Al-Nahrain University

College of Engineering

Laser and Optoelectronics Engineering Department

Study Plan

&

Course Syllabus

(2022-2023)

Study Plan

Ph.D Degree

Al- Nahrain University
College of Engineering
Department of Laser and Optoelectronics Engineering
Study Plan for the Ph.D Degree Course (2020-2021)

❖ First Semester

No.	CODE	SUBJECT	Hrs Per Week		Units
			Th	App	
1	UREQ 810	Technical English III	1	1	1
2	LAER 810	Advanced Laser Theory	3		3
3	LAER 811	Advanced Laser Photonics	3		3
4	LAER 812	Advanced Laser Technology	3		3
5	LAER 813	All Optical Signal Processing	3		3
Total			13	1	13
			14		

❖ Second Semester

No.	CODE	SUBJECT	Hrs Per Week		Units
			Th	App	
1	UREQ 820	Technical English IV	1	1	1
2	LAER 820	Advanced Optical System Engineering	3		3
3	LAER 821	Advanced Laser Interaction with Materials	3		3
4	LAER 822	Elective I	2		2
5	LAER 823	Elective II	2		2
6	LAER 823	Elective III	2		2
Total			13	1	13
			14		

Al- Nahrain University
College of Engineering
Department of Laser and Optoelectronics Engineering
Study Plan for the Ph.D Degree Course (2020-2021)

Approved Electives:

- Advanced Non-linear Optics
- Advanced Quantum Optics
- Advanced Laser Applications
- Laser Imaging
- Advanced Optoelectronics
- Nanophotonics Antenna
- Millimeter and Terahertz Technologies
- System Modeling
- Medical Laser Applications
- Advanced LADAR
- Special selected topics in laser and optoelectronics

Study Plan

M.Sc. Degree

Al- Nahrain University
College of Engineering
Department of Laser and Optoelectronics Engineering
Study Plan for the M.Sc. Degree Course (2020-2021)

❖ First Semester

No.	CODE	SUBJECT	Hrs Per Week		Units
			Th	App	
1	UREQ 710	Technical English I	1	1	1
2	LAER 710	Advanced Laser Design Technology	2	3	3
3	LAER 711	Advanced Laser Physics	3		3
4	LAER 712	Infrared System Engineering	2	1	2
5	LAER 713	Elective I	2	1	2
6	LAER 714	Elective II	2	1	2
Total			12	7	13
			19		

❖ Second Semester

No.	CODE	SUBJECT	Hrs Per Week		Units
			Th	App	
1	UREQ 720	Technical English II	1	1	1
2	LAER 720	Advanced Optical Signal Processing	3		3
3	LAER 721	Advanced Laser Applications	3		3
4	LAER 722	Advanced Photonics	2	1	2
5	LAER 723	Elective III	2	1	2
6	LAER 724	Elective IV	2	1	2
Total			13	4	13
			17		

Al- Nahrain University
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Department of Laser and Optoelectronics Engineering
Study Plan for the M.Sc. Degree Course (2020-2021)

Approved Electives:

1- Remote Sensing
2- Power Electronics
3- Thin Film Technology
4- Semiconductor Devices
5- Vacuum Technology
6- Optimization Technology
7- Advanced Numerical Analysis
8- Plasma Physics
9- Advanced Microprocessor Techniques
10- System Modeling
11- Structured Programming
12- Advanced Non-Linear Optics
13- System Identification
14- Optical Displays
15- Advanced Image Processing
16- Electro-Magnetic Radiation Systems
17- Modern Control
18- Superconductor
19- Neural Networks & Fuzzy Logic
20- Diffractive Optics
21- Advanced Optoelectronics
22- Special Selected Advanced Topics

Study Plan

B.Sc. Degree

Al- Nahrain University
College of Engineering
Department of Laser and Optoelectronics Engineering
Study Plan for the B.Sc. Degree Course (2020-2021)
First Year

❖ First Semester

No.	CODE	SUBJECT	Hrs Per Week			Units
			Th	App	Tut	
1	UREQ 110	Human Rights	1			1
2	UREQ 111	Computer Fundamentals and Programming I	1	2		2
3	MATH 110	Mathematics I	3		1	3
4	CREQ 110	Engineering Drawing I	1	2		2
5	CREQ 111	Workshop Technology		3		
6	PHYS 110	Physics	2	2		3
7	LAER 110	Mechanical Engineering I	2	2	1	3
8	LAER 111	Electrical Circuits I	2	3	1	3
9	LAER 112	Laser Principles	2			2
Total			14	14	3	19
			31			

❖ Second Semester

No.	CODE	SUBJECT	Hrs Per Week			Units
			Th	App	Tut	
1	UREQ 120	Arabic Language I	1			1
2	UREQ 121	English Language I	2			2
3	CREQ 120	Engineering Drawing II	1	2		2
4	CREQ 121	Elective	2			2
5	MATH 120	Mathematics II	3		1	3
6	LAER 120	Electrical Circuits II	2	3	1	3
7	LAER 121	Laser Physics I	2	2		3
8	LAER 122	Laser Safety	1			1
Total			14	7	2	17
			23			

Al- Nahrain University
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Second Year

