<table>
<thead>
<tr>
<th>Education</th>
<th></th>
<th>Ethics</th>
</tr>
</thead>
<tbody>
<tr>
<td>In GOD's own land, a fusion of scholastic students, innovative &amp; motivated researchers &amp; teachers and fast moving visionary leaders.</td>
<td></td>
<td>Stepping Stone and Sky reaching ladder to success</td>
</tr>
</tbody>
</table>

Course Structure & Syllabus For MS in Electronic Science

<table>
<thead>
<tr>
<th>Research</th>
<th></th>
<th>Service to Society</th>
</tr>
</thead>
</table>
| PO-Yupia, Dist: Papum Pare, Arunachal Pradesh, Pin-791112  
PhNo: 0360-2284801/2001582  
FaxNo: 0360-2284972  
Email-nitarunachal@gmail.com | | |
To achieve the target of being a global leader in the field of Technical and Science Education, there is some sort of time bound urgency to work quickly, massively and strongly, in respect of National Institute of Technology, Arunachal Pradesh being an “Institute of National Importance” (by an Act of Parliament) and being established only in Five years back in 2010. I have therefore adopted a ‘B’ formula as stated below to achieve the primary goal of producing world class visionary Engineers and Exceptionally brilliant Researchers and Innovators:

**B- FORMULA**

- Best for Teaching
- Best for Research
- Best for Entrepreneurship & Innovation
- Best for Services to Society

In implementing the ‘B’ formula in letter and spirit, the framing of syllabi has been taken as important legitimate parameter. Therefore, extraordinary efforts and dedications were directed for the last one year to frame a syllabi in a framework perhaps not available in the country as of today.

Besides attention on ‘B’ formula institute has given considerable importance to the major faults of current Technical Education while framing the syllabus. The major stumbling blocks in Technical Education today are:

I. The present system is producing “Academic Engineers” rather than “Practical Engineers”.
II. The present system of education makes the students to run after jobs rather than making them competent to create jobs.
III. There is lack of initiative to implement the reality of “Imagination is more important than knowledge”.

Taking due consideration of the findings made above, to my mind a credible syllabi has been framed in the institute in which the major innovations are introduction of:

I. I-Course (Industrial Course) one in each semester at least one, which is targeted to be taught by the Industrial Expert at least up to 50% of its component.
II. Man making and service to society oriented compulsory credit courses of NCC/NSS, values & ethics.

III. Compulsory audit course on Entrepreneurship for all branches.

   I. Many add-on courses, those are (non-credit courses), to be offered in vacation to enhance the employability of the students.
   II. Many audit courses like French, German, and Chinese to enhance the communication skill in global scale for the students.
   III. Research and imagination building courses such as Research Paper Communication.
   IV. Design Course as “Creative Design”.

Further, the syllabi have been framed not to fit in a given structure as we believe, structure is for syllabus and syllabus is not for structure. Therefore, as per requirement of the courses, the structure, the credit and the contact hours has been made available in case to case.

The syllabus is also innovative as it includes:

   I. In addition to the list of text and reference books, a list of journals and magazines for giving students a flexibility of open learning.
   II. System of examination in each course is conventional examination, open book examination and online examination.

Each course has been framed with definite objectives and learning outcomes. Syllabus has also identified the courses to be taught either of two models of teaching:

   I. J. C. Bose model of teaching where practice is the first theory.
   II. S. N. Bose model of teaching where theory is the first practice.

Besides the National Institute of Technology, Arunachal Pradesh has initiated a scheme of simple and best teaching in which for example:

   I. Instead of teaching RL, RC and RLC circuit separately, only RLC circuit will be taught and with given conditions on RLC circuits, RL and RC circuits will be derived and left to the students as interest building exercise.
   II. Instead of teaching separately High Pass Filter, Band Pass Filter and Low Pass Filter etc.; one circuit will be taught to derive out other circuits, on conditions by the students.

I am firmly confident that the framed syllabus will result in incredible achievements, accelerated growth and pretty emphatic win over any other systems and therefore, my students will not run after jobs rather jobs will run after them.

For the framing of this excellent piece of syllabus, I like to congratulate all members of faculty, Deans and HODs in no other terms but “Sabash!”.

Prof. Dr. C.T. Bhunia
Director, NIT, (A.P.)
### Syllabus for MS in Electronic Science

<table>
<thead>
<tr>
<th>SEM-I</th>
<th>Course Code</th>
<th>Course name</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit</th>
</tr>
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<tbody>
<tr>
<td>ELS-101</td>
<td>Mathematical Methods and Computer Programming (C++)</td>
<td>3</td>
<td>6</td>
<td>3+3</td>
<td></td>
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<tr>
<td>ELS-102</td>
<td>Analog and Digital Electronics</td>
<td>3</td>
<td>6</td>
<td>3+3</td>
<td></td>
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</tr>
<tr>
<td>ELS-103</td>
<td>Physics of Semiconductor Devices</td>
<td>3</td>
<td>6</td>
<td>3+3</td>
<td></td>
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<tr>
<td>ELS-104</td>
<td>Quantum Electronics</td>
<td>3</td>
<td>3</td>
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<tr>
<td>ELS-105</td>
<td>Materials for Electronics</td>
<td>3</td>
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<tr>
<td>ELS-P106</td>
<td>Practice on Analog Circuit Design</td>
<td>8</td>
<td>4</td>
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<tr>
<td>A. Analog circuit Design using PSpice with OrCAD Capture</td>
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<tr>
<td>B. Circuit Fault Diagnostics</td>
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<tbody>
<tr>
<td>ELS-201</td>
<td>Digital System Design</td>
<td>3</td>
<td>3</td>
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<td>ELS-202</td>
<td>Electronic and Optical Communication</td>
<td>3</td>
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<tr>
<td>ELS-203</td>
<td>Instrumentation and Measurement Techniques</td>
<td>3</td>
<td>6</td>
<td>3+3</td>
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<tr>
<td>ELS-204</td>
<td>Applied Electromagnetics, RF and Microwaves</td>
<td>3</td>
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<tr>
<td>ELS-205</td>
<td>Nano-Electronics</td>
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<td>ELS-206</td>
<td>Microelectronics Fabrication Technology</td>
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<td>A. Digital Circuit Design</td>
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<td>B. VHDL Based Practicals</td>
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<td>ELS-P207</td>
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<td>A. Microcontroller and Interfacing</td>
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<td>B. Virtual Instrumentation and Programming in LabVIEW</td>
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<tr>
<td>ELS-301</td>
<td>Industrial Training</td>
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<tr>
<td>ELS-302</td>
<td>Communication Skill and Seminars</td>
<td>3</td>
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<tr>
<td>ELS-303</td>
<td>Entrepreneurship Practice and Ethics</td>
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<tr>
<td>ELS-304</td>
<td>Elective (any one)</td>
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<td>Total</td>
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<td>95</td>
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</tbody>
</table>
List of Electives:
1. Java and Web-based Design
2. Material Growth and Characterization
3. Bio Electronics
4. Mobile Communication
5. Medical Instrumentation
6. Green Energy

Note:
Eligibility- B.Sc (Electronics Hons)
             B. Sc (Physics Hons)
             B.E./B.Tech. (ECE, EEE)
## Syllabus for MS in Electronic Science

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</tbody>
</table>

| Total | 15 | 26 | 28 |
Name of the Module: Mathematical Methods and Computer Programming (C++)
Module Code: ELS 101
Semester: 1st
Credit Value: 6 [P=6, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet with the objectives of:
1. To understand basic probabilistic inequalities and limit results and to be able to apply them to commonly arising models;
2. To be familiar with the fundamental properties and uses of discrete-time Markov chains;
3. To understand the fundamental properties of inner product spaces and orthonormal systems;
4. To grasp key properties and uses of Fourier series and transforms, and wavelets;
5. To understand discrete transform techniques, algorithms, and applications.

