce (4^{th} Semester) and the grads earned must be shown in the transcript. However the grades earned for viva-voce will not be taken into account for CGPA calculation.

16. Time Limits for the Completion of Bachelor's Degree:

A student must complete his studies for a Bachelor's Degree within maximum period of six academic years.

17. Improvement:

A student may be allowed to sit for improvement examination in order to improve his/her grade point in a particular course provided he/she has completed that course and appeared at the examination in that course and earned a grade "C" or bellow. However the following constraints will be operative:

A student is allowed to sit for improvement examination within one academic year.
A student is allowed to retake 25% of the total courses of a particular year.
A student need not attend classes for improving courses.
A student is allowed to improve only the score of final examination. The original scores of in-course examination, continuous assessment of laboratory courses and marks of oral examination will be retained.
For improving final results (after completing fourth year final examination) a student is allowed to sit for improvement examination within one academic year. He/She is allowed to retake 25% for the total courses of 4^{th} year.
It is not necessary to cancel the original results before appearing improvement examination. If the results are not improved, the original results will be retained.
For improvement examinations, the fees will be twice than the normal fees.
Retake of the courses will be mentioned in the transcripts issued.

18. Readmission:

A student who is not promoted to the next higher year may seek readmission in the present year and may continue studies as a regular student.
Marks of in-course assessment and laboratory performance assessment in the previous year may be retained by students seeking readmission, if they do not get the opportunity to repeat the courses due to late admission.
A student must complete his B.Sc. degree program within six consecutive academic years.
A student will not be allowed readmission twice in the same year.

19. Drop Out

A student failing to earn yearly CGPA for promotion from one year to the next year after taking improvement/readmission in any year shall be dropped out of the program.

20. Dean's Award:

As a recognition of excellent performance, the name of students obtaining an average CGPA of 3.75 or above in an academic year without appearing any improvement examination may be published in the list of Dean's Award of the Faculty.

21. Other General Regulation:

For any matter not carried in this guideline, rules for Graduation Program of National University will be applicable.

National University

Syllabus for B.Sc. Engineering in
Electronics & Communication Engineering
Session: 2007-2008

The B.Sc. Eng. program in Electronics and Communication Engineering (ECE) is designed to produce skilled graduates in the field to meet the growing demands of electronics and communication engineers in Bangladesh and abroad. The program consisting of 147 credits and normally extends for eight semesters, that is, four academic years.

Each 3 credit theoretical course requires 3 class hours per week for 15 weeks, that is, a total of 45 hours in each semester. Each credit of laboratory work requires at least 15 lab sessions (each of at least 2 hours duration). Each 3 credit theory course carries 100 marks, of which 20% marks are allocated for in-course assessment of class work (class tests, presentations, etc.) and the remaining 80% marks are reserved for the final examination. The duration of the final examination for each 3 credit theoretical course is 3 hours.

The duration of the final examination for each laboratory course will be at least 3 hours and the marks for each laboratory course (1.5 credits) will be 50, of which 40% marks are allocated for in-course assessment and the remaining marks are reserved for the Lab Final examination. Each viva-voce examination will be conducted for 50 marks by a committee appointed by the National University.

The minimum CGPA requirement for the bachelor's degree in Electronics and Communication Engineering is 2.00 or above and having no F grade in any course. The grading system introduced by the University Grants Commission (UGC) of Bangladesh will be followed for evaluation of the performance of the students. (Please consult the General Rules for the undergraduate program for admission requirements, semester duration, grading system, project evaluation and other relevant information.)

Semester-Wise Course Distribution:

1st Semester (Year 1)

Course Code	Course Title	Credits
ECE-101	English	3.0
ECE-102	Physics-I (Electricity, Magnetism & Optics)	3.0
ECE-103	Math - I: Differential and Integral Calculus	3.0
ECE-104	Math - II: Linear Algebra	3.0
ECE-105	Fundamentals of Computer and Programming	3.0
ECE-106	Physics – I Lab	1.5
ECE-107	Fundamentals of Computer Lab	1.5
	Total	**18**

2nd Semester (Year 1)

Course Code	Course Title	Credits
ECE-111	Physics – II (Modern Physics, Heat & Thermodynamics)	3.0
ECE-112	Math – III: Differential Equations & Complex Variables	3.0
ECE-113	Electrical Circuits – I	3.0
ECE-114	Electronic Circuits - I	3.0
ECE-115	Digital Electronics - I	3.0
ECE-116	Electrical Circuits – I Lab	1.5
ECE 117	Electronics – I Lab	1.5
	Total	**18**

3rd Semester (Year 2)

Course Code	Course Title	Credits
ECE-201	Statistics and Probability	3.0
ECE-202	Math-IV: Engineering Mathematics	3.0
ECE-203	Electrical Circuits – II	3.0
ECE-204	Electronic Circuits - II	3.0
ECE-205	Object Oriented Programming	3.0
ECE-206	Electrical Circuits – II Lab	1.5
ECE-207	Object Oriented Programming Lab	1.5
ECE-208	Electronic Circuits – II Lab	1.5
	Total	**19.5**

4th Semester (Year 2)

Course Code	Course Title	Credits
ECE-211	Fundamentals of Communications	3.0
ECE-212	Instrumentation and Measurements	3.0
ECE-213	Digital Electronics – II	3.0
ECE-214	Signals and Systems	3.0
ECE-215	Computer Architecture	3.0
ECE-216	Digital Electronics – II Lab	1.5
ECE-217	Fundamentals of Communications Lab	1.5
ECE-219	Viva Voce	2.0
	Total	**20**

5th Semester (Year 3)

Course Code	Course Title	Credits
ECE-301	Electromagnetic Fields and Waves	3.0
ECE-302	Numerical Analysis	3.0
ECE-303	Microprocessors & Assembly Language	3.0
ECE-304	Data Communications	3.0
ECE-305	Electronic Materials	3.0
ECE-306	Data Communications Lab	1.5
ECE-307	Microprocessors & Assembly Language Lab	1.5
	Total	**18**

6th Semester (Year 3)

Course Code	Course Title	Credits
ECE-311	Optical Fiber Communication	3.0
ECE-312	Digital Signal Processing	3.0
ECE-313	Industrial & Power Electronics	3.0
ECE-314	Antenna & Propagation	3.0
ECE-315	Computer Peripherals and Interfacing	3.0
ECE-316	Computer Peripherals and Interfacing Lab	1.5
ECE-317	Industrial & Power Electronics Lab	1.5
	Total	**18**

7th Semester (Year 4)

Course Code	Course Title	Credits
ECE-401	Microwave Engineering	3.0
ECE-402	Wireless Communication Systems	3.0
ECE-403	Control Systems	3.0
ECE-404	Computer Networks	3.0
ECE-405	Industrial Management	3.0
ECE-406	Computer Networks Lab	1.5
ECE-407	Wireless Communication Lab	1.5
ECE-439	Project (to be started)	
	Total	**18**

8th Semester (Year 4)

Course Code	Course Title	Credits
ECE-411	Information Theory and Coding	3.0
ECE-412	Biomedical Instruments	3.0
ECE-413	Network Security	3.0
ECE-42x	Optional (Select one from optional courses)	3.0
ECE-439	Project Report and Project Defense	5.5
	Total	**17.5**

Optional Courses		
Code	**Title**	**Credits**
ECE-420	Neural networks	3.0
ECE-421	Digital Image Processing	3.0
ECE-422	Multimedia Communications	3.0

ECE-423	High Speed Telecommunication	3.0
ECE-424	Radar and Navigation	3.0
ECE-425	Radio and Television Engineering	3.0
ECE-426	IC and VLSI Technology	3.0

The total number of credits for the Bachelor's program in Electronics and Communication Engineering is **147**, of which 2 credits are allocated for viva voce examination.

Course Contents
For Electronics and Communication Engineering (ECE)

1st Semester (Year 1)

ECE-101: English

1. Reading and Comprehension: Thematic structure, vocabulary, cohesive and rhetorical devices, grammatical items, intention/attitude of the writer, précis (i) comprehension (ii) paragraph (iii) précis (iv) essay (v) amplification (vi) dialogue-writing.
2. Structures: The sentence:
Normal group – a) determiners b) adverb c) adjective d) non-adjective e) headword f) prepositional phrase g) infinitive phrase h) participle phrase i) appositive.
Verbal group – a) the tenses b) the modal auxiliaries c) phrasal verbs
Verb Modifiers – a) adverbials of time b) adverbials of place c) adverbials of manner d) adverbials of duration, Completing sentences, correction of sentences, transformation of sentences, framing of which questions.
3. Notions and Functions: i) emotion attitudes ii) moral attitudes iii) suasion iv) intellectual attitudes v) socializing.
4. Letters: Application, Request, Enquiries, Quotations, Tender to newspaper, Formal and informal, Advertisements, etc.
5. Translations: English to Bengali and Bengali to English.
6. Technical Writing: Projects, reports, and thesis.