❖ First Semester

No.	CODE	SUBJECT	Hrs Per Week			Units
			Th	App	Tut	
1	UREQ 210	English Language II	2			2
2	UREQ 211	Principles of Management	1			1
3	UREQ 212	Arabic Language II	1			1
4	UREQ 213	Computer Fundamentals and Programming II	1	2		2
5	MATH 210	Mathematics III	3		1	3
6	LAER 210	Electronics I	2	3	1	3
7	LAER 211	Electromagnetic Fields I	2		1	2
8	LAER 212	Optics	2	2	1	3
9	LAER 213	Mechanical Engineering II	2	2	1	3
Total			16	9	5	20
			30			

❖ Second Semester

No.	CODE	SUBJECT	Hrs Per Week			Units
			Th	App	Tut	
1	UREQ 220	Democracy	1			1
2	MATH 220	Mathematics IV	3		1	3
3	LAER 220	Electromagnetic Fields II	2		1	2
4	LAER 221	Electronics II	2	3	1	3
5	LAER 222	Digital Techniques I	2	3	1	3
6	LAER 223	Laser Physics II	2	2		3
7	LAER 224	Laser Detection Systems	2	2		3
8	LAER 225	Laser Materials	2			2
Total			16	10	4	20
			30			

AL-Nahrain University
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Third Year

❖ First Semester

No.	CODE	SUBJECT	Hrs Per Week			Units
			Th	App	Tut	
1	LAER 310	Digital Techniques II	2	3	1	3
2	LAER 311	Optoelectronics	2			2
3	LAER 312	Engineering Analysis	3			3
4	LAER 313	Networks and Communication Networks	2			2
5	LAER 314	Computer Architecture	2	3		3
6	LAER 315	Quantum Mechanics	2			2
7	LAER 316	Laser Applications I	2	2		3
Total			15	8	1	18
			24			

❖ Second Semester

No.	CODE	SUBJECT	Hrs Per Week			Units
			Th	App	Tut	
1	UREQ 320	English Language III	2			2
2	CREQ 320	Engineering Statistics	2			2
3	TRAN#90	Summer Training				
4	LAER 320	Control Theory	2		1	2
5	LAER 321	Wave Propagation	2			2
6	LAER 322	Numerical Analysis	2	3	1	3
7	LAER 323	Industrial Management	2			2
8	LAER 324	Spectroscopy	2	2		3
9	LAER 325	Communication Theory	2		1	2
Total			16	5	3	18
			24			

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Fourth Year

❖ First Semester

No.	CODE	SUBJECT	Hrs Per Week			Units
			Th	App	Tut	
1	CREQ 410	Project		4		2
2	UREQ 410	English Language IV	2			2
3	LAER 410	Optical Fibers	2	2		3
4	LAER 411	Control Engineering	2	3	1	3
5	LAER 412	Optical System Engineering	2		1	2
6	LAER 413	Laser Applications II	2			2
7	LAER 414	Elective I	2			2
8	LAER 415	Elective II	2			2
Total			14	9	2	18
			25			

❖ Second Semester

No.	CODE	SUBJECT	Hrs Per Week			Units
			Th	App	Tut	
1	CREQ 420	Project		4		2
2	ETHC 420	Professional Ethics	1			1
3	LAER 420	Laser Design Technology	2	2	1	3
4	LAER 421	Optical Communications	2	2		3
5	LAER 422	Image Processing	2	2		3
6	LAER 423	Computer Interface	2	2		3
7	LAER 424	Elective III	2			2
8	LAER 425	Elective IV	2			2
9	LAER 426	Seminar		1		
Total			13	13	1	19
			27			

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Nahrain University
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Department of Laser and Optoelectronics Engineering
Study Plan for the B.Sc. Degree Course (2020-2021)

Approved Electives:

1- Chemistry
2- Biology
3- Geology
4- General Science
5- Optical Signal Processing
6- High power Laser Techniques
7- Laser Power Supply
8- Integrated Optics
9- Micro Controller
10- Thin Film Technology
11- Renewable Energy
12- Fiber Sensors
13- Nonlinear Optics
14- Nanotechnology
15- Photonics
16- Remote Sensing
17- Quantum Optics
18- Solar Cells Fabrication
19- Plasmonic
20- Special Topics

Course Syllabus

Stage: First

First Semester

Laser Principles

First Year	First Semester	Compulsory
2 hrs Theoretical		2 Units

- Laser Fundamentals
- The Wave nature of Light
- Experimenting with Light Young Experiment
- The Spectrum and Wavelength
- Energy Levels in Atom
- Energy States in Molecular
- Absorption, Spontaneous and Stimulated Emission
- The Boltzmann Distribution
- Population Inversion
- Pumping Mechanisms
- Blackbody Radiation
- Einstein Relations
- Introduction to Laser Theory
- Three Level Lasers
- Four Level Lasers
- Standing Wave
- Spectral Distribution of Laser Output
- Temporal Characteristics of Lasers
- Spatial Characteristics of Lasers
- Laser Light Beam Properties

Mathematics I

First Year	First Semester	Compulsory
3 hrs Theoretical	1 hr Tutorials	3 Units

1. **Prerequisites for calculus**

   - Coordinates and graphs in the plane
   - Slope, and equations for lines
   - Functions and their graphs
   - Shifts of functions
   - Trigonometric functions
   - Absolute value
   - Limits

2. **Derivatives**

   - Slopes, tangent lines, and derivatives
   - Differentiation rules
   - Velocity, speed, and other rates of change
   - Derivatives of trigonometric functions
   - The chain rule
   - Implicit differentiation and fractional powers

Computer Fundamentals and Programming I

First Year	First Semester	Compulsory
1 hr Theoretical	2 hrs Applied	2 Units

- Introduction to MATLAB
- Mathematical Functions
- Matrix Generation
- Array Operations and Linear Equations
- Programming using MATLAB
- Control Flow and Operations
- Computer Fundamentals and Applications I
- Computer Fundamentals and Applications II (Word & Power Points)

Physics

First Year	First Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- Waves
- Electromagnetic Waves,
- Reflection and Refraction of Light,
- Interference and Diffraction,
- Electric Forces and Fields Electric Potential.