B. Subject Matter:
UNIT I:
Differential equations and their solutions, Bessel functions of first and second kind.
Inequalities and limit theorems: Bounds on tail probabilities, moment generating functions, notions of convergence, laws of large numbers, the central limit theorem, statistical applications, Monte Carlo simulation.

UNIT II:
Fourier representations, Inner product spaces and orthonormal systems, Periodic functions and Fourier series, Results and applications, The Fourier transform and its properties.
Discrete Fourier methods: The Discrete Fourier transform, efficient algorithms implementing it, and applications.

UNIT III:
Introduction to object oriented programming, comparison with structured programming object oriented terminology data abstraction , Inheritance , polymorphism. New keywords, type compatibility, scope operator, function in C++, function prototype, In line function, Default argument, Overloading, Operator overloading, Unary operator, Binary operator.

UNIT IV:
Class: definition, Object, Data member and instance variable methods, Implicit object, class scope, Access specifier, Operator method, Constructor, Copy constructor, Destructor, Assignment calls, Static member, Dynamic objects, Array of objects, Friend functions, Pointer to member. Inheritance and polymorphism: simple inheritance, constructor and destructor in inheritance, protected access specifier, class conversions, multiple inheritance, multiple base classes, and virtual base classes. Polymorphism: Virtual function, abstract base classes, Using polymorphism with example, Generic function, generic classes. Stream in C++: Inserter, Extractor, Formatting, Manipulator, Error handling, user defined streams, defining Insertion and extractor operator.

C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

D. Examination Pattern:
1. Theoretical Examination: Written
E. Reading Lists:

BOOKS:
5. Trivedi, "Programming with ANSI C++", Oxford University Press

MAGAZINES:
1. Mathematics for Students and Teachers
2. Mathematics Today
3. Mathematics of Life

JOURNALS:
1. Journal of Mathematical Physics
2. Journal of Online Mathematics and its Applications
3. Journal of Computational Physics
4. Journal of Mathematics Research
Name of the Module: Analog and Digital Electronics
Module Code: ELS 102
Semester: 1st
Credit Value: 6 [P=6, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet with the objectives of:
1. Understand basic analog and digital electronics, including semiconductor properties, operational amplifiers, combinational and sequential logic and analog-to-digital digital-to-analog conversion techniques.
2. Finally, students will gain experience in with the design of analog amplifiers, power supplies and logic devices

B. Subject Matter:
UNIT I:
Operational Amplifiers: DC performance - The operational amplifier. Input resistance, Output resistance, Open loop gain, Bias currents, Offset currents, Offset voltage, Differential mode gain. Common mode gain, Common mode rejection ratio, Negative feedback, Open loop gain and closed loop gain, Inverter amplifier, Addition amplifier, Non-inverter amplifier, Voltage follower, Transimpedance amplifier (Current to voltage converter), Howland pump, Differential amplifier.

UNIT II:

UNIT III:

UNIT IV:
Memories: Structure: address and data bus, ROM, PROM, EPROM and flash RAM, Volatiles Memories: RAM, SRAM, DRAM, Addressing modes.
AD Converters: Sampling, Real time sampling and equivalent time sampling, Sampling frequency, Sampling theorem (Nyquist), Anti-aliasing filtering, Sampling and holding, Conversion. Quantification - Information unit (Bit), Discretization noise, Integrative Analog to Digital (A/D) conversion, The linear counting method, The successive approximation method, Flash conversion.

C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%
D. Examination Pattern:
1. Theoretical Examination: Written

E. Reading Lists:

BOOKS:

MAGAZINES:
1. IEEE Circuits Magazine
2. Electronics for you.

JOURNALS:
1. IEEE Journal of Solid State Circuits
2. IETE Journal of Research
3. IETE Technical Review
Name of the Module: Physics of Semiconductor Devices
Module Code: ELS 103
Semester: 1st
Credit Value: 6 \([P=6, T=0, L=3]\)
Module Leader:

A. Objectives:
The course is designed to meet with the objectives of:
1. To know different kinds of semiconductors that are changing the way we live i.e. in our cell phones, in our optical-fiber communications systems, in our CD and DVD players, and soon in our home and office lights.
2. Imparting theoretical knowledge and to develop computing skills to the students in the area of semiconductor science and technology

B. Subject Matter:
UNIT I:

UNIT II:

UNIT III:
**Insulator and Heterostructure Field Effect Transistors:** Heterostructures, Strained Heterostructures, Band Discontinuities, Band Bending and Sub-band Formation, Channel Control in HFETs, Quasi-Static MISFET Theory Using Boltzmann Approximation, Quasi-Static HFET Theory Using Analytic Approximation, Quasi-Static Equivalent Circuit Refinements, Small-Signal Analysis, Transient Analysis, Hot Carrier Injection Effects, Effects Due to DX Centers, Off-Equilibrium Effects, p-channel Field Effect Transistors.

UNIT IV:
**Heterostructure Bipolar Transistors:** Quasi-Static Analysis, Implications of Heterostructures and Alloy Grading, High Current Considerations of the Base–Collector Junction, Generation and Recombination Effects, Small-Signal Analysis, Small-Signal Effects of Alloy Grading, Transit Time Resonance Effects, Transient Analysis; Hot Carrier and Tunneling Structures- Quantum-Mechanical Reflections, Hot Carrier Structures, Resonant and Sequential Tunneling, Resonant Tunneling Transistors with Coupled Barrier Tunneling.

C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%
D. Examination Pattern:
   1. Theoretical Examination: Written

E. Reading Lists:

BOOKS:

MAGAZINES:
   1. Physics Today
   2. Semiconductor Today
   3. Silicon Semiconductor

JOURNALS:
   1. Semiconductor Science and Technology
   2. Physical Review B.
   3. IEEE Electron Devices Letter
   4. IEEE Transactions on Device and Materials Reliability
   5. Semiconductors
   6. Journal of Applied Physics
Name of the Module: Quantum Electronics
Module Code: ELS 104
Semester: 1\textsuperscript{st}
Credit Value: 3 [P=0, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet the objectives of:
1. Understand the basics of Quantum Mechanics and behavior of electrons in confined potentials
2. Understand the Quantum Theory of Solids and electronic properties
3. Understand the nature of light and light-matter interaction
4. Familiarity with modern Quantum Electron Devices
5. Follow the scientific literature to recognize new trends

B. Subject Matter:

UNIT I:
Basic Quantum Mechanics: Wave - particle duality; basic postulates of Wave Mechanics; Schrödinger equation; Wave function and its interpretation; Time independent Schrödinger equation; Wave packet and uncertainty principle. Operators and their role in QM; Eigenvalues and eigenfunctions; Hermitian operators; Potential wells; Rectangular potential well, triangular potential well; parabolic potential well; harmonic oscillators; creation and annihilation operators. Hydrogen atom problem. Time dependent perturbation theory. Maxwell-Boltzmann, Bose and Fermi distributions.