Recommended books:

- Advanced Learners functional English by Chowdhury & Hossain.
- Oxford English for Computing by Boeckner, Keith, and Brown.
- High School English Grammar and Composition by Waren & Martin.

ECE-102: Physics-I (Electricity, Magnetism, & Optics)

Electrostatics: Electronic charge, Conservation & quantization of charge, Coulomb's law, Electric field and field strength, Lines of force, Point charge and dipole in an electric field, Electric flux & Gauss's law, Applications of Gauss's law, Electric potential and field strength, Potential due to a point charge, Group of point charges, Potential due to continuous charge distribution, Electric potential energy.
Capacitance and Dielectrics: Capacitance, calculation of capacitance, Parallel plate capacitor with and without dielectric, Dielectric – an atomic view, Gauss's law for capacitor, The three electric vectors, Energy storage in an electric field.
Magnetism and Electromagnetism: The magnetic field, Definition of **B**, permeability of a medium, Magnetic force on a current, Torque on a current loop, Circulating charges, Ampere's law, Lines of magnetic induction, Force between two parallel current carrying conductors, **B** for a solenoid, Biot-Savart law, Faraday's law of electromagnetic induction, Lenz's law, Time varying magnetic field, Inductance and calculation of inductance; Magnetic properties of matter - paramagnetism, diamagnetism, ferromagnetism, Intensity of magnetization, Magnetization curve, Hysteresis, the three magnetic vectors, Gauss's law for magnetism, Magnetic induction and susceptibility, Magnetic circuit, Ampere turns, Comparison between magnetic and electric circuits.
Optics: Optical interference, Young's experiment, Coherence, Intensity in Young's experiment, Thin Film interference, Newton's rings, Michelson's interferometer, Diffraction, Diffraction grating, Polarization, Double refraction, Optical activity.

Recommended Books:

- Physics Part-II by David Halliday & Robert Resnick
- Fundamentals of Physics by Halliday & Robert Resnick

ECE-103: Math-I: Differential & Integral Calculus

Differential Calculus: Limits, Continuity and differentiability; Successive differentiation of various types of functions; Leibnitz`s theorem; Rolle`s theorem; Mean value theorem in finite and infinite forms; Lagrange`s form of remainders; Cauchy`s form of remainder; Evaluation of indeterminate forms by L` Hospitals rule; Partial differentiation; Euler`s Theorem; Maximum and minimum values of functions of single variable
Integral Calculus: Definitions of integration; Integration by the method of substitutions; Integration by parts; Standard integrals; Integration by the method of successive reduction; Definite integrals and its properties and use in summing series;. Beta function and Gamma function;

Recommended Books:

- Integral Calculus by Anton
- Integral Calculus by Abdul Matin
- Integral Calculus by Khose Mohammad
- Integral Calculus by B.C. Das and B. N. Mukharjhee
- Differential Calculus by B.C. Das and B. N. Mukharjhee
- Ordinary Differential Equation by B.D. Sharma

ECE-104: Math-II: Linear Algebra

Vectors in R^n, Different operations on vectors, Dot product and cross product, Norm and distance in R^n, Cauchy Schwartz theorem, Minkowski's inequality.
Linear equations and system of linear equations, Solution of linear equations.
Matrix, Different operations on matrix, Transpose matrix, square matrix, Inverse matrix, symmetric matrix.
Vector space and subspace.
Linear dependence and independence on vector space, Basis and dimensions, Rank of matrix, Coordinates.
Linear mapping, Different types of mapping, Kernel and image of linear mappings, Singular and non-singular mappings, Isomorphism, Matrix Representation.
Eigen values and Eigen vectors.

Recommended Books:

- Linear Algebra, Schaums Outline Series
- Linear Algebra by Abdur Rahman.

ECE-105: Fundamentals of Computer & Programming

Introduction: Data and Information, History of Computer, Computer Generations, Types of Computer: Mainframe, Mini and Microcomputer, Different types of Micro Computer, Expanded Computer System, Number Systems: Binary, Decimal, Octal and Hexadecimal numbers, Classification of Hardware and Software, Input and Output Devices, Primary and Secondary Storage Devices

Programming in C:
Introduction: A Simple C program, Preparing and Running a C Program.
C Fundamentals: Character Set, Identifiers, Keywords, Data Types, Constants, Variables, Declarations, Expressions, Statements, Symbolic Constants.
Operators and Expressions: Operators, Types of Operators, Library Functions, Data input and output, preparing and running a complete C program.

Control Structures: Branching: if, if.else, nested if, ladder if, switch, break, Looping: while, do..while, for, Nested control structures.
Functions: Definition and Declaration, Accessing, Processing, Function Prototypes, Passing arguments, Function Calling and Returning Values.
Arrays: Definition and declaration, Types of arrays, processing an Array, Passing arrays to functions.
Pointers: Definitions and declarations, Passing pointer to functions, Dynamic Memory Allocations, Operations on Pointers, Arrays of Pointers.
Structures and Unions: Definition, Processing, User Defined Data Types, Structure and Pointers, Passing Structures to Functions, Unions.
Data Files: Definition and Declaration, Types of data files, Creating, Opening, closing and processing files.

Recommended Books:

- Computer Fundamentals by M. Lutfar Rahman and M. Alamgir Hossain.
- Programming in C (3rd Edition) (Developer's Library) by Stephen Kochan.
- The C Programming Language (2nd Edition) by Brian W. Kernighan, Dennis Ritchie, and Dennis M. Ritchie.
- Absolute Beginner's Guide to C (2nd Edition) by Greg Perry.
- C Programming for the Absolute Beginner (For the Absolute Beginner (Series).) by Michael Vine.
- C Programming: A Modern Approach, Second Edition by K. N. King.
- C by Example (Cambridge Computer Science Texts) by Noel Kalicharan.

ECE-106: Physics – I Lab

Based on ECE-102 Physics – I.

ECE-107: Fundamentals of Computer & Programming Lab

Based on ECE-107 Fundamentals of Computer & Programming.

2nd Semester (Year 1)

ECE-111: Physics – II (Modern Physics, Heat and Thermodynamics)

Properties of Matter: Atoms, Molecules and forces between them, Bonds – ionic, covalent, metallic, Hydrogen bond and Van Der Walls force, Crystals and their types, Defects and deformations
Atomic Physics: Wave particle duality, Photoelectric effect, Quantum theory of light, X-rays and X-ray diffraction, Compton Effect, De Broglie waves, Phase and group velocities, Particle diffraction, Uncertainty principle.
Atomic Structure: Rutherford model of atom, Electron orbits, Atomic spectra, Bohr atom, Energy levels and spectra, Atomic excitation.
Quantum Mechanics: Wave function & wave equation, Time dependent Schrödinger's equation, Particle in a box, Reflection and transmission by a barrier.
Heat and thermodynamics: Temperature and thermometry, Thermal expansions and calorimetry, Heat transfer, First law and second law of thermodynamics with simple applications, Properties of thermodynamic substances.

Recommended Books:

- Concepts of Modern Physics by Arthur Beiser
- Fundamentals of Classical Thermodynamics, Richard E. Sonntag, Claus Borgnakke and Gordon V. Van Wylen., 6th ed., John Wiley & Sons, 1998.
- Engineering Thermodynamics by S.L. Somasundaram.
- Fundamentals of Engineering Thermodynamics, Michael J. Moran and Howard N. Shapiro, John Wiley & Sons.

ECE-112: Math – III:Differential Equations and Complex Variables

Ordinary Differential Equation: Degree and order of ordinary differential equations, Formation of differential equations, Solution of first order differential equations by various methods, Solution of first order but higher degree ordinary differential equations, Solution of general linear equations of second and higher orders with constant coefficients, Solution of homogeneous linear equations and its applications.
Complex Variables: Complex number system; General functions of a complex variable; Limits and continuity of a function of complex variable and related theorems; Complex differentiation and the Cauchy-Riemann Equations; Mapping by elementary functions; Line integral of a complex function; Cauchy's Integral Theorem; Cauchy's Integral Formula; Liouville's Theorem; Laurent's Theorem. Singular points; Residue; Cauchy's Residue theorem. Evaluation of residues; Contour integration; conformal mapping.

Recommended Books

- Ordinary Differential Equation by B.D. Sharma
- Complex Variables by Schaum's Outlines Series
- Functions of a complex variable by Dewan Abdul Quddus
- Functions of a complex variable by Kedar Nath Ram Nath
- Laplace Transform by Schaums Outline Series

ECE-113: Electrical Circuits – I

Electric current and Ohm's law: Modern electron theory of electricity, Effect of temperature of resistance, EMF and potential difference, Ohm's law, Electric power and energy, Heating effect of current, Concept of alternating current (AC), AC waveforms, Average and effective values of AC signals.
Laws of DC Circuit: Kirchhoff's voltage and current laws, Series and parallel networks; Network analysis - methods of branch and loop currents, Mesh analysis, nodal analysis, Bridge networks, Delta-Way conversion; Thevenin's and Norton's theorems, Maximum power transfer theorem, Millman's theorem, Reciprocity theorem.
Capacitive and Inductive Circuits: Capacitance and dielectrics, Capacitors in series and parallel, Energy storage, Transients in RC circuits, Initial values; Magnetic field, Flux density, Permeability, reluctance, Ohm's law for magnetic field, Magnetizing force, Inductance, Induced voltage, RL transients, Initial values, Inductors in series and parallel, RLC circuits with DC source.