Electrical Circuits I

First Year	First Semester	Compulsory
2 hrs Theoretical	3 hrs Applied 1 hr Tutorial	3 Units

- Introduction about current, voltage, and power.
- Circuit elements, current and voltage sources.
- Ohm's Law, Power, and Energy.
- Series Circuits: Voltage sources in series, Kirchhoff's voltage low, interchanging series elements, voltage divider rule, Voltage Sources and Ground.
- Parallel Circuits: Parallel elements, total conductance and resistance, Kirchhoff's current low, current divider rule, voltage sources in parallel, open and short circuits.

Engineering Drawing I

First Year	First Semester	Compulsory
1 hrs Theoretical	2 hrs Applied	2 Units

ENGINEERING DRAWING:

- Fundamentals of eng. drawing, lettering,
- Geometrical construction of shapes,
- Orthogonal projection Isometric Drawing: Drawing sheet layout calculations for isometric drawing
- Sectional drawing: types and techniques
- Development of sectional views
- Assembly drawing: Fundamentals and techniques of developing assembly drawings
- Orthographic and sectional assembly views

DESCRIPTIVE GEOMETRY:

- Basics and definitions,
- Methods of graphical representation, theory of projection,
- Projection of points and straight lines,
- Operations of determination straight lines parameters

Mechanical Engineering I

First Year	First Semester	Compulsory
2 hrs Theoretical	2 hrs Applied 1 hr Tutorial	3 Units

PART ONE: THERMODYNAMICS

- Basic Concepts and Definitions: Thermodynamic system, Control volume, properties and state of a substance, Processes and cycles, The system of units (ISO units)
- Properties of pure substances: Vapour-Liquid-Solid phase equilibrium in a pure substance, Independent properties of a pure substance, Equation of state,
- Practicing Tables of thermodynamics

PART TWO: HEAT TRANSFER

- Introduction to Heat Transfer: Types of heat transfer, conduction Heat transfer, Thermal conductivity, Convection heat transfer, Heat transfer coefficient
- One-Dimensional Steady-State Conduction in Plane and Composite Walls

Course Syllabus

Stage: First

Second Semester

Mathematics II

First Year	Second Semester	Compulsory
3 hrs Theoretical	1 hr Tutorials	3 Units

1. **Integration**
   - Definite integrals
   - Indefinite integrals
   - Applications of definite integrals (Areas between curves, lengths of curves (in the plane
2. **Inverse functions and their derivatives**
   - ln X, e X, and logarithmic differentiation
   - Other exponential and logarithmic functions
   - The inverse trigonometric functions
   - Derivatives and integrals of inverse functions
3. **Techniques of integration**
   - Basic integration formulas
   - Integration by parts
   - Trigonometric integrals
   - Trigonometric substitution
   - Rational functions and partial functions
   - Integral using tables method
   - Improper integrals

Laser Physics I

First Year	Second Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- Electromagnetic Waves (wave Eq.s): Definition, properties, Maxwell equations, wave equation,
- Energy carried by electromagnetic waves,
- Momentum and radiation pressure of EMW for surfaces of: perfect absorption, perfect reflection and partial absorption,
- Basic components of laser system and properties of laser light,
- Laser Resonators and Stability: Passive optical resonator, types of resonators, stability of resonators,
- Free space propagation of Gaussian beam,
- Laser oscillation: Gain, Losses, Threshold, Power and Frequency,
- Laser bandwidth, laser broadening mechanisms.

Electrical Circuits II

First Year	Second Semester	Compulsory
2 hrs Theoretical	3 hrs Applied 1 hr Tutorial	3 Units

- Series –Parallel network elements, descriptive examples, ladder network,
- Methods of Analysis and Selected Topics (dc): Current sources, source conversions, current sources in parallel, current sources in series.
- Branch- current analysis, mesh analysis, nodal analysis, Y-D and D-Y conversion,
- Superposition theorem,
- Thevenin's theorem,
- Norton theorem.
- Sinusoidal ac voltage characteristics and definitions, the sine wave, the general format for the sinusoidal voltage or current, phase relation, average value, the effective value (rms), AC current through various circuit elements.
- Series and parallel ac circuits. Series- parallel ac Network.

Laser Safety

First Year	Second Semester	Compulsory
1 hrs Theoretical		1 Units

- **Basic concepts** (electromagnetic spectrum, the basic laser terminology , fundamentals of lasers, the characteristics of laser light, how a laser works and common lasers).
- **Non-beam hazards:** non-beam hazards associated with industrial lasers include electrical hazards from laser power supply and fire hazards).
- **Laser classes:** all lasers are classified according to the level of laser radiation that is accessible during normal operation. According to the American National standards for safe use of laser ANSIZ136.1 lasers can be classified into seven laser hazard classes.
- **Eye injury:** Exploration of the parts of eye and type of injuries that can occur to the various parts of eye based on the type of laser.
- **Skin injury:** summary of laser effect on skin tissue.
- **Laser hazard evaluation:** explains hazard evaluation term such as maximum permissible exposure (MPE), nominal hazard zone (NHZ) and optical density (OD).
- **Control measures:** include both administrative controls and engineering controls.