UNIT II:
Quantum Theory of Solids: Motion of electrons in a periodic potential; Kronig-Penney model; E-k diagram; Brillouin zone; Concept of effective mass and of hole; Density-of-states function; Distinction between metals, insulators and semiconductors. Transport in solids; Boltzmann equation; Conductivity; Mobility; Diffusion constant; Thermal properties of electron gas. Thermal properties; lattice vibrations; phonons; heat capacity; thermal conductivity.

UNIT III:

UNIT IV:
Quantum Electronic Devices: Review of Quantum Nanostructures: Quantum Wells, Wires and Dots; Tunneling phenomena; Resonant Tunneling; Electron Devices: HEMTs, Resonant Tunneling Diodes; Single Electron Transistors; Various forms of Lasers; Quantum Cascade Lasers; Photodetectors; QW and QD Infrared Photodetectors. Emerging Areas: Carbon Nanotubes, Graphene, Nanophotonics

C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%
D. Examination Pattern:
   1. Theoretical Examination: Written

E. Reading Lists:

BOOKS:

MAGAZINES:
1. 21st century Science and Technology
2. Discover

JOURNALS:
1. IEEE J. Quantum Electronics
2. IEEE J. Selected Topics in Quantum Electronics
3. IEEE J. Nanotechnology
4. Journal of Applied Physics
5. Applied Physics Letters
Name of the Module: Materials for Electronics

Module Code: ELS 105

Semester: 1st

Credit Value: 3 [P=0, T=0, L=3]

Module Leader:

A. Objectives:
The course is designed to meet with the objectives of:

1. To impart knowledge of different electronics materials and various components used in electronic industries
2. To describe the suitability and characteristics of various electronics components for different applications

B. Subject Matter:

UNIT I:

Semiconductor materials: Classification of semiconductors - Elemental, compound and alloy semiconductors, Crystal structure, Intrinsic and extrinsic semiconductors, Fermi level, Equivalent carrier concentration in semiconductors, Doped semiconductors, Carrier compensation, Kronig-Penny model, Effective mass, Recombination and generation in semiconductors, Shockley-Read-Hall (SRH) statistics.

UNIT II:

Special Materials in Electronics: Composite materials - Composites of glasses, polymers, metals and ceramics; properties and applications;
Polymers - Mechanism of polymerization, conducting polymers, application of polymers in electronics and optoelectronics.
Liquid crystals - Nematic, Cholesteric and Smectic liquid crystals, liquid crystal displays; Optical fibre materials.

UNIT III:

Dielectric and Ferroelectric Materials: Dielectric materials as capacitive elements, polar dielectrics, properties and applications in electronics. Ferroelectrics - physical properties and classification, properties modifications, non-linearities, applications in electronic devices.
Magnetic materials: Ferromagnetic materials and their applications, Transition metals and alloys as ferromagnets, hard and soft magnetic materials. Ferrites - Elementary idea of spinels. Garnets and Hexagonal ferrites, application of ferrites in electronics, magnetic bubbles.

UNIT IV:

Electronic transport in crystalline organic materials and conductive polymers.
Transport properties: Basic device structure of Organic Electronic Devices. OLEDs and PLEDs, Flexible displays, Organic transistors, Organic field effect transistors, Organic solar cells – device architecture and characterization.
Essential characteristic of the electrode materials for organic electronic devices, R&D for new electrode materials, Organic electronic materials and their processing techniques.

C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%
D. Examination Pattern:
1. Theoretical Examination: Written

E. Reading Lists:

BOOKS:
1. V. Raghavan “Material science in engineering” PHI Learning, 2004

MAGAZINES:
1. Materials R & D News
2. Physics Today

JOURNALS:
1. Physica E
2. Physical Review Letters
3. Material Chemistry and Physics
4. Material Science in Semiconductor Processing
5. Science
6. Semiconductors
Name of the Module: Practice on Analog Circuit Design
Module Code: ELS-P106
Semester: 1st
Credit Value: 4 [P=8, T=0, L=0]
Module Leader:

A. Analog Circuit Design using PSpice with OrCAD Capture
   1. Circuit Creation with Capture
      • Create a new Analog,
      • mixed AD project
      • Place circuit parts
      • Connect the parts
      • Specify values and names
   2. Specify type of simulation
      • Create a simulation profile
      • Select type of analysis: Bias, DC sweep, Transient, AC sweep
      • Run PSpice
   3. View the results
      • Add traces to the probe window
      • Use cursors to analyze waveforms
      • Check the output file, if needed
      • Save or print the results

B. Circuit Fault Diagnostics
   • Fault location techniques
     I. Fault dictionary techniques
     II. Approximation techniques
     III. Fault verification techniques
     IV. Parameter identification techniques
     V. Artificial intelligence techniques
   • DC Approach Technique
   • Frequency-Domain Approach:

Books:
2. Rashid “Microelectronics Circuits” PWS Publication
4. M. H. Rashid “Introduction to PSpice using OrCAD for circuits and electronics” Pearson/Prentice Hall, 2004
### SEM-II

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course name</th>
<th>L</th>
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<td>ELS-202</td>
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<td>Nano-Electronics</td>
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<td>Practice on Interfacing</td>
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<td>B. Virtual Instrumentation and Programming in LabVIEW</td>
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| Total       | 15 | 22 | 29 |
Name of the Module: Digital System Design  
Module Code: ELS 201  
Semester: 2nd  
Credit Value: 3 \[P=0, \ T=0, \ L=3\]  
Module Leader:  

A. Objectives:  
The course is designed to meet with the objectives of:  
1. To understand sequential & combinational logic design techniques  
2. To learn various digital circuits using VHDL  
3. To learn PLD, CPLD, FPGA & their application......  

B. Subject Matter:  
UNIT I:  
Introductions: Introduction to Computer-aided design tools for digital systems. Hardware description languages; introduction to VHDL, data objects, classes and data types, Operators, Overloading, logical operators, Types of delays, Entity and Architecture declaration, Introduction to behavioral, dataflow and structural models.  

UNIT II:  
VHDL Statements: Assignment statements, sequential statements and process, conditional statements, case statement Array and loops, resolution functions, Packages and Libraries, concurrent statements. Subprograms: Application of Functions and Procedures, Structural Modelling, component declaration, structural layout and generics.  