Recommended Books:

- Introductory circuit Analysis by Robert L. Boylestad, 10^{th} edition.
- Introduction to Electric Circuits" 5^{th} edition by Richard C. Dorf.
- Electric Circuits Fundamentals, 5^{th} edition by Thomas L. Floyd.
- Electrical Circuit Analysis, Hayt and Kemmerly, published by McGraw-Hill.
- A text Book of Electrical Technologies by B.L. Theraja.

ECE-114: Electronic Circuits – I

Semiconductor Diode: Introduction to semiconductors, p-type and n-type semiconductors; p-n junction diode characteristics, diode load line, Diode applications: half and full wave rectifiers, clipping and clamping circuits, regulated power supply using Zener diode, LED and photo diodes.
Bipolar Junction Transistor (BJT): Construction and operation, amplifying action, Transistor circuit configurations (CE, CB, CC), BJT biasing, relations between alpha and beta, leakage current in a transistor, Thermal runaway of a transistor, I-V

characteristics, DC load line and Q point, transistor biasing factor, effect on bias variations, stability factor for CB and CE configuration, different methods of transistor biasing, AC load line.

Field Effect Transistors (FET): JFET construction, operation and characteristics, biasing of FET, MOSFET construction, operation and characteristics, depletion and enhancement type MOSFETs, biasing and application of depletion and enhancement MOSFETs,.

BJT small signal amplifier circuit analysis: BJT Amplifiers CE, CB, CC configurations, DC analysis of transistor circuits, Collector feedback configuration, h-parameter model of transistor. Relationship between CC, CB, CE parameters, expressions for voltage gain, current gain, input resistance and output resistance. Effects of coupling and bypass capacitor. Hybrid Pi equivalent circuit, gain bandwidth product, Frequency response, Frequency compensation, Low frequency compensation, High frequency compensation, Cascade amplifier.

FET small signal amplifier analysis: Amplifier with source resistance, Small signal model, AC small signal operation, Loading effect, Source follower (common drain) circuit, Common gate circuit, Design of FET amplifier circuits (CS, CD and CG).

Recommended Books:

- Electronic Devices by Floyd – 5th edition
- Micro-electronics by Jacob Millman and Arvin Grabel
- Electronics Devices and Circuits Theory by Robert L. Boylestad, Louis Nashelsky.
- OpAmp Applications Handbook, (Analog Devices Inc., edited by Walt Jang)
- Schaum's Outline of Electronic Devices and Circuits, Second Edition, by Jim Cathey.

ECE-115: Digital Electronics – I

Number Systems and Codes: Decimal, binary, Octal and hexadecimal number systems and conversion, BCD, Alphanumeric, Grey, Excess-3, ASCII codes.

Digital Logic: Boolean algebra, De Morgan's theorem, Logic gates and their truth tables, Canonical form of logic expressions.

Combinational Logic Circuits: Sum of Products form (SOP), Product of Sum form (POS), Max term, Min term, Algebraic simplification, designing combinational logic circuits, Simplification using K-map, K-map and don't care term.

Flip-Flops and Related Devices: Sequential circuits, NAND gate latch, NOR gate latch, Clock signal and clocked flip-flops, Asynchronous inputs of flip-flops, flip-flop timing considerations, Race-around condition, master-slave flip-flop, Flip-flop

applications, Design of synchronous and asynchronous counters, Ring counter, Johnson counter, Different types of registers, Application of counter.
Arithmetic Circuits: Half adder, Parallel binary adder, Parallel binary adder with register, Parallel adder ICs, 2's complement system and circuit, BCD adder, Subtract circuit, Multiplier circuit.
Integrated Circuit Logic Families: TTL logic family, Standard TTL and other TTL series characteristics, TTL open collector output, Tristate TTL, ECL family and its characteristics, MOS, PMOS, NMOS, and CMOS families.

Recommended books:

- Principles of Digital Electronics by T.J. Tocci.
- Modern Digital Electronics by R.P. Jain.
- Digital electronics by by Morris Mano.
- Digital Systems by M. Lutfar Rahman.

ECE-206: Electrical Circuits – I Lab

Based on course ECE-113

ECE-207: Electronics – I Lab

Based on course ECE-114 and ECE-115

3rd Semester (Year 2)

ECE-201: Statistics & Probability:

Statistics: Frequency distribution of data: Population and sample, Collection and representation of statistical data. Tabulation of data. Class intervals. Frequency distribution, discrete, continuous and cumulative distributions. Histograms and frequency polygons. Graphical representation of data.
Statistical Measures: Measures of central tendency – arithmetic mean, median, mode, geometric mean, weighted average, harmonic mean. Measures of dispersion – range, standard deviation, variance, coefficient of variation, moments, skewness, kurtosis. Correlation theory: Linear correlation, Measures of correlation and its significance. Regression and curve fitting: Linear and non-linear regression, Methods of least squares. Curve fitting.
Probability: Definition of probability and related concepts. Laws of probability, Conditional probability and Baye's theorem, Discrete and continuous random variables, Probabiloty mass functions, probability density function, Joint Distribution, Marginal and conditional distribution, Independence of Random Variables, Mathematical

expectations. Probability distributions: Binomial, Poisson and Normal distributions and their properties.
Covariance, correlation and regression: simple correlation, measures of correlation and its significance, regression and curve fitting, Linear and non-linear regression. Methods of Least squares and curve fitting, Rank correlation.
Fundamentals of time series: Introduction to time series.

Recommended Books:

- An Introduction to Statistics by S.P Gupta and M.P Gupta
- Theory and Problem of Statistics by Schaum's Outlines Series
- Basic Statistics by Abdul Jalil and Rezina Ferdouse
- Understanding Statistics by Graham Upton and Ian Cook
- An Introduction to Statistics and Probability by Dr. Nurul Islam

ECE-202: Math-IV: Engineering Mathematics

Fourier Analysis: Real and complex form of Fourier series; Finite transform; Fourier Integral; Fourier transforms and their uses in solving boundary value problems of wave equations.
Laplace Transforms: Definition; Laplace transforms of some elementary functions; Sufficient conditions for existence of Laplace transforms; Inverse Laplace transforms; Laplace transforms of derivatives. The unit step function.
Periodic function. Some special theorems on Laplace transforms; Solutions of differential equations by Laplace transforms.
Vector Algebra and Vector Calculus: Additions, subtractions, dot and cross products, triple product and their geometrical interpretation and application, differentiation and integration of vectors, line surface and volume integrals, gradient, divergence, curl and their physical significance, divergence theorem and Gauss's theorem and their applications.

Recommended Books:

- Mathematical Methods by Abdur Rahman
- Fourier Transform by Schaums Outline
- Laplace Transform by Schaums Outline
- Physical Mathematics by B.D. Gupta.

ECE-203: Electrical Circuits – II

AC Fundamentals: Basic principles of AC generators, Equations of alternating voltage and current, Attributes of a sinusoidal signal, Phase relations, Average value, RMS value, Form factor, Vector diagrams, Addition of two AC equations; Response of basic

R, L, and C elements to sinusoidal voltage and current, Frequency response of basic elements, Average power and power factor, complex Numbers, Rectangular form, Polar form, conversion between forms, Phasors.

Series and Parallel AC circuits: Impedance and Phasor diagrams, AC through series RL circuits, Frequency response of series RL circuits, AC through series RC circuits, Admittance and susceptance, AC power, Power factor, Power triangle, Series R-L-C circuits and resonance; Parallel AC circuit with R, L, and C, Resonance in parallel RLC circuit, quality factor.

AC Network Analysis in Frequency domain: Mesh circuit method, Node voltage method, Equivalent Y and Δ connections.

Polyphase Circuits: Three-phase generator, Y connected generator with Y connected load, Y-Δ systems, Δ connected generator, Systems with unbalanced loads.

Filters and Two Port Networks: One port and two port networks, High pass, low pass, band pass networks and filters, Hay power frequencies.

Complex Frequency: Network analysis in the S domain, Network response in the S plane, natural response and forced response.

Fourier Methods: Trigonometric and exponential Fourier series, Waveform symmetry, Line spectrum, Effective values and power, Application in circuit analysis

The Laplace Transform: Selected Laplace transforms, Initial value and final value theorems, Partial fraction expansions, etc.

Recommended Books:

- Introductory Circuit Analysis by Robert Boylested.
- A Textbook of Electrical Technology by B.L. Theraja.
- Schaums Outline Series on Theory and Problem of Electric Circuits by Joseph A. Edminister.