Engineering Drawing II

First Year	Second Semester	Compulsory
1 hrs Theoretical	2 hrs Applied	2 Units

Drawing using AutoCAD

- Benefits of CAD,
- Limitations,
- Applications,
- Working with AutoCAD,
- Working with files,
- Drawing: rectangle, circle, line, arc, polygon,
- Modification tools.

Chemistry

First Year	Second Semester	Elective
2 hrs Theoretical		2 Units

- Introduction to chemistry
- Branches of chemistry
- Introduction to analytical chemistry:

  i) Qualitative analysis, ii) Quantitative analysis, iii) Instrumental methods of analysis
- Solutions types
- Methods for the expression of concentration of solutions:

  i) Molarity, ii) Normality, iii) Formality, iv) Mole fraction, v) Percentage ratio, vi) Parts per million (ppm) vii) Parts per billion (ppb) viii) Density and specific gravity of solutions
- Calculation of equivalent weight:

  i) Equivalent weight for acid, ii) Equivalent weight for base, iii) Equivalent weight for salts, iv) Oxidizing and reducing agent
- Dilution
- P-functions
- Chemical stoichiometry
- Titration
- Chemical equilibrium
- Solubility product principle

Course Syllabus

Stage: Second

First Semester

Electromagnetic Fields I

SecondYear	First Semester	Compulsory
2 hrs Theoretical	1 hr Tutorial	2 Units

- Scalar and Vector Fields,
- Vector Algebra, Vectors in Cartesian Coordinates, Dot and Cross Products, Vectors in Cylindrical and Spherical Coordinates.
- Coulombs Law, Charge, N-Point Charge, Line Charge, Sheet Charge, Volume Charge.
- Definition of Electric Field, Point Electric Flux and Flux Density Concept of Flux.
- Gauss's Law with Applications to Symmetrical Charge Distributions. Divergence Theorem.
- Work and Energy in the Electric Field.
- The Line Integral Potential Difference and Potential for Various Charge Distribution
- Dipole Example, Energy Density in the Electrostatic Field

Mechanical Engineering II

Second Year	First Semester	Compulsory
2 hrs Theoretical	2 hrs Applied 1 hr Tutorial	3 Units

PART ONE: STATIC MECHANICS

- Basics and definitions of mechanics,
- scalars and vectors,
- two-dimensional analyses (force systems, moments, couples, resultants),
- three-dimensional analyses (force systems, moments, couples, resultants), and
- two-dimensional equilibrium.

PART TWO: STRENGTH OF MATERIALS

- Basics and definitions,
- simple stress,
- simple strain,
- shear stress,
- stress-strain curve, and
- statically indeterminate member.

Electronics I

Second Year	First Semester	Compulsory
2 hrs Theoretical	3 hrs Applied 1 hr Tutorial	3 Units

- **Semiconductor Diodes**

  Unbiased PN Junction, Forward & Reverse Biased PN Junction,

- **Diode Characteristics**

  Diode Equation, Diode Equivalent Circuits, Graphical Solution, Breakdown & Zener Diodes, Tunnel Diode & Backward Diode, Other Special Diodes. Diode Applications Rectifiers, Capacitor Filter, Clipping & Clamping Circuits, Voltage Stabilization.

- **Bipolar Junction Transistor (BJT)**

  Current Components, Characteristics of CE, CB & CC Configurations Operating Point and Operating Regions. Biasing the BJT Fixed Bias, Collector to Base Bias & Self Bias Circuits, Stability Factors. Small Signal Low Frequency Analysis Graphical Analysis, Two Port Devices & The BJT Hybrid Model, Conversion Formulas, Comparison of BJT Amplifier Configurations, Cascading Amplifiers, Simplified Mode

Mathematics III

Second Year	First Semester	Compulsory
3 hrs Theoretical	1 hr Tutorial	3 Units

1. **Ordinary Differential Equation (ODE):**
   - Basic concepts
   - Exact ODEs of first order
   - Integrating factors
   - Linear ODE
   - Bernoulli equation
   - Homogeneous linear ODE of second order
   - Homogeneous linear ODE with constant coefficients
   - Differential operators
   - Euler-Cauchy equations
   - Existence and Uniqueness of Solutions Wronskian
   - Nonhomogeneous ODEs
   - Solution by Variation of Parameters
   - Systems of ODEs
   - Nonhomogeneous linear systems of ODEs.
2. **Sequence and Series:**
   - Infinite series
   - Limits of sequences of numbers
   - Infinite series
   - Series without negative terms
   - Comparison and integral test
   - Series with negative terms
   - Ratio and root test
   - Alternating series and absolute convergence
   - Power series
   - Taylor series
   - Maclaurin series