UNIT III:  
Sequential and Combinational Circuit Design: VHDL Models and Simulation of combinational circuits such as Multiplexers, Demultiplexers, encoders, decoders, code converters, comparators, implementation of Boolean functions etc.  
Sequential Circuits Design - VHDL Models and Simulation of Sequential Circuits Shift Registers, Counters etc.  

UNIT IV:  
Prototyping and case studies: Design with CPLDs and FPGAs - Programmable logic devices : ROM, PLS, PALs, GAL, PEEL, CPLDs and FPGA. Design implementation using CPLDs and FPGAs Design of Microcomputer: Basic components of a computer, specifications, architecture of a simple microcomputer system, implementation of a simple microcomputer system using VHDL.  

C. Teaching/ Learning/ Practice Pattern:  
Teaching: 70%  
Learning: 30%  
Practice: 0%  

D. Examination Pattern:  
1. Theoretical Examination: Written  

E. Reading Lists:  
BOOKS:  
MAGAZINES:
   1. Neweelectroncis (Digital Magazine)

JOURNALS:
   1. Digital Creativity
   2. Digital Investigation
   3. International Journal of Design
Name of the Module: **Electronic and Optical Communication**

**Module Code:** ELS 202  
**Semester:** 2nd  
**Credit Value:** 3[P=0, T=0, L=3]  
**Module Leader:**

A. **Objectives:**
The course is designed to meet with the objectives of:
1. To introduce the student about Optical Fiber, Wave propagation, Detectors and its structures and functions.
2. To study different circuits used in communication
3. To study different transmission & reception systems

B. **Subject Matter:**

**UNIT I:**
Fundamentals of signal transmission and signal processing, Signals and systems, Fourier transform, FFT, Z-transformer, Laplace transform, Filters

**UNIT II:**

**UNIT III:**
*Linear and non-linear signal quantizing*: Compander and expander, ASK, PSK, FSK, Modem, Channel band width, Shannon’s theorem (channel capacity).

**UNIT IV:**
*Optical Communication*: Optical fibers, Dispersion and loss in optical fibers, Optical couplers and modulators, Semiconductor detectors for optical communications, basic requirements of characteristics, Semiconductor lasers for optical communication, Basic optical communication systems- Intensity modulation, Direct detection system, Regeneration, Signal to noise ratio and Bit error rate, Optical amplification, Wavelength division multiplexing, Coherent detection.

C. **Teaching/ Learning/ Practice Pattern:**
Teaching: 70%
Learning: 30%
Practice: 0%

D. **Examination Pattern:**
1. Theoretical Examination: Written

E. **Reading Lists:**

**BOOKS:**
7. J. C. Polaris “Optical fiber communications”, 5e, Prentice-Hall
MAGAZINES:
1. IEEE Communications Magazine

JOURNALS:
1. IEEE Journal of Lightwave Technology
2. IEEE Journal of Selected Areas of Communication
3. Journal of Optical Networking
Name of the Module: **Instrumentation and Measurement Techniques**

**Module Code:** ELS 203  
**Semester:** 2nd  
**Credit Value:** 6 \([P=6, \ T=0, \ L=3]\)

**Module Leader:**

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**A. Objectives:**
The course is designed to meet with the objectives of:
1. To understand the application of basic electronics assumptions and circuits.
2. To understand the basic working principle of transducers and actuators and further signal conditioning, data processing circuits.
3. To understand instrumentation required and needed in different disciplines.
4. To understand the correlation of electronics with other disciplines.

**B. Subject Matter:**

**UNIT I:**

**Measurement Instrumentation:** Introduction and definitions, Measurement Instrumentation- Metrology, Instrument modeling, Model of a measurement instrument, Dynamic characteristics, Instrument performance, Implementing measurement acquisition, Principles and methodology of measurements, Analyzing measurements obtained by an instrument, Base definitions, Electronic instrumentation, Electronic instrumentation functionality, The role of instrumentation in quality control.


**UNIT II:**

**Physical Principles of Optical, Thermal and Mechanical Sensors:** Optical sensors, Luminous flux, The relative luminous efficiency curve of the human eye, Black body as a reference for optical sensors, Black body radiation, Dark currents, Spectral and total sensitivities, Sources of fundamental noise sources in optical sensors, Photoconductive sensors, Principle of photodiode, fabrication, Photodiode equation, Force and deformation sensors, Resistive gauges, Piezoelectric effect, Piezoelectricity and pyroelectricity, Construction of piezoelectric sensors, Thermal sensors, Concepts related to temperature and thermometry, Contact temperature measurement of solids, Thermistor and Resistance thermometers.

**UNIT III:**

**Real-time Data Acquisition and Processing Systems:** Electronic devices for signal sampling and quantification, Nyquist sampling, Quantification noise, Over-sampling and reconstruction, Under-sampling, Analog-to-digital converters, Real-time digital analysis by a specialized processor, Fixed point and floating point analysis, General structure of a DSP, Multiplication/accumulation structure, Using standard filtering Algorithms. General structure of a real-time filtering program, FIR filter and simple Convolutions, IIR filters.

**UNIT IV:**

**Instrument and Measurement Chains:**
Measurement devices: Intensity measurements, Oscilloscopes, Spectrum analyzers, Sweeping analyzers, FFT analyzers, Network analyzers, Impedance analyzers, Measurement with a network analyzer, The parallel bus IEEE488 Serial busses, Description of PC busses External acquisition cards: the VXI system, Functions of the VXI bus, Description of the VXI bus
C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

D. Examination Pattern:
1. Theoretical Examination: Written

E. Reading Lists:

BOOKS:

MAGAZINES:
1. Electronics For You
2. Electrical Design News (EDN)

JOURNALS:
1. IEEE Transaction on Instrumentation and Measurement
2. Journal of Advanced Research in Instrumentation and Control Engineering
3. Measurement Science and Technology
Name of the Module: Applied Electromagnetics, RF and Microwaves
Module Code: ELS 204
Semester: 2nd
Credit Value: 3 \([P=0, T=0, L=3]\)
Module Leader:

A. Objectives:
The course is designed to meet with the objectives of:
1. To be able to analyze and design various RF transmission line media
2. To get the ability to analyze and design RF matching networks for complex impedances.
3. To get the ability to design RF/Microwave passive and active components
4. To be able to analyze various parameters of antenna & antenna systems
5. To be able to create and present a report on a design project

B. Subject Matter:
UNIT I:
Electromagnetic waves: Revision: Maxwell equations, wave propagation in conducting and non conducting media, reflection and refraction of polarized electromagnetic waves at an interference of non-conducting media, EM frequency spectrum, electromagnetic sources and detectors.

UNIT II:
Principles of transport of electromagnetic energy:
Transmission Lines: Different types of transmission lines, two wire transmission line, lumped and distributed parameters, transmission line equations for voltages and currents using circuit theory and field theory, characteristic impedance, propagation constants, attenuation and phase constants, phase velocity, reflection and transmission coefficient, SWR, line impedance, normalized impedance and admittance, Numerical exercises using circuit and Phasor theory, Smith-chart, construction and applications, single stub and double stub matching, shielding of transmission lines.
Microstripline – Introduction to striplines, characteristic impedance, effective dielectric constant, dielectric ohmic and radiation losses in microstripline, Q-factor of microstripline, different types of microstriplines such as parallel, coplanar, shielded striplines
Waveguides – concept of cut-off frequency, guide impedance, phase velocity, guide wavelength for TE and TM modes, Applications to TE mode in rectangular waveguide, power losses in a rectangular waveguide, circular waveguide.