ECE-204: Electronic Circuits – II

Feedback Amplifier: Principle of feedback amplifier, Positive and negative feedback, Advantages of negative feedback - gain stability, Decreased distortion, increased bandwidth, Forms of negative feedback, Practical negative feedback circuits.

Power Amplifiers: Classification of large signal amplifiers - class A, AB, B and C, Harmonic distortion, efficiency and figure of merit of class A, AB, B; transformer - coupled amplifiers, push pull amplifiers, Complementary symmetry amplifiers, Tuned amplifiers - Single tuned circuits using BJTs and FETs, Impedance transformations and transformer coupling, Narrow band tuned amplifiers, Cascade tuned amplifiers, Synchronous and stagger tuning, Neutralization.

Oscillators: Sinusoidal oscillators, the Barkhausen criterion, Practical considerations, Analysis and design of RC phase shift oscillators, Hartley and Colpitts oscillators. Amplitude stabilizations, Crystal oscillators, Frequency stability, Stability criterion,

Operational Amplifiers: Difference amplifier; CMMR; Ideal operational amplifier; Inverting amplifier; Non-inverting amplifier; General-purpose IC operational amplifier; Integrator; Differentiator, adder, Voltage follower, Reference voltage source, V to I and I to V converter, Current amplifiers, Charge amplifiers, Differential amplifier, Instrumentation amplifier, Log and antilog amplifiers, Function generators, Precision rectifiers, Comparators, Window comparators, Schmitt trigger, Miller Sweep, Bootstrap sweep, Analog multiplier, Analog divider, Square rooters.

Recommended Books:

- Electronics Devices and Circuits Theory by Robert L. Boylestad, Louis Nashelsky.
- Op-Amp and Linear Integrated Circuits by R.L. Gayakawad.
- Op-Amp and Linear Integrated Circuits by R.F. Caoughlin.
- Schaum's Outline of Electronic Devices and Circuits, Second Edition, by Jim Cathey.
- Pulse and Digital Electronics by G.K. Mithal.
- Pulse and Digital Switching Waveforms by Millman and Taub.

ECE-205: Object Oriented Programming

Principles of object oriented programming, Beginning with C++, Tokens, Expressions and Control Structure, Functions in C++, Classes and Objects, Constructors and Destructors, Operator overloading and type conversion, Inheritance, Extending Classes, Pointers, virtual functions and Polymorphism, Managing console I/O operations, Working with files.

Recommended books:

- Object-Oriented Programming with C++ by E. Balagurusamy
- Teach Yourself C++ by Herbert Schildt
- Turbo C++ The Complete Reference by Herbert Schildt
- Turbo C++ by Robert Lafore.

ECE-206: Electrical Circuits – II Lab

Based on course ECE-203 Electrical Circuits – II.

ECE-207: Object Oriented Programming Lab

Based on course ECE-205 Object Oriented Programming.

ECE-208: Electronic Circuits – II Lab

Based on course ECE-204 Electronic Circuits – II.

4th Semester (Year 2)

ECE-211: Fundamentals of Communications

Noise: Shot noise, White noise, Gain in decibels, Signal to noise ratio.
Radio Communication systems: Amplitude modulation (AM), AM broadcast technical standards, Double sideband suppressed carrier (DSBSC), Single sideband suppressed carrier (SSB), Vestigial sideband (VSB), Phase modulation (PM) and frequency modulation (FM), Envelop detector, Product modulator, AM transmitter, Superheterodyne receiver, FM transmitters and recivers.
Pulse and digital signaling: Pulse code modulation (PCM), Delta modulation (DM), Adaptive delta modulation (ADM), Differential PCM (DPCM), Adaptive DPCM (ADPCM), Time division multiplexing (TDM), Frequency division multiplexing (FDM).
Telephony: Background and concept, The simple telephone connection, Conventional analog switching in telephone networks, Analog telephone versus digital telephone systems, Basic switching functions, Introductory switching concepts, Numbering concept for telephony, Digital switching – space division and time division.
Mobile Telephony: Mobile radio systems, How a cellular telephone call is made, The cellular system design fundamentals – Frequency reuse, channel assignment strategies, Handoff strategies, Interference and system capacity, Trunking and grade of service, Cell splitting, Multipath propagation and fading, Doppler shift, Cellular system standards – AMPS, GSM, CDMA (IS-95).

Recommended books:

- Communication Systems by Simon Haykin.
- Modern Communication Systems Principle and Applications by Loen W. Couch.
- Telecommunication System Engineering by R.L. Freeman.
- Cellular Mobile Systems Engineering, Saleh Faruque.
- Wireless Communication Principles and Practice by T.S. Rappaport.
- Fundamentals of Communication by M. Lutfar Rahman (Editor).

ECE-212: Electrical Instrumentation & Measurements

Introduction: Significance and methods of measurements, Direct and indirect methods and standard types of instruments.
Analog Voltmeters and Ammeters: Different types of analog voltmeters, Accuracy and error of analog voltmeters. Different types of ammeters, Accuracy and errors of analog ammeters.
Digital Voltmeters: Staircase ramp type, Successive approximation type, Integrating type, Delta pulse modulation type.
Digital Multimeters: DC voltage attenuator, Current to voltage converter, AC/DC converter, Resistance to voltage converter, HF/LF converter, Automation in Multimeters, Automatic polarity indication and auto ranging digital instrumentations.
Oscilloscope and Signal Generator: Single beam and dual beam types, Sampling and storage types, Sweep frequency generations, Function generators.
Analyzers: Wave analyzer, Harmonic generators, Frequency synthesizer and spectrum analyzers, Analog and digital frequency meters, Recorders and displays.
Data Acquisition: Data loggers, Data acquisition and control, PC-based instrumentation.

Recommended books:

- Instrumentation, Measurements and Feedback by B.E. Jones.
- Electronics Instrumentation and Measurement Techniques by W.D. Cooper.
- Instrumentation Technology by B.B. Jones and Butterworth.
- Industrial Instrumentation Fundamentals by A.E. Fribance.

ECE-213: Digital Electronics – II

Decoding and Encoding: Decoders, BCD to 7 segment decoder, BCD to decimal decoder, Encoders, Switch encoder.

Multiplexing and Demultiplexing: Multiplexer, Demultiplexer, MUX and DEMUX applications, Comparator, Parity generator and checker.
Converters: Digital to Analog Converter(DAC), Weighted register DAC, R-2R ladder, DAC specifications, Analog to digital converters (ADC), Digital ramp ADC, Successive approximation ADC, Flash ADC, Continuous conversion type ADC, Examples of ADC and DAC ICs, Principle of digital instruments, Digital multimeters, Phasemeters, Frequency meters.
Semiconductor Memories: Memory organization and operation, Expansion of work size and work capacity, Classification and characterization of memory, Organization of RAM and ROM, Advancements of semiconductor memories, PLA, PLD, PAL.

Recommended books:

- Principles of Digital Electronics by T.J. Tocci.
- Modern Digital Electronics by R.P. Jain.
- Digital Electronics by Morris Mano.
- Digital Systems by M. Lutfar Rahman.

ECE-214: Signals and Systems

Signals: Continuous-time and discrete-time signals, Even and odd signals, Periodic and non-Periodic signals, Deterministic and random signals, Energy and Power signal, Unit impulse and unit impulse functions; Some elementary D-T signals: Unit Sample Sequence, Step signal, Ramp & Exponential signal. Simple manipulation of D-T signals. Sampling and aliasing.
Systems: Digital System, D-T system, Block diagram representation of D-T systems. Different types of systems: Relax & Non-Relax system, Static and Dynamic system, Time Invariant and Time Variant System, Linear and Non-Linear system, Causal and Non-Causal system, Stable & Unstable system. Time Domain Representations for Linear Time Invariant Systems. Convolution theorem, Convolution sum; Correlation - Auto correlation and Cross correlation, Properties.
Fourier Representations of Signals: Discrete time periodic signals - the discrete time Fourier series Continuous time periodic signals - the Fourier series Discrete time non-periodic signals - the discrete time Fourier transform Continuous time non-periodic signals - the Fourier transform Properties of Fourier representations.
Laplace Transform: Region of convergence, Inverse Laplace transform, Analysis of LTI systems using Laplace transform.

Recommended Books:

- Communications Systems by Simon Haykin.
- Digital Signal Processing by Proakis and Manolakis.

- Signals and Systems, A.V. Oppenheim, A.S. Willsky and I.T. Young, Prentice Hall, 1983.
- Signals and Systems - Continuous and Discrete, R.F. Ziemer, W.H. Tranter and D.R. Fannin, 4th edition, Prentice Hall, 1998.
- Introduction to Signals and Systems, Douglas K. Lindner, Mc-Graw Hill International Edition: c1999.
- Signals and Systems, Simon Haykin, Barry van Veen, John Wiley and Sons (Asia) Private Limited, c1998.
- Signals and Linear Systems, Robert A. Gabel, Richard A. Roberts, John Wiley and Sons (SEA) Private Limited, c1995.
- Principles of Communication: Systems, Modulation and Noise, 5th Edition by R. E. Ziemer.