Optics

Second Year	First Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- Introduction to geometric optics (ray optics)
- Optical path
- Refractive index, laws of reflection and refraction, TIR
- Snell's law
- Fermat's principle
- Prisms, TIR by prisms, refraction by prisms, angular deviation by prisms, dispersion power
- Spectrometer, spectroscope, spectrograph, Polarized light, methods of polarization, Polaroid, Nicol prism
- Malus's law
- Spherical surfaces, images formed by spherical surfaces, lenses, image formation, magnification, main types of lenses, combination of thin lenses, thick lenses, aperture stop and field stope
- Lens aberrations
- Interference and diffraction, Franhofer diffraction
- Analytical ray tracing, matrix methods,
- Snell's law matrix, thin lens matrix, complex system matrix

Computer Fundamentals and Programming II

Second Year	First Semester	Compulsory
1 hrs Theoretical	2 hrs Applied	2 Units

- Algorithms
- Loops
- While Loops
- Vectors and Matrices
- Plotting Function
- Multiple Plots
- Relational and Logical Operations
- Microsoft Excel Basics
- Microsoft Excel Features
- Excel Equations

Course Syllabus

Stage: Second

Second Semester

Mathematics IV

Second Year	Second Semester	Compulsory
3 hrs Theoretical	1 hr Tutorial	3 Units

1. **Fourier Analysis**

- Fourier Series
- Arbitrary Period. Even and Odd Functions. Half-Range Expansions
- Forced Oscillations
- Fourier Integral
- Fourier Cosine and Sine Transforms
- Fourier Transform. Discrete and Fast Fourier Transforms

2. **Laplace Transforms**

- Laplace Transform. Linearity. First Shifting Theorem (*s*-Shifting)
- Transforms of Derivatives and Integrals ODEs
- Unit Step Function (Heaviside Function).
- Second Shifting Theorem (*t*-Shifting)
- Short Impulses. Dirac's Delta Function. Partial Fractions
- Convolution. Integral Equations
- Differentiation and Integration of Transforms.
- ODEs with Variable Coefficients
- Systems of ODEs
- Laplace Transform: General Formulas
- Table of Laplace Transforms

3. **Matrices**

Electronics II

Second Year	Second Semester	Compulsory
2 hrs Theoretical	3 hrs Applied 1 hr Tutorial	3 Units

- **JFET Characteristics and Applications**.

  Amplifier Frequency Response Analysis, Low Frequency Regions, Medium Frequency Regions, High Frequency Regions. Feedback Amplifier **,** Feedback Concepts. Feedback Topologies and Types. Effect of –ve Feedback on Amplifiers Performances.

- **Operational Amplifier,**

  Ideal and Non-ideal Characteristics. Applications of Operational Amplifier Inverting and Non-inverting Amplifier, Summation, Subtraction, Integration, Differentiation, Comparator, Active Filters and Oscillators. Tuned Amplifiers, Main characteristics, Analysis of Single Tuned Amplifier, Double Tuned Amplifier.

Electromagnetic Fields II

Second Year	Second Semester	Compulsory
2 hrs Theoretical	1 hr Tutorial	2 Units

- Conductors, dielectrics, capacitances and the boundary conditions.
- Laplace and Poisson's Equations.
- Magnetic Field Intensity, BiotSavart Law, Ampere's Circuital Law, Stokes Theorem and Magnetic Flux Density, Scalar and Vector Magnetic Potentials.
- Magnetic Forces due to moving charge. Magnetic Materials and their Boundary Conditions.
- Time – Varying Fields, Faraday's Law and Maxwell's Equations for Time Varying Fields.

Laser Physics II

Second Year	Second Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- Reducing laser bandwidth methods, single mode laser.
- Types of laser outputs: Measuring the outputs of lasers.
- Special mechanisms for creating short pulses: Q-switching, Mode locking.
- Laser pumping.
- Types of lasers: Solid state lasers, Gas lasers, Dye lasers, Semiconductor lasers and Free electron laser.

Laser Materials

Second Year	Second Semester	Compulsory
2 hrs Theoretical		2 Units

- General introduction: possible themes on engineering materials properties.
- Introduction to the models of atom.
- Bonding and types of bonding
- Crystalline structure: Internal structure of materials
- unit cell, types of solids.
- Miller indices, Crystal directions and planes
- Some Aspects of Laser Materials: Types of active medium for different laser.
- Crystal Defects
- Types of crystal defects
- Crystal structure of laser crystal and Laser glasses
- Structure and laser emission of laser glasses, Neodymium laser glasses.

Laser Detection Systems

Second Year	Second Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- Radiation theory.
- Type of detections.
- Photoemission detectors.
- Type of Photoemission detectors.
- Photoconduction detectors.
- Type of Photoconduction detectors.
- Photo diode detectors.
- Thermal detector
- Photo-acoustic detector.
- IR system.
- Thermal camera. Range detection.
- Thermal detection.
- Noise measurement.

Digital Techniques I

Second Year	Second Semester	Compulsory
2 hrs Theoretical	3 hrs Applied 1 hr Tutorial	3 Units

- Introduction to digital system, digital and analog quantities, basic logic operations.
- Decimal and Binary Numbers (Conversion), Binary Arithmetic, 1's and 2's Complement of Binary Numbers, Singed Numbers and their Arithmetic Operations.
- Hexadecimal and Octal Numbers, BCD and Digital Codes.
- Logic Gates: Inverter, AND Gate, OR Gate, NAND Gate, NOR Gate, Exclusive-OR and Exclusive-NOR Gates.
- Boolean algebra and logic simplifications, standard forms of Boolean expressions.
- Karnaugh Map: - Karnaugh Map SOP minimization, - Karnaugh Map POS minimization.
- Basic Combinational Logic Circuits and their implementation, Universal Properties of NAND and NOR Gates, and their use in Combinational Logic, Logic Circuit Operation with pulse Waveforms.
- Functions of combinational logic: Basic and Parallel Adders.
- Comparator, -decoders, -encoders,
- Code converters,
- Multiplexers (Data selectors),
- Demultiplexers,
- Parity generators/checkers.