UNIT III:
Electromagnetic radiation: Potentials of electromagnetic fields, gauge transformations, Lorentz gauge and Coulomb gauge condition, Retarded potential, radiation from oscillating dipoles, concept of near zone and radiation zone, radiation resistance , Role of Antenna in exciting different TE, TM modes in wave guides.
Antenna parameters- Gain, directivity, power, aperture, different types, radiation pattern and application areas of antennas; Basic antennas, small loop, short dipoles and slot antennas, Reflector antennas – open out two conductor antenna, conical and horn antennas Aperture antennas – parabolic dish antennas, dielectric lens antennas End fire antenna – yagi-uda and axial mode helix antennas, stripline feed antennas Microstrip antennas.

UNIT IV:
Applications of Electromagnetics in Electronic system: Electromagnetic effects in high speed digital systems e.g. reset signal on a PC card, CD player on air plane interface with the navigation system, ECL technology on a fiber-glass circuit board, EMI/EMC, shielding, Global positioning satellite.

C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

D. Examination Pattern:
   1. Theoretical Examination: Written

E. Reading Lists:

BOOKS:
6. J. D. Kraus “Antennas & Wave Propagation”, 4e, Tata McGrow Hill

MAGAZINES:
1. Microwaves & RF
2. Antenna systems & Technology

JOURNALS:
1. IET Microwaves, Antennas & Propagation
2. Microwave Journal
3. Microwaves and Optical Technology Letters
4. Electromagnetics
Name of the Module: Nano-Electronics
Module Code: ELS 205
Semester: 2nd
Credit Value: 3[P=0, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet with the objectives of:
1. introduce the students to nanoelectronics, nanodevices, spintronics and molecular electronics
2. identify quantum mechanics behind nanoelectronics
3. describe the principle and the operation of nanoelectronic devices
4. explain the principle and application of spintronic devices

B. Subject Matter:
UNIT I:
Fundamental physics and quantum mechanics: Electrons in one atom, Photoelectric effect, the uncertainty principle, wave function, Schrödinger equation, Eigenfunctions, Quantum numbers, Superposition of eigenfunctions, Probability densities, Angular momentum, Spins, Hermitean operators, two particle system, Nanocluster with tens of atoms, Quantum well and tunneling.

UNIT II
Nanoscale CMOS devices: Scaling of CMOS, Short channel effects, Technologies to combat short channel effects, Gate Engineering, Strain Engineering, Gate all around MOSFET, Nanowire FETs.

UNIT III:
Nanoelectronic devices: Nanowires, quantum dots, nanopillars, quantum transport and tunneling effects, spin-dependent electron transport, molecular electronics, and single electron transistors, Graphene and carbon nanotube transistors.

UNIT III:
Spintronics: Basics of magnetism and the origin of magnetism at the atomic scale, magnetic properties of thin films and nanostructures, Giant magnetoresistance (GMR) and tunnel magnetoresistance (TMR), Operation principle of magnetic nano-oscillators, Operation principle of spin transistor.

C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

D. Examination Pattern:
1. Theoretical Examination: Written

E. Reading Lists:
BOOKS:
4. George W. Hanson, “Fundamentals of nanoelectronics”, Pearson/Prentice,2008 (for nanoelectronics);
MAGAZINES:
1. Nano
2. Nano Today

JOURNALS:
1. Journal of Nano Research
2. Journal of Nanomaterials
3. Journal of Nanoparticle Research
4. Journal of Nanoscience and Technology
5. NanoScale Research Letters
6. Nanoscience and Nanotechnology Letters
**Name of the Module:** Microelectronics Fabrication Technology

**Module Code:** ELS 206  
**Semester:** 2nd  
**Credit Value:** 3\([P=0, \ T=0, \ L=3]\)  
**Module Leader:**

### A. Objectives:
The course is designed to meet with the objectives of:

1. To understand how a silicon wafer is turned into an operating chip
2. Ability to evaluate and analyze concepts in lithography, etch, and fabrication flow
3. Ability to evaluate and analyze concepts in surface modification: doping and oxidation.
4. Ability to evaluate and analyze concepts in film deposition, interconnections, contacts, packaging

### B. Subject Matter:

#### UNIT I:

**Materials for microelectronics technology:** Czochralski growth of silicon crystals, Silicon wafers shaping, lapping and polishing, LEC growth of GaAs and InP crystals, Basics of epitaxial growth techniques.


#### UNIT II:

**Pattern Transfer with Dry etching Techniques:** Introduction, Dry Etching: Definitions and Jargon, Plasmas or Discharges Physical Etching: Ion Etching or Sputtering and Ion-Beam Milling, Plasma Etching (Radical Etching) Physical/Chemical Etching.

Doping of Si, Oxidation of Silicon, Deposition of thin films Physical Vapor Deposition, Chemical Vapor Deposition, Sol-Gel Deposition Technique; Doctors' Blade or Tape Casting, Plasma Spraying, Deposition and Arraying Methods of Organic Layers in BIOMEMS, Thin versus Thick Film Deposition, Selection Criteria for Deposition Method.

#### UNIT III:

**Microelectronic Fabrication:** Fabrication of monolithic diodes, Fabrication of integrated transistors, idea of buried layer fabrication, Monolithic circuit layout and design rule, Isolation methods, MOSFET, MOS integrated circuit, Large and medium scale integration, Hybrid Integrated circuits

#### UNIT IV:

**Surface Micromachining:** Mechanical Properties of Thin Films, Surface Micromachining Processes, Poly-Si Surface Micromachining Modifications, Non-Poly-Si Surface Micromachining Modifications, Materials Case Studies

Liga and Micromolding: LIGA-Background, LIGA and LIGA-Like Process Steps.