ECE-215: Computer Architecture

Overview of Computer Organization and architecture: Organization and Structure, Structure and Functions, Simple machine code sequence to illustrate action, system buses, interconnection structures (Bus structure and bus types), Interrupts and instruction cycle.
Storage and Input/Output Systems: Overview of memory system, memory chip organization and error correction, cache memory, memory storage devices. Overview of I/O, programmed and interrupt-driven I/Os, direct memory access (DMA).
Computer Arithmetic: Integer representation and arithmetic, floating-point representation (IEEE), floating-point arithmetic. Arithmetic and Logic Unit (ALU), Bit Sliced ALU
Instruction Set and Register: Computer function (fetch and execute cycles), interrupts, Machine instruction characteristics, types of operands and operations, instruction functions, addressing modes, instruction formats, instruction pipelining.
Control Unit: Micro-operations, hardwired control unit, control unit operation, micro-instruction sequencing and execution, micro-programmed control unit.
High performance computer systems: Techniques to achieve high performance, RISC, CISC, introduction to superscalar processor, parallel processor, array processor.

Recommended Books:

- Computer Organization and Architecture, 6th edition, by William Stallings.
- Computer Architecture: A Quantitative Approach by John Hennessey.
- Computer Organization and Architecture: Designing for Performance (7th Edition) by William Stallings (Hardcover - Jul 11, 2005)
- The Essentials of Computer Organization And Architecture by Linda Null and Julia Lobur (Hardcover - Feb 15, 2006)

- Computer Organization by Carl Hamacher, Zvonko Vranesic, and Safwat Zaky (Hardcover - Aug 2, 2001)
- Schaum's Outline of Computer Architecture by Nick Carter (Paperback - Dec 26,2001)

ECE-216: Digital Electronics – II Lab

Based on course ECE-213 Digital Electronics – II.

ECE-217: Fundamentals of Communications Lab

Based on course ECE-211 Fundamentals of Communications.

ECE-219: Viva-Voce

Viva-voce is based on all the courses covered in the 4th semester.

5th Semester Year 3

ECE-301: Electromagnetic Fields and Waves

Static electric field: Postulates of electrostatics, Coulomb's law for discrete and continuously distributed charges, Gauss's law and its applications, electric potential due to charge distribution, conductors and dielectrics in static electric field, flux density – boundary conditions; capacitance – electrostatic energy and forces, energy in terms of field equations, capacitance calculations of different geometries; boundary value problems – Poisson's and Laplace's equations in different co-ordinate systems, steady electric current, Ohm's law, continuity equation, Joule's law, resistance calculation,
Static magnetic field: Postulates of magneto statics, Biot-Savart's law, Ampere's law and applications, vector magnetic potential, magnetic dipole, magnetization, magnetic field intensity and relative permeability, boundary conditions for magnetic fields, magnetic energy, magnetic forces, torque and inductance for different geometries.
Time varying fields and Maxwell's equations: Faraday's law of electromagnetic induction, Maxwell's equations – differential and integral form, boundary conditions, potential functions, time harmonic fields and Poynting theorem.

Plane electromagnetic waves: Propagation and reflection of electromagnetic waves in unbounded media, plane waves in loss-less media – Doppler effect, transverse electromagnetic waves, polarization of plane waves, plane waves in lossy media, loss-less dielectrics, good conductors, group velocity, instantaneous and average power densities, normal and oblique incidence of plane waves at plane boundaries for different polarizations.

Recommended Books:

- Fundamentals of Electromagnetics with Engineering Applications, 2005, S.M. Wentworth,
- Fields and Waves in Communication Electronics, Simon Ramo, J.R. Whinnery, T.V. Duzer, 3rd Edition.
- Fields and Waves in Communication Electronics, 3rd Ed., 1989, S. Ramo, J.R. Whinnery and T. VanDuzer, Wiley.
- Elements of Electromagnetics, 3rd Ed., 2001, M.N.O. Sadiku, Oxford University Press.
- Electricity and Magnetism, K.K. Tewari.S. Chand & Company Ltd.
- Electromagnetics, J.A. Edminister, TATA McGraw Hill Edition.
- Field and Wave Electromagnetics, David K. Cheng, Addison Wesley Publishing Co., 1992, 2nd Edition.

ECE-302: Numerical Analysis

Solution of equation in one variable (Fixed-point iteration Method, Newton Raphson Method, Error Analysis), Interpolation polynomial for equal and unequal interval, Solving Systems of Linear Equations (Direct Method, Gaussian elimination with backward substitution, using matrix operation), Numerical Solution of Ordinary differential Equation (Euler Method, Runge-Kutta Method, Finite Difference Method), Numerical Differentiation and Integration (Richardson's extrapolation method, Adaptive quadrature, Trapezoidal and Simpson's rule), Illustrative programming projects and use of computer to implement the projects.

Recommended books:

- Nymerical Analysis : Richard L Burden, J. Douglas Faires, 7^{th} edition
- Numerical Analysis, Vipin and Vasishtha.
- Numerical Analysis : J.H. Mathews, Numerical Mehods for Computer Science , Engineering and Mathematics, Prentice-Hall, 1987

ECE-303: Microprocessors & Assembly Language

Microprocessors: Evaluation of Microprocessors, register and accumulator based microprocessor, programmable logic device, memory organization, I/O techniques, 8086 microprocessor: internal architecture, addressing modes, pin configuration and function, memory bank, interrupt interface, maximum/minimum mode interface, read/write cycle.
Advanced Microprocessors: Overview, internal architecture, memory management of 80186, 80286, 80386, and 80486 microprocessor. Overview of Pentium processor, co-processor, Alpha processor, and pipeline processor.
Assembly Language: Types of assembler, assembly programming basics, instruction formats, assembly instruction types: Data transfer instruction, Arithmetic and Logic instruction, shift and rotate instruction, Transfer control and conditional processing, String processing, Input/Output, Interrupts, Procedures and macro.

Recommended Books:

- Microprocessor and microprocessor based system design by M. Rafiquzzaman.
- The 8088 and 8086 microprocessors by W. A. Triebel.
- Introduction to Microprocessors by John Crisp
- INTEL Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Prentium ProProcessor, Pentium II, III, 4 by Barry B. Brey
- The Art of Assembly Language by Randall Hyde

ECE-304: Data Communications

Introduction; A data communication Model, Data Communication tasks, Data Communication networks standards, Introduction to OSI and TCP/IP models.
Data Transmission: Spectrum and bandwidth, Transmission impairments, Channel capacity and data rate, transmission media- coaxial cable. twisted pair, fiber optics, wireless transmission, electromagnetic spectrum, microwaves, radio waves, infrared and satellite communication.
Data Encoding: Digital data and digital signaling, NRZL, NRZI. Bipolar AMI, Manchester and differential Manchester encoding. Digital data and Analog signaling, ASK, FSK, PSK, QPSK, QAM and their performance. Analog data and digital signaling – PCM, DM.
Data Transmission techniques: Asynchronous and synchronous data transmission technique, EIA 232 & V.24 interface standard.
Data Link Control: Flow control, Error Detection - Parity and CRC, Error correction and Hamming code, Error Control (Stop and Wait, Go back N ARQ. Selective Reject ARQ), High-level Data Link Control (HDLC),
Multiplexing: Frequency Division Multiplexing, Synchronous Time-Division Multiplexing, Statistical Time- division Multiplexing, wavelength division multiplexing.

Data Communication Networking: Circuit switching, Space division and TDM switching, Packet switching, Virtual circuit and datagram.

Recommended books:

- Data and Computer Communications, W. Stallings, Macmillan, 6th Edition
- Computer Networks, A. S. Tanenbaum, Prentice Hall, 1996.
- Data Communications and Networking, 4/e, McGraw-Hill, Behrouz A. Forouzan

ECE-305: Electronic Materials

Structural properties: Crystalline, amorphous, polymer, binding force, elastic properties, dislocations, defects, etc. Thermal and electrical properties: specific heat, thermal expansion, thermal conductivity.
Dielectric properties of solids: Basic relationship and parameters, model of dielectric polarization, ferroelectricity and piezo-electricity.
Optical properties of solids: Classical theory, free carrier effects, lattice absorption, electrical absorption.
Magnetic properties of solids: Atomic magnetic moments, dia and paramagnetism, ferromagnetism, anti ferromagnetism, magnetic resonance.
Superconductivity: Theory of superconductivity, superconductors and some applications.
Nano-Technology: Carbon as a nano material, structure of carbon, carbon nanotube, quantum dots and nanowires.

Recommended Books:

- Electronic Processes in Materials by Azaroff and Brophy.
- Semiconductor and Electronic Devices by Streetman.
- Handbook of Nano-structured Materials and Nano Technology b H S Nawla.

ECE-306: Data Communications Lab

Based on course ECE-304 Data Communications.