Course Syllabus

Stage: Third

First Semester

Digital Techniques II

Third Year	First Semester	Compulsory
2 hrs Theoretical	3 hrs Applied 1 hr Tutorial	3 Units

- Sequential logic circuit, latches,
- flip-flops, flip-flop applications,
- counters, asynchronous counter, synchronous counter, cascade counters, counter decoding, counter applications,
- shift registers types and their applications,
- Digital to Analogue and Analogue to Digital Converters.

Optoelectronics

Third Year	First Semester	Compulsory
2 hrs Theoretical		2 Units

- **CHAPTER ONE (Fundamentals of optoelectronics)**

Basics of semiconductors, junction, Homojunction, Hetrojunction, junction width, junction barrio, junction I-V characteristics

- **CHAPTER TWO (Optoelectronics Devices)**

Light emitters, Light detectors, Forward biasing, reverse biasing, energy band diagram.

- **CHAPTER THREE (Light Emitters)**

Light emitting diode, I-V characteristics, Material and control the emitting wavelength, Quantum efficiency, Surface emitting, Edge emitting, Rate equation. Laser Diode, Modes (longitudinal, transverse and lateral), laser threshold gain, threshold gain, External quantum efficiency.

- **CHAPTER FOUR (Detector)**

Types of Detector, Photodiodes, phototransister, photomultiplier, Avalanche detector, Light Emitting Device (LED), structure, solar cells, solar cell generations.

- **CHAPTER FIVE (Optoelectronics Effects)**

Uniaxial crystal, optoelectronic effects, Electro-optic effect, Acousto-optic effect, Anisotropic crystal, Pockel cell, Kerr cell, phase modulation, amplitude modulation. Longitudinal & Transverse modes, Applications.

Engineering Analysis

Third Year	First Semester	Compulsory
3 hrs Theoretical		3 Units

- System of linear equations and applications of linear systems
- Evaluating Determinants, Rank, Null, and basis by Row Reduction
- General Vector Spaces
- LU-decomposition.
- Eigenvalues and Eigenvectors
- General Linear Transformations

Quantum Mechanics

Third Year	First Semester	Compulsory
2 hrs Theoretical		2 Units

Chapter One: Physical Foundations of Quantum Mechanics

- Introduction
- Quantum mechanics (Q.M)
- The needs of Q.M
- Phenomenon couldn't be interpreted by classical physics: Black body radiation, Atom stability, Photo electric effect
- Natural duality of matter and radiation
- Uncertainty principle
- Correspondence principle

Chapter Two: Elementary Properties of Quantum Mechanics

- Introduction
- Wave function and its interpretation
- Mathematical interpretation of the wave function
- Derivation of Schrödinger wave equation
- Operators, Operators properties, Operator equation
- Eigen value equation: Eigen value and eigen functions
- Observables
- Expectation values
- Variance
- Equation of motion and constant of motion
- Degeneracy
- Conservation of probability and probability current density
- Quantized states
- Parity

Chapter Three: Simplified quantum systems

- Introduction
- Free particle
- Schrödinger equation in one dimension
- Potential step (finite and infinite height)
- Particle in a box in one dimension
- Particle in a box in three dimension
- Density of states
- Potential barrier penetration
- Potential well

Networks and Communication Networks

Third Year	First Semester	Compulsory
2 hrs Theoretical		2 Units

- Basic Circuit Analysis and Techniques
- Optical Communications Networks
- Signal Waveforms
- Energy Storage Elements
- Series RLC Circuit
- Communication Networks Architecture and Services
- Future Cellular Network Architecture
- FIRST- AND SECOND ORDER CIRCUITS Response
- Filter Design (Passive Low Pass Filter)
- Sinusoidal Steady-State Response
- Laplace Transforms
- Network Functions
- Frequency Response
- Fourier Series
- Ac Power Systems

Computer Architecture

Third Year	First Semester	Compulsory
2 hrs Theoretical	3 hrs Applied	3 Units

- Syllabus presentation, Introduction to µprocessors and µcomputers, and General Architecture of µcomputer.
- Microarchitecture of 8086 µprocessor, Software Model of 8086, Memory Address Space and Data Organization.
- Data Types, Segment Register and Memory Segmentation, and Instruction Pointer.
- Data Registers, Pointer and Index Registers, and Status Register.
- Generating Memory Address, The Stack, and Input/Output Address Space.
- Introduction to Assembly Language Programming, Instructions Set, and The MOV Instruction.
- Register Operand Addressing Mode, Immediate Operand Addressing Mode,
- Memory Operand Addressing Modes.
- Converting Assembly Language Instructions to Machine Code, and Encoding A Complete Program in Machine Code.
- Data Transfer Instructions, and Arithmetic Instructions (Addition).
- Arithmetic Instructions (Subtraction, Multiplication, and Division), and Logic, Shift, and Rotate Instructions.
- Flag Control Instructions, Compare Instructions, Control Flow Instructions, (Subroutine, Loops, and String Instructions).
- 8086 Hardware Specifications, Pin Out, Minimum and Maximum Modes, System Clock, Bus Cycle and Timing States.
- Memory Interface Circuits, (Types of Input/Output, their Instructions and Bus Cycle), Isolated Input/Output Interface and Data Transfers.