Miniaturization Techniques: Top-down &Bottom-up manufacturing: Introduction, Absolute and Relative Tolerance in Manufacturing,

Historical Note: Human Manufacturing, Section I: Top-Down Manufacturing Methods, Section II: Bottom-Up Approaches

### C. Teaching/ Learning/ Practice Pattern:

Teaching: 70%  
Learning: 30%  
Practice: 0%

### D. Examination Pattern:
Syllabus for MS in Electronic Science

1. Theoretical Examination: Written

E. Reading Lists:

BOOKS:
4. IC Fabrication : J.A. Elcott

MAGAZINES:
1. Physics Today
2. Chip Scale Review

JOURNALS:
1. Microelectronics Journal
2. Journal of Vacuum Science and Technology
3. Material Science in Semiconductor Processing
4. Thin Solid Films
5. Journal of Micro/Nanolithography, MEMS and MOEMS
Syllabus for MS in Electronic Science

Name of the Module: Practice on Digital Circuit Design
Module Code: ELS-P206
Semester: 2nd
Credit Value: 4 [P=8, T=0, L=0]
Module Leader:

A. Digital Circuit Design:
   1. Frequency Counter using CMOS IC’s (Battery Operated)
   2. 3 digit combinational lock design
   3. Design and implementation of logic level converters (CMOS to TTL and TTL to CMOS)
   4. Keyboard encoder
   5. Practical based on state machine (Vending Machine, Washing Machine)
   6. Stepper Motor Control (Sequence Generator)
   7. Adder using Carry Look Ahead
   8. Function Generator using EPROM and DAC

B. VHDL based practical:
   1. Practical Based on VHDL Programming (Combinational Logic)
      a. Parity Generator and checker
      b. Hamming Code Generator
      c. Manchester code Generator
   2. Designing of 4 × 2 bit Multiplier using VHDL
   3. Practical Based on VHDL Programming (Sequential)
      a. 8 bit binary counter
      b. Universal shift register
   4. Four bit ALU design using VHDL
   5. Design of Simple Memory (RAM) model using VHDL.
   6. Keyboard Scanning (Counter Method) using VHDL
   7. Designing of Traffic light Controller using VHDL.
   8. Implementation of 8-bit multiplexer on FPGA Board.
   9. Designing of Digital logic for RPM Measurement using VHDL.
   10. Code Converter (BCD to seven Segment)

Books:
3. J. Wakerley “Digital Design Principles”, Prentice Hall of India
Name of the Module: Practice on Interfacing
Module Code: ELS-P207
Semester: 2nd
Credit Value: 4 [P=8, T=0, L=0]
Module Leader:

A. Microcontroller and Interfacing:
   1. Flashing an LED (use a PIC16F688 microcontroller to flash an LED on and off)
   2. Basic digital input and output (Learn how to read digital inputs from a push button switch)
      Every time the push button is pressed, the LED will be toggled on and off. You will also
      learn about the bouncing characteristic of a switch, and how to take care of that.
   3. Four bit binary counter
   4. Interfacing a character LCD
   5. Analog-to-digital conversion (ADC)
   6. Interfacing a seven segment display
   7. Timers and Counters
   8. Asynchronous serial communication
   9. Pulse width modulation (PWM) using CCP model
   10. DC motor control
   11. Multiplexing seven segment LED displays
   12. Basics of LED dot matrix display
   13. Read and write to internal EEPROM
   14. Inter-Integrated circuit (I2C) communication
   15. Scrolling text message on LED dot matrix display
   16. Sleep and Wake PIC microcontrollers
   17. Matrix keypad interfacing
   18. Servo motor control
   19. Interfacing a Graphical LCD (GLCD)
      Reference: http://embedded-lab.com/blog/?page_id=26

B. Virtual Instrumentation and Programming in LabVIEW:

   LabView a software platform for Integration of hardware and software for measuring
   and control purposes
   1. Convert C to F
      Create VI that take a numeric value representing degrees Celsius and Convert it to degrees
      Fahrenheit.
   2. Create a simple Calculator
   3. Create a Thermometer with using a Selector (VI)
      Create a simple LabVIEW application (VI) with a Front Panel with some Controls and
      Indicators.
      Create the logic by connecting the Terminals on the Block Diagram.
   4. Create a Temperature History monitoring using with While loop
   5. Create below VI
      Create a VI which its output is random number between 0-100 when a selector key is on
      and 0 when the selector key is off

Books:
<table>
<thead>
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<td>ELS-302</td>
<td>Communication Skill and Seminar</td>
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<td>ELS-303</td>
<td>Entrepreneurship Practice and Ethics</td>
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**Name of the Module: Industrial Training**

**Module Code:** ELS-301  
**Semester:** 3rd  
**Credit Value:** 2 \[P=0, T=0, L=0\]  
**Module Leader:**

After visiting electronics/instrumentation/allied industry, every student shall have to submit a detailed report to the department, based on his/her observations about the organization, working, major equipments, software, engineering/technology involved, raw materials/components, products and deliverables, research and development, etc.

**Name of the Module: Communication Skill and Seminar**

**Module Code:** ELS-302  
**Semester:** 3rd  
**Credit Value:** 3 \[P=0, T=0, L=3\]  
**Module Leader:**

-To be allowed by HOD
Name of the Module: Entrepreneurship Practice and Ethics

Module Code: ELS-303
Semester: 3rd
Credit Value: 2 \([P=15, T=0, L=0]\)

Module Leader:

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

1. Describe and explain the concept of entrepreneurship and the types and characteristics of small businesses
2. Recognise and recall the psychological theories of entrepreneurship and analyse how entrepreneurs acquire resources and persuade others to invest in their novel venture.
3. In doing so, the module will allow students to develop their critical skills and to analyse the internal and external factors that impact on entrepreneurship and how they intertwine to create success.
4. Students will be able to develop understanding of how entrepreneurs use their social skills to acquire resources and the characteristics of ventures which are ethically and socially oriented.
5. Through the assessments, they will be able to demonstrate how entrepreneurship connects to the development and performance of larger organisations and, through a series of examples of “real-life” entrepreneurs, how entrepreneurship theory relates to practice.
6. Outline how entrepreneurship connects to innovation in large businesses

Introduction:
Experience in emerging economies has shown that the development of the private sector of the economy is a vital part of the restructuring needed to move from a command economy to a social market economy. As jobs disappear in the traditional state-owned sector, the key dynamic force in market economies, and more generally in economic development, will be entrepreneurs. Throughout the world - in India as well as in North East Region and other developing economies - a large percentage of the new jobs are created in new enterprises and in rapidly expanding firms.

If it is so evident that the creation of small and medium sized companies is vital to the creation of jobs and wealth in developing countries, why is it so difficult to stimulate private enterprise in areas like India? One of the reasons frequently given is the poor image of entrepreneurs in many of these countries. They are too often seen as gangsters, villains, and thieves rather than heroes and champions of economic development. So there is an important link between ethics and entrepreneurship.

In this paper we would like to explain first what entrepreneurship is and refute some of the myths which have grown up about entrepreneurs. The second part of this paper discusses what may be a more controversial proposition: that business ethics is important to entrepreneurial success.
List of Electives:
1. Java and Web-based Design
2. Material Growth and Characterization
3. Bio Electronics
4. Mobile Communication
5. Medical Instrumentation
6. Green Energy
Name of the Module: Java and Web-based Design
Module Code: ELS 304A
Semester: 3rd
Credit Value: 4 [P=0, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet with the objectives of:
1. understanding the concept of object oriented programming approach
2. understanding java programming language
3. Ability to design the web pages

B. Subject Matter:
UNIT I:

UNIT II:
Using CSS for Web Designing: Introduction to CSS-benefits of CSS-Working with CSS, Web page editing with CSS-the text-using colours with CSS-positioning elements with CSS, page layout with CSS.