ECE-307: Microprocessors & Assembly Language Lab

Based on course ECE-303 Microprocessor and Assembly Language.

6th Semester (Year 3)

ECE-311: Optical Fiber Communication

Introduction: Electromagnetic spectrum, Use of light in communication, Types of fiber Loses in fibers, Dispersion, Light sources for fibers, Photo detector, connector and splices, fiber optic communication systems, Electro--optical conversion devices (HDs, LEDs, ADDS, PINs, etc.), Circuit considerations, Repeater, Receiver, Optical switching, Optical-interconnection, Integrated--Optics, Modulation Techniques: Intensity .Modulation, Direct Detection, Fiber link, OFDM, WDM, DWDM, Free Space Optical link, Broadband optical fiber network, traps-oceanic fiber cable

Optical fibers: Modes of propagation, transmission characteristics, wave-guide analysis. Optical sources: light emitting diode (LED), and semiconductor laser diode (SLD); operational principles, characteristics curves; optical transmitter design using LED/SLD. Optical amplifiers: laser and fibre amplifier. Photodetectors: p-i-N and avalanche photodetectors (APDs), noise sources.

Transmission link analysis: Point-to-point and point-to-multi-point links, system configuration, link power budget, rise time budget, line coding schemes, transmission systems limitations, design of fibre-optic systems. Optical data buses, optical networks, fibre distributed data interface (FDDI) and synchronous optical network (SONET). SDH. Optical frequency division multiplexing (OFDM) and wavelength division multiplexing (WDM) transmission systems

Recommended Books:

- Optical Fibre Communications by John Senior Optical Fibre Communications by Cruiser, Gerdkiser.
- Opto-Electronic by Wilson and Hawks Laser Electronics by Joseph T Verdeyen.
- Optical Fiber Communications by Senior.
- Optical Communications (Wiley Series in Telecommunications and Signal Processing) by Robert M. Gagliardi and Sherman Karp.

ECE-312: Digital Signal Processing

Introduction to digital signal processing: Sampling of continuous-time and discrete-time signals, The z-transform, Linear time-invariant model of discrete-time systems, Frequency domain representation of discrete-time systems and signals.

Structure of discrete-time systems: Signal flow graph representation of digital networks, Matrix representation of digital networks, Basic network structures for FIR and IIR systems.
Digital filter design techniques: Design of FIR and IIR filters from analog filters using windows, Computer aided design techniques for filters, Discrete Fourier series and discrete Fourier transforms, Convolution and correlation, Algorithms for the computation of the DFT and FFT, Power spectrum. Adaptive Filter: characteristics, LMS, NLMS algorithms.
Digital signal processor architecture: evolution of DSP architecture, Different architecture, Important architectural element of a DSP, Application of DSP in speech and image processing, RADAR, Pattern recognition, etc.

Recommended Books:

- Digital Signal Processing: Principles, Algorithms and Applications by John G. Proakis, Dimitris Manolakis.
- Digital Signal Processing: An Overview of Basic Principles, J. Cartinhour.
- Signal Processing Algorithms in Matlab, S. D. Stearns and R. A. Davis.
- Digital Signal Processing Using MATLAB by Vinay K. Ingle.
- Schaum's Outline of Digital Signal Processing (Schaum's) by Monson H. Hayes.

ECE-313: Industrial & Power Electronics

Transducers: Active and passive transducers, Position and displacement transducers – potentiometer, LVDT; Pressure transducer; Temperature transducer; Optical transducer; Ultrasonic transducer; Flow transducer; Strain gauge transducer; Speed transducer.
Thyristors: Schottky rectifier; Zener diode; Diode and transistor packages; SRC and TRIAC; GTO; IGBT, Applications.
Triggering devices: UJT, UJT relaxation oscillator, phase control circuit, programmable UJT (PUT); DIAC; Silicon Bilateral Switch (SBS); Asymmetrical AC trigger devices.

Power Electronic Converters: Fixed output voltage and phase controlled AC/DC converters, Single phase, Three phase; DC/DC converters – Chopper regulator, Step-up, Step-down, Switch mode regulators, Thyristor chopper circuits; A simplified single phase cycloconverter; DC/AC inverter – Push-pull inverter, PWM, Transformer-less inverters, MPPT, Grid-interactive inverters.
Motor Devices: DC and AC motor devices, speed and position control of DC motor, microprocessor based motor drive.

Recommended Books:

- A course in Electrical and Electronic Instrumentation and Measurement Techniques by A K Sohani.
- Power Electronics Converters Applications and Design by N Mohan, TM Undeland and WR Robbins.
- Electronics in Industry by Chute & Chute.
- Power Electronics, Circuits, Devices and Applications by M H Rashid.
- Industrial Electronics by James T. Humphries and Leslie P. Sheets.
- Principles of Power Electronics by J G Kassakian, M F Schlecht and J C Verghese.

ECE-314: Antenna & Propagation

Definitions, Types of antennas: wire antennas, aperture antennas, array antennas, reflector antennas & lens antennas. Radiation mechanism of antenna, radiation pattern, isotropic, directional and omnidirectional pattern, principle pattern, radiation pattern lobes, field regions, radian and tertian.
Parameters: Fundamental parameters of antenna, radiation power density, radiation intensity, gain, directive gain, power gain, directivity, antenna efficiency, effective aperture, physical aperture, transmission between two antenna, radar equation, front to back ration, antenna band width, antenna beam width. Internal-equation methods, current distribution; self and mutual impedances.
Antenna arrays, design and sysnthesis. Reflector type antennas. Babiner's principles and complementary antennas. Application of reaction concept and variational principles in antennas and propagation. Frequency independent antennas, Scattering and diffraction. Selected topics in microwave antennas. Antenna measurements. Application of broadcasting, microwave links, satellite communications and radio astronomy.

Recommended Books:

- Antenna and Propagation for Wireless Communication Systems by Saunders, Simon R. Aleja.
- Radio Antennas and Propagation: Radio Engineering Fundamentals by William Gosling.
- Microwave Engineering, by David M. Pozer.
- Channels, Propagation and Antennas for Mobile Communications by Rodney Vaughan Andersen, Jorgen Bach.
- Geometric Theory of Diffraction, by Hansen Robert, C.

ECE-315: Computer Peripherals and Interfacing

Interfacing: Design and operation of interface between computer and the outside world; sensors, transducers and signal conditioning circuits, interfacing memory, system bus, IEEE 488 bus, RS-232. Study and applications of peripheral chips: Parallel ports(8255), USART(8251). Interrupt controller (8259). DMA controller (8257).
Peripherals: Keyboards, printers (dot-matrix, laser, ink-jet), VDUs, computer graphics hardware, plotters, disc-drivers, CD-ROM, A/D converters, stepper motors.

Recommended books:

- Microprocessors and Interfacing, Douglas V. Hall, McGraw-Hill
- Microprocessors Architecture Programming and Software, By Gaonkar.
- Computer Peripherals, By Barry Wilkinson.

ECE-316: Computer Peripherals and Interfacing Lab

Based on course ECE-315 Computer Peripherals and Interfacing.

ECE-317: Industrial & Power Electronics Lab

Based on course ECE-313 Industrial and Power Electronics.

7th Semester Year 4

ECE-401: Microwave Engineering

Introduction: VHF, UHF and microwave frequency ranges.
Microwave transmission lines: Transmission line equation and solution, Reflection and transmission coefficient, Standing wave and standing wave ratio, Smith chart, impedance transformation and matching.
Waveguides and components: Rectangular waveguide, Circular waveguide, Waveguide components, cavities and resonators, Directional couplers, Circulators and isolators.
Microstrip Lines: Wave propagation and micro strip lines, dielectric constants, characteristic impedance, attenuation factors.

Microwave Devices: Microwave transistor, Varactor diode, IMPATT diode, Gunn diode, Schottky barrier diode, Backward diode, Point contact diode, Klystron, Reflex Klystron, TWT and magnetron.

Recommended Books:

- Electronic Communication Systems by Kennedy, McGraw-Hill.
- Fields and Waves in Communication Technology, S. Ramo, J.R. Whinnery, Th. van Duzer, John Wiley & Sons, Inc.
- Foundations for Microwave Engineers, R. E. Collin, IEEE (John Wiley & Sons)
- Microwave Transistors, Amplifiers, Analysis and Design by Guillermo Gonzalez, Prentice Hall.
- Microwave Engineering by David M Pozar by John Wiley.
- Microwave Devices and Circuits by Leo, Prentice Hall.
- Foundations for Microwave Engineering by R E Collins, McGraw-Hill.