Laser Applications I

Third Year	First Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- **Industrial Lasers and Their Applications:**
  Types of industrial lasers (high power, moderate power, low power lasers), characteristics of sample lasers, chart of industrial laser applications, introduction to laser material processing systems, Desired features of laser material processing, Basic elements of laser material processing systems, Types of beam delivery systems: moving workpiece, moving laser/moving mirror, moving mirrors, moving mirrors/moving workpiece, optical fiber, pictorial examples of beam delivery systems
- **Basic optics for laser material processing:**
  Lens arrangements, Mirrors arrangements, Beam expanders, Analysis of focusing characteristics for laser material processing.
- **Interaction of high-power laser radiation with solids:**
  Introduction, Absorption of laser radiation by solids and affecting factors, Heating phase (melting, evaporation, plasma formation), The chart of laser material processing and operational requirements
- **Heating of solids:**
  The basic theory of heat transfer in solids (Fourier law of heat conduction), Instantaneous source, Constant heat flux (point source analysis), Pulsed heat flux (point source analysis), Circular source, Estimation of melting, depth, Estimation of vaporization depth.
- **Laser surface treatment; techniques and analysis.**
  Features and advantages, process limitations, affecting factors, Types of laser surface treatment techniques (chart of requirements, transformation hardening, shock hardening, laser alloying, laser glazing, laser cladding, Semiconductor annealing.
- **Laser beam welding.**
  Features and advantages, process limitations, Affecting factors, Laser beam welding mechanisms (conduction welding and analysis, keyhole welding), Pictorial examples of laser welds, Assessment of laser beam weld quality
- **Laser cutting**
  Features and advantages, Affecting factors, Laser cutting mechanisms (vaporization cutting, cutting by fusion and ejection, cutting by fusion in reactive gas, controlled fracture, scribing), Assessment of laser cut quality.

Course Syllabus

Stage: Third

Second Semester

Engineering Statistics

Third Year	Second Semester	Compulsory
2 hrs Theoretical		2 Units

- Introduction
- Frequency Distribution
- Construct Frequency Distribution Table
- Mean of Group Data
- Median, Mode, and other Measures of Central Tendency
- Standard Deviation and other Measures of Dispersion
- Probability

Control Theory

Third Year	Second Semester	Compulsory
2 hrs Theoretical	1 hr Tutorial	2 Units

- Introduction : Definition of automatic control system .Mathematical representation of control components, control system (Electronic and Mechanical systems).
- Transfer function representation Definition, poles zero, stability definitions.
- Routh stability criterion
- Block diagram representation
- Definition, Block diagram reduction.
- Signal flow graphs
- Control system classification Definition of order, Type and steady state error constants
- Transient response analysis
- First impulse and step responses
- Second order impulse and step responses
- Stability
- Lead and lag compensators design

Numerical Analysis

Third Year	Second Semester	Compulsory
2 hrs Theoretical	3 hrs Applied 1 hr Tutorial	3 Units

- Numerical solution of nonlinear equations which includes equations, Newton-Raphson method, Fixed-point method, bisection method and linear interpolation method,
- Numerical solution of system of linear simultaneous equations which includes gauss elimination method, gauss-jordan elimination method and jacobbi method,
- Interpolation & curve fitting,
- Numerical Integration and
- Numerical solution of differential equations

Wave Propagation

Third Year	Second Semester	Compulsory
2 hrs Theoretical		2 Units

- Introduction Maxwell's equations in time varying fields, Maxwell's equations in time in-varying fields
- Maxwell's equations in phasor notation, Maxwell's equations in polarization and magnetization forms.
- Electromagnetic Waves
- Power loss in a Plane Conductor and Poynting Vector and the Flow of Power
- Wave between Parallel Planes , Transverse Electric Wave , and Transverse Magnetic Waves
- Characteristics of TE and TM Waves, Transverse EM Waves, Velocity of Propagation and Wave Impedance
- Wave Guides
- Time Variations, Polarization, and Reflection.
- Normal Incidence and Reflection at the Surface of Conductive Medium

Communication Theory

Third Year	Second Semester	Compulsory
2 hrs Theoretical	1 hr Tutorial	2 Units

- Introduction: model of communication system, processing of information
- Size of a siugnal
- Classification of signals
- Signal representation using Fourier series and Fourier transform
- Signal energy and energy spectral density
- Signal power and power spectral density
- Aperiodic signal repreentation by Fourier integral,
- Transforms of some useful functions
- Signal transmission through a linear system
- Ideal and practical filters
- Amplitude modulation schemes. AM modulation and demodulation, DSB-SC
- VSB and SSB modulation and Demodulation
- Quadrature amplitude modulation (QAM)
- Angle modulation: phase and frequency modulation
- Generation of FM, demodulation of FM
- Bandwidth and spectrum consideration.
- Signal to noise ratio in amplitude and angle modulation systems
- Sample theory, pulse code modulation (PCM)