UNIT III:
Script Language for Web Development: Overview of script languages, comparison between script language and programming language, the Perl programming language- features and benefits, the PHP programming language-features, benefits and drawbacks of PHP programming language, the Python programming language.
The LAMP Stack: Overview of a LAMP stack-origin-benefits and drawbacks of LAMP stack, Installing and using the LAMP stack, managing LAMP with PHPMyAdmin.
Search Engines: Overview, working of a search engine, getting higher ranking for your site on a search engine; Web Design Tools: HTML Editors, Adobe Photoshop, Adobe flash, Firebug Browser.

UNIT IV:
Java Basics: Java-features, working with java, java classes, control statements in java; Classes and Objects: Object oriented programming language, Basic concept, advantages-disadvantages, Applications of OOP, object oriented software development in java, methods, Inheritance: Multiple Inheritance and Interfaces, Inner Classes, Sample programs.
Core Java API: Introduction to API, Installing and using the Java development kit, handling exceptions, Threads-creating a thread, swing- the swing packages; Servlets and JSP: overview of Servlets and JSP, working of Servlets-life cycle of a servlet, comparison of servlets with other script languages, Handling client requests and sending a response, usage of JSP.
C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

D. Examination Pattern:

E. Reading Lists:

BOOKS:
2. Vishal Layka “Learn Java for Web Development”, Apress
3. Nicholas S. Williams “Professional Java for Web Applications”, Wiley India

MAGAZINES & Web site:
1. Developing Java Applications

JOURNALS:
1. ACM Transactions on Computing Education
2. Automated Software Engineering
3. Applied Soft Computing
4. Advances in Engineering Software
5. ACM Transactions on the Web
Name of the Module: Materials Growth and Characterization

Module Code: ELS 304B
Semester: 3rd
Credit Value: 4 \( [P=0, T=0, L=3] \)

Module Leader:

A. Objectives:
The course is designed to meet with the objectives of:
1. To get an overview of the various materials used in today’s electronics
2. To familiarize with the state-of-art techniques for materials growth
3. To familiarize with state-of-art materials characterization procedures.

B. Subject Matter:
UNIT I:
   **Growth of crystalline materials**: nucleation and crystallization, Czochralski and floating zone growth of Si, LEC and Bridgemann growth of compound semiconductors, Epitaxial growth- LPE, MBE, MOVPE and MBE.

UNIT II:
   **Deposition of thin films**: physical vapour deposition-evaporation, sputtering, laser processing, plasma and ion beam processing, chemical vapour deposition-CVD, LPCVD, PECVD. Solution growth- hydrothermal, co-precipitation, Sol-gel technique, Vapor-liquid-solid (VLS) growth, spray pyrolysis, Dip print coating, Growth of quantum sized structures.

UNIT III:
   **Electron beam instruments**: Transmission electron and scanning electron microscopes, Auger electron spectroscopy, x-ray spectrometers, electron microprobe, electron spectrometers. Interpretation of different information: selected area and convergent beam electron diffraction patterns. Analysis of micrographs in TEM, SEM and HRTEM: theories of diffraction contrast in TEM, analysis of images in TEM and SEM. Interpretation of analytical data: EDS, WDS, Auger, EELS, ESCA, SIMS.
   **Optical Spectroscopy**: Atomic absorption spectroscopy, infrared spectroscopy and Raman spectroscopy, Photoluminescence; scanning Tunneling and Atomic Force Microscopy; NMR: Principles and applications; Electrical Characterization: I-V, C-V, Hall effect, Low and high temperature effect.

UNIT IV:
   **Electron-specimen interactions**: scattered electron, X-rays, Auger electrons, electron beam induced currents, cathodoluminescence.

C. Teaching/ Learning/ Practice Pattern:
Teaching: 70%
Learning: 30%
Practice: 0%

D. Examination Pattern:
   1. Theoretical Examination: Written

E. Reading Lists:
Syllabus for MS in Electronic Science

BOOKS:

MAGAZINES:
1. Physics Today
2. Materials Today
3. Photonics Spectra
4. MRS Bulletin

JOURNALS:
1. Applied Surface Science
2. Materials Characterization
3. Thin Solid Films
4. Materials Science in Semiconductor Processing
5. Journal of Crystal Growth
6. Journal of Applied Physics
7. Nature Nanotechnology
8. Chemistry of Materials
10. Nano Letters
Name of the Module: Bio-Electronics  
Module Code: ELS 304C  
Semester: 3rd  
Credit Value: 4 [P=2, T=0, L=3]  
Module Leader:

A. Objectives:  
The course is designed to meet the objectives of:  
1. Understanding of the basic physico-chemical properties of Proteins and DNA and physiological properties of membranes.  
2. Understanding of the electrical properties of membranes,  
3. Understanding of the design and use of bioelectrodes.

B. Subject matter:  
UNIT I:  

UNIT II:  
Membrain: Introduction, Water shortages and need for membrane technology composition, Classification of membranes, Membrane processes, Principle of membrane filtration, Microfiltration membranes: introduction to frontal and cross flow filtration, development of knowledge and understanding of solid liquid separations and cake filtration, general membrane equations and adaptation to cake filtration, calculation of cake properties, time of filtration, bed depth and process optimisation, case studies,

UNIT III:  
Biomechanics: Introduction, Human Motion: Linear and Angular Motion, Discrete and Continuous Motion, Planes of Motion, Axes of Rotation, Body Segment Anatomical Terminology, Body Segment Motion Terminology, Biomechanical Model, Real World Applications, molecular bases of contractility and mobility, biostatics.

UNIT IV:  

C. Teaching/Learning/Practice Pattern:  
Teaching : 70%  
Learning : 30%  
Practice : 00%

D. Examination Pattern:  

E. Reading List:  
BOOKS:  

MAGAZINES:
1. Science Digest
2. BioMechanics

JOURNALS:
1. Journal of Applied Biomechanics
2. Journal of Biomechanics
3. Biomechanics Journal
4. Journal of Applied Biomaterials and Biomechanics
5. Nature Scientific Reports
Name of the Module: Mobile Communication
Module Code: ELS 304D
Semester: 3rd
Credit Value: 4 [P=2, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet the objectives of:
4. To make the students to understand modern mobile communication systems such as 2G, 2.5G, 3G, 4G, and Bluetooth.
5. To make students familiarization about Co-channel and Adjacent channel interferences, Improving Coverage and System capacity Techniques,
6. To make the students to Propagation Models for Wireless Networks, Multipath Effects in Mobile Communication, Models for Multipath Reception, Mobile antenna system, Multiple Access Techniques.

B. Subject matter:
UNIT I:

UNIT II:

UNIT III:
Modulation Techniques for mobile communication: Choice of modulation scheme, Linear and Non-Linear modulation scheme, Amplitude and Angle modulation (FM & PM), Analog and Digital modulation Techniques, BPSK, QPSK, Line coding, GMSK scheme, Receiver performance in multipath channels, Example of a Multicarrier Modulation: OFDM.
Multiple Access Techniques for wireless communication: Narrowband Systems, Wideband Systems, Frequency Division Multiple Access, Time Division Multiple Access, Spread Spectrum Multiple Access, Space Division Multiple Access.