ECE-402: Wireless Communication Systems

Digital Modulation Technique: Modern communication systems, BPSK, DPSK, QPSK, OQPSK, MSK, GMSK, MFSK, Spread spectrum modulation techniques, DS-SS, FH--SS, Multipath channels, intelligent cells, micro and nano cells.
Satellite Communication: Introduction, Orbits, Station Peeping. Satellite altitude, Transmission path, Path loss, Noise consideration, Satellite system, Saturation flux density, Effective isotropic radiated power, Multiple access methods, Earth station antenna, satellite link, design, frequency plan, Satellite communication for Internet, VSAT Network, GNSS-GPS and Galileo Systems, GIS, Multiple Access Techniques.
Mobile Communication: Mobile-Multimedia traffic, Flow control, Bandwidth allocation, Channels, lst, 2^{nd} and 3rd generation wireless networks. Cellular mobile system engineering.
Free-space propagation : Propagation model. Multipath propagation, Propagation environment, Marine environment
Microcells: Two Ray Model, Freznel Zone, RF coverage, Indoor coverage, Outdoor coverage, computer aided Techniques, Single coverage plot, composite coverage plot, RF survey, Cellular traffic, Trunking efficiencies.

Recommended Books:

- Introduction to Wireless Systems, Shankar P.M, Wiley, 2002
- Fundamentals of Wireless Communication, Tse D. and Viswanath P., Cambridge, 2005

- Wireless Communications and Networking, Stallings W., Prentice Hall 1st Edition, 2001
- Satellite Communication Systems: Systems, Techniques, and Technology, Maral G. and Bousquet M., Wiley 4th Edition, 2002, ISBN 0-471-49654-5.
- Mobile Satellite Communication Networks, Sheriff R.E. and Fun Hun Y., Wiley, 2001.

ECE403: Control Systems

Introduction: Introduction to, control, systems, Definitions and Mathematical background.
System Equations: State concepts, Transfer function and block diagram, Mechanical translation systems, Mechanical rotational systems.
Solution of Differential Equations: Standard inputs to control systems, Steady-state response and transient response.
Laplace Transform: Definition, Laplace transform theorem, Application of the Laplace transforms to differential equations, inverse, transformation, Heaviside, partial-.fraction expansion theorems.
System Representation: Block diagrams, Determination of the overall transfer function, Standard block din grain terminology, Simulation diagrams, Signal flow graphs.
Control System Characteristics: Routh-Hurwitz stability criterion, Feedback system types, Analysis of system types, Steady-state error coefficients, Nonunity-feedback system.
Root Locus: Plotting roots of a characteristics equation, Quantitative analysis of the root locus, Open-loop transfer function, Poles of the control ratio, Application of the magnitude and angle condition.
Frequency Response: Correlation of the sinusoidal and time responses, Frequency response curves, Bode plots (Logarithmic plots), General frequency transfer function relationships, Nyquist's stability criterion, Definitions of phase margins and gain margins and their relation of stability.

Recommended books

- Linear control systems and design by John J.D. Azzo
- Control engineering by C.C. Bissel
- Modern control systems by RR Dorf

ECE-404: Computer Networks and Internet

Introduction: Introduction to computer Networks, Protocols and Architecture-TCP/IP protocol suit, The OSI Reference Model,

Local Area Networks and the Medium Access Sublayer: LAN Technology, Architecture. Topology, Wireless LAN, Ethernet and Fast-Ethernet, and Gigabit Ethernet Multiple access – CSMA/CD, CSMA/CA. Token Ring and FDDI, Bridges, Bridges operation, Switches, Wireless LAN.
Frame relay and Cell Relay: Frame Relay services and protocol, ATM overview, ATM LAN.
Internetworking: principles of internetworking, connectionless & connection oriented internetworking. The Internet protocol, Routing Protocol, IPv6, ICMPv6.
The Transport Layer: The transport service, transport service primitives, socket primitives, TCP & UDP.
Distributed Applications: Simple Network Management Protocol -SNMPv2, Electronic mail - SMTP and MIME, Hypertext Transfer protocol (HTTP), Video on Demand.

Recommended books:

- Data and Computer Communications. - W. Stallings, Macmillan, 6th Edition.
- Computer Networks, -A.S. Tanenbaum, Prentice Hall, 1996.
- Data Communications and Networking, 4/e, McGraw-Hill, Behrouz A. Forouzan

ECE-405: Industrial Management

Introduction, evolution, management function, organization.
Organization: Theory and structure, coordination, span of control, authority delegation, groups, committee, and task force, manpower planning.
Personnel management: Scope, importance, need hierarchy, motivation, job redesign, leadership, participative management, training, performance appraisal, wages, and incentives, informal groups, organization change and conflict.
Cost and Financial Management: elements of costs of products, depreciation, Break-even analysis, Investment Analysis, Benefit cost analysis.
Management accounting: cost planning and control, budget and budgetary control, development planning process.
Marketing management: concepts, strategy, sales promotion, patent laws.
Technology management: management of innovation and changes, technology lifecycle.

ECE-406: Computer Networks Lab

Based on course ECE-404 Computer Networks.

ECE-407: Wireless Communications Lab

Based on course ECE-402 Wireless Communication Systems.

8th Semester (Year 4)

ECE-411: Information Theory and Coding

Block and Convolutional Codes for High Spectral Efficiency: Trellis Coded Modulation (TCM), Coding with Diversity. Turbo Codes. And Iterative Decoding: MAP Algorithms. ARQ schemes. General concepts of coding theory. Noise and error correcting codes. Linear codes including the Hamming, Golary, the Reed-Muller codes, Finite and Number Fields. Algebraic Function fields, algebraic curves and their applications, Cyclic codes (including the BCH, Reed-Solomon, Justesen, Goppa, and Quadratic Residue codes). Decoding techniques for some of these codes. Application to information processing. Information measures: entropy, relative entropy, and mutual information, Asymptotic equipartition theory, Entropy rates, source coding and data compression, unannei capacity, Differential entropy and Gaussian channel, Rate-distortion theory.

Recommended Books:

- Information and Coding Theory (Springer Undergraduate Mathematics Series) by Gareth A. Jones, J.Mary Jones.
- Theory of Information & Coding by Robert McEliece.
- Fundamentals of Information Theory and Coding Design (Discrete Mathematics and Its Applications) by Roberto Togneri, Christopher J. S. Desilva.
- Digital Communication by Simon Haykins.
- Information Theory by Thomas & Cover.
- The Theory of Information and Coding: Student Edition (Encyclopedia of Mathematics and its Applications) by R. J. McEliece (Hardcover - Aug 2, 2004)

ECE-412: Biomedical Instruments

Human Anatomy & Physiology: Anatomy & Physiology of major systems of the body - generation & propagation of Bioelectric potentials.Transducers, Leads & Electrodes: Transducers for biological applications types, properties, characteristics & selection.
Leads & Electrodes: Types, materials, properties, characteristics. Method of application and selection - equivalent circuits of leads & electrodes. Fundamentals of

biomaterials: Compatability studies of metals, ceramic plastics used in the inplantable devices.
EEG : Working principles, lead system & clinical applications
EMG : Working principles, & clinical applications. Evoked potential systems, Audiometry.
Theraputic instruments: Diathermy, defibrilletor, cardiac pacemakers, stimulators. Power source for implantable devices.Laser Applications in machine.
X-Rays: Production & use in machine, basics of radiography, diagnostic & therapeutic - X-Ray film construction and processing, interaction with body. Fundamentals of Radiation Therapy.
Blood pressure - Diastolic & Systolic measurement by invasive and non invasive methods - Ultra sound, Spygmomanometer Automated methods - direct methods.
Blood flow: Electro-magnetic, Ultrasound, Blood cell counters. Applications of Ultra sound-basic physics of Ultra sound generation, Echo cardiography, Modes of Scan, Doppler measurements, Biological effects - colour doppler.

Recommended books:

- Principles of Applied Biomedical Instrumentation, Geddes & Baker..
- Biomedical Instrumentation and Measurements, Cromwel..
- Hand book of Bio -medical Instrumentation, R.S. Kandpur..
- Fundamental Physics of Radiography, Massey & Meridith..
- Medical Physics , Christanson..
- Hand book of Analytical Equipment, R.S. Kandpur.

ECE-413: Network Security

Cryptography and Cryptography Algorithms: Traditional cryptography, Cryptanalysis, Private-key (Symmetric-key) and Public-key (asymmetric-key) cryptographic algorithms, DES and Block cipher modes, Advanced Encryption Standard (AES), RSA and other public key cryptosystems, Key Management, Diffie-Hellman key exchange, Elliptic curve cryptography. Cryptographic hash functions, Secure Hash Algorithms, Message authentication codes, Digital signatures and digital signature standard.
Cryptography and Network Security: Data origin authentication and Data integrity, Key distribution, Key management, Kerberos and X.509 authentication service, Certificate authority (CA) and public key infrastructure (PKI), E-mail security, PGP and S/MIME, IP security (IPSec), Authentication header and ESP, Security associations, key management, Oakley key determination protocol and ISAKMP, Web security considerations, secure socket layer (SSL) and transport layer security (TLS), Secure electronic transactions (SET).

Recommended books:

- Hand Book of Applied Cryptography - Menezes, Van Oorschot and Vanstone, CRC Press.
- Cryptography and Network Security, Principles and Practice - William Stallings, Printece Hall.
- Applied Cryptography - Bruce Schneier.
- Network Security - Kaufman, Perlman and Speciner.

Optional Courses

ECE-420: Neural networks

Preliminaries: Neural computations, Classifiers, Approximators, Simple memory and restoration patterns, Optimizing networks, Clustering and feature detecting networks, Development of artificial neural systems, Future trends.
Fundamental concepts and models of artificial neural systems: Biological neuron and their artificial models, Models of artificial neural networks, McCulloch's Pitts neural model, Feed forward and feedback network, Neural processing, Learning and adaptation, Neural network learning rules, Associative memory, BAM, MAM, FAM, Hopfield networks, Self organizing networks, ART networks, Back propagation network.
Applications of neural algorithm and systems: Character recognition, Control networks, Robot kinematics, Expert systems.

Recommended books:

- Introduction to Artificial Neural Systems by Jacek M. Zurada.
- Artificial Intelligence by E Rich, McGraw-Hill
- Neural Networks, A Comprehensive Foundation, 2nd edition, by Simon Haykin, Prentice-Hall, 1999.
- Neural Networks: Algorithm, Applications, and Programming Techniques, J. Freeman and D. Skapura, Addison-Wesley, 1992.
- Adaptive Pattern Recognition and Neural Networks, Y-H Pao, Addison-Wesley, 1989.

ECE-421: Digital Image Processing

Fundamentals of Digital Image Processing: Formation of an image**,** Imaging in the ultraviolet band, Imaging in the visible band, Imaging in the microwave band, imaging in the radio band, X-ray imaging, gamma ray imaging, Components of an image processing system, Steps in DIP,
Digital Image: Elements of visual perception – structure of the human eye, image formation in the eye.
Image Sensing and Acquisition: Image sensor, Sensor strip, Sensor arrays, Image formation model.
Image Sampling and Quantization: representing digital image, Basic relationship between pixels, Image operation on pixel basis,
Image Enhancement in the Spatial Domain: Gray level transformations, Histogram processing, Enhancement using arithmetic logic operations, spatial filtering, Smoothing and sharpening spatial filters.
Image Enhance in the Frequency Domain: Fourier transform, 1D and 2D FT, Properties of 2D FT, DFT, FFT; Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering.
Image Restoration: Model of image restoration process, Restoration in the presence of noise, Estimation of the degradation function.
Color Image Processing: Color models, Color Image processing, Color transformation, Color Image compression.
Wavelet and Multiresolution Processing: Wavelet transforms.
Image Compression: Image compression models.

Book references:

- Digital Image Processing by rafael C. Gonzalez and Richard E. Woods..
- Fundamentals of Digital Image Processing, Anil K. Jain, Prentice Hall, 1989.
- Digital Image Processing, Gonzalez and Woods, 2nd edition, Prentice Hall, 2001.
- Digital Image Processing, William K. Pratt, 3rd Edition, John Wiley, 2001.
- Digital Image Processing, Kenneth R. Castleman, Prentice Hall, 1996.

ECE-422: Multimedia Communication

Fundamentals, Introduction of international standards, Image coding: DCT/subband/VQ, Image coding: JPEG, Video coding: ITU-T H.261, H.263, H.263 Version 2, Video coding: ISO MPEG-1, MPEG-2 , MPEG audio coding, ITU-T speech coding: G.72x, MPEG-4 Video, Systems: ITU-T H.320, H.323, H.324, etc., Systems: MPEG-1, MPEG-2, MPEG-4 Systems, Multipoint data conferencing: T.120, Networking issues: error resilience, network characteristics, Quality of Service (QoS),

Error resilience in video codecs: H.26x and MPEG, Multimedia over IP: Multicast, RTP/RTCP, packetization, streaming, Multimedia over ATM, Multimedia over wireless/mobile networks.
This course introduces technologies for multimedia communications. We will address how to efficiently represent multimedia data, including video, image, and audio, and how to deliver them over a variety of networks. In the coding aspect, state-of-the-art compression technologies will be presented. Emphasis will be given to a number of standards, including H.26x, MPEG, and JPEG. In the networking aspect, special considerations for sending multimedia over ATM, wireless, and IP networks, such as error resilience and quality of service, will be discussed. The H.32x series, standards for audiovisual communication systems in various network environments, will be described. Current research results in multimedia communications will be reviewed through student seminars in the last weeks of the course.

Recommended Books:

- Multimedia Communication Systems: Techniques, Standards, and Networks by K. R. Rao.
- Introduction to Multimedia Systems (Communications, Networking, and Multimedia) by Sugata Mitra, Gaurav Bhatnagar.

ECE-423: High Speed Telecommunication

Networking terminology, Evolution of Internet, Networking basics and Internet protocol stack, TCP performance analysis, TCP sequence number plots; Wireless networks – Wireless internet protocol and performance, Wireless TCP issues, Multichannel MAC issues, Vegas and Multicast rate control, Video server broadcasting, IEEE 802.11 and 802.16; ATM networks: ATM terminology, Cell networking, ATM signaling, ATM adaptation layer, ATM switching, ATM traffic management; Network traffic management and modeling, Connection and admission control; High-speed LAN, Performance modeling and estimation – Probability and stochastic process, queuing analysis, self similar traffic; Congestion and traffic management, Internet routing, Quality of Service (QoS).

Recommended books:

- High-Speed Networks and Internets by William Stallings.
- Computer Networks and Systems – Queuing Theory and Performance Evaluation by Thomas G. Robertazzi.
- Principles of Wireless Networks by Kaveh Pahlavan and Prashant Krishnamurthy.

ECE-424: Radar and Navigation

Fundamentals, Basic principle, Radar development, Applications of radar, Power, Frequencies used in Radar, Factors governing radar performance, Radar equation and range, Factors influencing maximum range, Effect of noise, Types of Radar, CW & FM radar; Doppler effect; MTI & Pulse radar; Modulators, Multiple access techniques, Receivers, Duplexers, Radar antenna, Tracking radar and radar systems,

Recommended Books:

- Microwave and Radar Engineering by M. Kulkarni
- Microwave Principle by J Reich
- Microwave Devices and Circuits by Y. Liao
- Introduction to Radar System by M. I. Skolnik.
- Microwave Engineering by David M. Pozar

ECE-425: Radio and Television Engineering

Introduction to radio frequencies; Radio frequency amplifiers; Amplitude modulation and demodulation, Angle modulation and demodulation, Frequency conversion and Mixing; Radio transmitter and receiver, Superheterodyne receiver; Antennas.
Television fundamentals; Analysis and synthesis of TV pictures, Composite video signal, TV picture tube; TV cameras – types, construction and operating principle; Color signal; TV receivers; TV measurements; Colorimetry.
Television transmission systems – PAL, SECAM and NTSC systems, TV signal transmission and distribution systems.
Introduction to satellite TV receiver system – elements of the system and construction, creation and operation of the system.

ECE-426: IC and VLSI Technology

IC processing, Wafer production and clean room principles, Silicon processing, Lithography, Oxidation, Doping techniques, Thin film deposition, Etching, Back-end technology, Layer processes used in IC fabrication, Designing a fabrication process to specifically meet physical and electrical specifications for the final chip, Integrating the fabrication steps, IC packaging, Yields in IC processing, Microsystem products, Microfabrication process, nanotechnology.
CMOS VLSI design process and focuses on design at the circuit and physical levels, Terminologies and trends in VLSI design. MOS transistor theory, CMOS processing technology, resistance and capacitance estimation, CMOS design styles,. NMOS and CMOS inverters, dc, transient and tranfer characteristics. Designing and testing basic

logic gates and other VLSi building blocks such as adders, multipliers, counters, barrel shifters, etc. using computer aided design tools and hardware in the laboratory.

Recommended books:

- Silicon VLSI Technology: Fundamentals, Practice, and Modeling by James D. Plummer, Michael D. Deal, Peter B. Griffin.
- Solid State Electronic Devices, Fifth Edition, Ben Streetman, Sanyay Banerjee, Prentice Hall, 2000.
- Silicon VLSI Technology, James D. Plummer, Michael D. Deal, Peter B. Griffin, Prentice Hall, 2000.
- Principles of CMOS VLSI Design, Neil H. E. Weste and Kamran Eshraghian, Addison Wesley.
- Analysis and Design of Digital Integrated Circuits, Third Edition, David A. Hodges, Horace G. Jackson, and Resve A. Saleh, McGraw-Hill, 2004.

ECE-439: Project Report and Project Defense

The project work must be started in the 7^{th} semester of the 4^{th} year and it must be completed by the end of 8^{th} semester. The project work must be carried out under the supervision of a teacher. Group projects may be allowed but a group must not consist of more than two students. A project report will be submitted after the completion of the project work. A panel of examiners appointed by the National University will conduct the project defense and also evaluate the project report. The evaluation of project work carrying 200 marks is as follows:

a. Project Report 100 marks.
b. Project Defense 100 marks.