UNIT IV:
Wireless access protocols: IEEE 802.11 standard, WLAN Family, WLAN transmission technology, WLAN system architecture, Collision Sense Multiple Access with Collision Detection(CSMA/CD) and CSMA Collision avoidance (CSMA/CA), 802.11 PHY and MAC layers, IEEE 802.11 Distributed Co-ordinate System (DCF) and Point Co-ordination Function (PCF), WLAN family, HyperLAN, Bluetooth, Brief overview of WiMAX for wireless broadband communication.
Basic Mobile IP operations: types, concepts, Four basic entities for MIPv4, Mobile IPv4 Registration, Tunneling, MIPv4 Reverse Tunneling, MIPv4 Triangular Routing, Mobile Network Layer Considerations: Limitations of MIPv4, MIPv6 and HMIPv6, Dynamic Host Configuration
protocol, Micromobility solutions to the host mobility problem, Routing in Mobile ad-hoc network, DSDV, DSR, AODV, Alternative metrics. Transport Layer Considerations: Traditional TCP, Classical TCP improvements- WAP, WAP 2.0.

**Mobile Operating Systems**: PalmOS, Pocket PC and Windows CE, Embedded Linux and other Mobile Operating Systems.

**Application Layer Considerations**: Adaptation, Disconnected operations, Mobile Agents, Business implications and mobile commerce. Emerging Technologies such as Wearable Computing- challenges and concerns.

C. **Teaching/Learning/Practice Pattern**:

- **Teaching**: 70%
- **Learning**: 30%
- **Practice**: 0%

D. **Examination Pattern**:

1. Theoretical Examination: Open book/ Regular examination

E. **Reading List**:

**BOOKS**:

5. R. Pandya, "Mobile and Personal Communication Systems and Services", New Delhi PHI
9. R. Blake, "Wireless Communications Technology", Delmar, Singapore: Thomson Asia Pvt Ltd

**MAGAZINES**:

1. IEEE Communication Magazine

**JOURNALS**:

1. IEEE Transactions on Wireless Communication
2. International Journal of Mobile Communication
Name of the Module: Medical Instrumentation
Module Code: ELS 304E
Semester: 3rd
Credit Value: 4 [P=0, T=0, L=3]
Module Leader:

A. Objectives:
The course is designed to meet the objectives of:
1. Students will be able to know basics of human biology, concepts of medical instrumentation.
2. Knowledge about sensors and working principle will be introduced to the students.

B. Subject matter:
UNIT I:
**Human Biology:** Basic concepts of Quantitative Physiology, Microbiology and Immunology, Notion of nervous system, respiratory system, circulatory system and excretory system with special emphasis on origin and alteration of physiological potentials for measurement of different pathophysiological parameters in these systems.

UNIT II:
**Basic Concepts of Medical Instrumentation:** Medical measurements and their associated constraints, classification of biomedical instruments, interfering and modifying inputs, compensation techniques, generalized static and dynamic characteristics commercial medical instrumentation development process, regulation of medical devices.

UNIT III:
**Basic Sensors and Principles:** Inertial sensors for measurement of pressure and flow, optical sensors for measurement of oxygen content, vitreo-retinal functions, thermal sensors, biosensors for bacteria detection, electrochemical sensors, Origin of biopotentials and their measurements like ENG, EMG, ECG, ERG, EEG, Principles of construction and operation of biopotential measuring equipments, Signal processing of Biopotentials, Analysis of non-stationary data with special emphasis on electroencephalographic data processing.

UNIT IV:
**Measurements of physiological parameters:** Description and principles of operation of analog and digital circuits for signal conditioning of biomedical sensor outputs with special emphasis to signal modulation, encoding and interfacing and electrical safety, blood pressure measurement, flow measurements and analyses by Brookfield cone-plate viscometer, Cahn surface tension balance and electronetics bubble pulsating surfactometer, measurement of respiratory parameters by spirometer, blood glucose measurement by Doppler Ultrasonography; medical imaging systems like CAT Scan, MRI, USG etc.

C. List of Experiments: NIL

D. Teaching/Learning/Practice Pattern:
   Teaching : 70%
   Learning : 30%
   Practice : 0%

E. Examination Pattern:

F. Reading List:

**BOOKS:**
3. John G. Webster, “Medical Instrumentation-Application and Design”, Wiley India Pvt Ltd.

MAGAZINES:
1. Biomedical Sciences Instrumentations
2. IEEE Engineering in Medicine and Biology

JOURNALS:
1. IEEE Transactions on Biomedical Engineering
2. IEEE Transactions on biomedical Circuits
3. Bioprocess and Biosystems Engineering
Name of the Module: **Green Energy**

Module Code: **ELS 304F**

Semester: 3rd

Credit Value: 4 [P=0, T=0, L=3]

Module Leader:

A. Objectives:
The course is designed to meet the objectives of:

1. Understanding include concentrated solar power (CSP), solar photovoltaic (solar PV), wind, biofuels, hydropower, geothermal, nuclear power, ocean thermal energy conversion (OTEC), harvesting tidal and wave power.
2. Understanding of life cycle impact of assessment (LCIA) of renewable energy sources, energy storage technologies capable of overcoming the intermittency of solar and wind energy sources, role of the smart-grids and distributed energy generation in reducing CO₂ emissions from the electricity generation sector, main CO₂ capture technologies (both pre-combustion and post combustion), carbon capture and storage (CCS), and role of the hydrogen economy in reducing greenhouse gas emissions from the transportation sector,

B. Subject matter:
UNIT I:

UNIT II:
**Solar Energy:** Sun and its Energy: Basics of Solar Energy; Solar Energy in the Past; Solar thermal energy; Solar Photovoltaics, Storage of generated power.

UNIT III:
**Wind Energy:** Historical Background; Wind Resources; Wind Turbines; Environmental Impact.

UNIT IV:
**Ocean Energy:** Ocean Energy, Potential against Wind and Solar; Wave Characteristics and Statistics; Wave Energy Devices; Tide characteristics and Statistics; Tide Energy Technologies; Ocean Thermal Energy; Osmotic Power; Ocean Bio-mass.

**Geothermal Energy:** Geothermal Resources; Geothermal Technologies.

C. Teaching/Learning/Practice Pattern:

- Teaching : 70%
- Learning : 30%
- Practice : 00%

D. Examination Pattern:


E. Reading List:

**BOOKS:**


MAGAZINES:
1. Renewable Energy World
2. Renewable Energy

JOURNALS:
1. International Journal of Green Energy
2. Journal in Green and Renewable Energy
3. International Journal of Sustainable and Green Energy
4. Renewable Energy
Name of the Module: Research Project and Presentation

Module Code: ELS-401
Semester: 4th
Credit Value: 20\(P=40, T=0, L=0\)

Module Leader:

Students will be able to decide their Research Project in any of the following fields:

A. Electronic- Devices & Material Development  
B. Photovoltaics/ Optoelectronics  
C. Device Simulation  
D. Theoretical Modelling  
E. Others (depending on the availability of guide)

Each research project will be written up as a thesis and should be submitted in four copies.