Spectroscopy

Third Year	Second Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

Chapter one: Principles of spectroscopy science

- Definitions: -The spectroscopy science, Light and radiation, Hertiz
- The Wave Nature of radiation
- Spectral parameters and their units
- Angular separation of waves to produce a spectrum
- Mono chromator
- Planck – Einstein Relation
- Photons – Materials interaction
- The molecules moving have four types of energy
- Type of spectrum
- The instrument of spectrum measurement
- Hydrogen atom spectrum
- Bohr Hypothesis
- Energy levels of H-atom
- The broadening of spectrum line

Chapter two: Microwave spectroscopy

- Rotation of linear molecules
- Rotation of rigid linear diatomic molecules classically.
- Selection Rules for Rigid Rotator
- Intensity of rotation lines of rigid rotator
- Stark effect
- Microwave spectrometer
- Non – Rigid Rotator
- Micro wave application

Chapter three: Infrared Spectroscopy (IR)

- Vibrational energy of diatomic molecule
- An harmonic oscillator
- The effects of an harmonicas
- Population of vibration energy levels
- Over tones frequency
- Combination bands and differences bands
- Born-Oppenheimer principle
- Vibration – Rotation spectroscopy of diatomic molecules
- The vibrational-rotational absorption spectrum
- IR Spectrometer
- IR applications
- Orational Infrared spectrum for polyatomic molecules, The Features of Rotational level.

Industrial Management

Third Year	Second Semester	Compulsory
2 hrs Theoretical		2 Units

- **Fundamentals And Definitions:**

Industrial engineering, Production, Manufacturing, Resources of production for manufacturing systems, Productivity.

- **Management:**

Introduction, Management functions, Hierarchical structure of Management: strategic level, management level, operational level, functional structure of management systems, Manufacturing optimization.

- **Modes Of Production:**

Classification of production modes categories: Mass production, Job production, Batch production, Group technology, Just In Time(JIT) production, flexible manufacturing system (FMS).

- **Product Planning And Design:**

Product planning, Product life cycle, Planning system for a new product, Product design, Product structure and explosion, Calculating net required parts and materials.

- **Process Planning:**

Process planning, Process design, Work flow analysis, Economical selection of work station, Operation design.

- **Quality Engineering:**

Quality Control (Q.C.), Total Quality Control/Management, Offline/Online Quality Control,Statistical quality control (normal curve, control chart), Inspection.

Course Syllabus

Stage: Fourth

First Semester

Control Engineering

Fourth Year	First Semester	Compulsory
2 hrs Theoretical	3 hrs Applied 1 hr Tutorial	3 Units

- **Frequency analysis:**

  Bode plot, Cont. Bode plot, root locut, Cont. root locus, Nyquist, Cont. Nyquist, and polar plot.

- **State- Space- Analysis:**

  Definitions, Vector in Space, Basis, Change of Basis, Solution of the State-Space Equation, Construction of the State- Space from the Transfer Function, Determining the Transfer Function from The state- Space Equation, Stability Analysis, Observability and Controllability.

- **Phase Plane:**

  Definitions, Drawing of Phase, Trajectory of Nonlinear and Linear 2^{nd} Order Differential Equation.

- **State space Representation**

Optical Fibers

Fourth Year	First Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- Introduction, historical review, basic characteristics of optical fiber.
- Optical propagation, acceptance angle, numerical aperture, optical modes, step index and graded index fibers, cut-off wavelength, single mode fibers and multi-modes fibers.
- Fiber losses (Attenuation Coefficient, Material Absorption, Rayleigh Scattering and Waveguide Imperfections)
- Dispersion in optical fiber (Group-Velocity Dispersion, Material Dispersion, Waveguide
- Dispersion, Higher-Order Dispersion and Polarization-Mode Dispersion).
- Dispersion Managements
- Fiber nonlinearities (Stimulated Light Scattering, Nonlinear Phase Modulation and Four-Wave Mixing)
- Special Types of OFs and Their Applications
- Fiber Manufacturing

Optical System Engineering

Fourth Year	First Semester	Compulsory
2 hrs Theoretical	1 hr Tutorial	2 Units

- Lens quality, general principles of optical design, design requirements and process
- Lens optimization, types of optical evaluation, spot diagrams, lens bending
- Optical system networks
- Multi-element lenses, achromatic doublets.
- Symmetric lens pairs, triplets,
- Optical system performance, combination formulas, CEF, the f-y curve.
- NA versus f-number, laser expander theory
- Focusing laser pulses, GVD, aberration calculation
- Telephoto, Telescope
- The microscope
- Eye engineering, focusing system of the eye
- Eye aberration, sensitivity, conditions, optical parameter

Laser Applications II

Fourth Year	First Semester	Compulsory
2 hrs Theoretical		2 Units

- Introduction to Medical Laser Applications
- Introduction to Anatomy
- Laser Beam Delivery Arrangements for Medical Applications
- Laser Tissue Interaction
- Mathematical Analysis of Photothermal Effects
- Laser Therapy
- Laser Applications in Dental Industry
- Laser Application in Ophthalmology
- Laser Application in Dermatology
- Laser Application in Surgery

Laser Power Supply

Fourth Year	First Semester	Elective
2 hrs Theoretical		2 Units

1. The Power Diode:

Diode as a Switch, Some Properties of PN Junction, Common Diode Types Typical Diode Ratings, Typical Applications of Diodes.

2. Thyristors:

Basic Structure and Operation, Static Characteristics, Dynamic Switching Characteristics, Thyristor Parameters, Types of Thyristors.

3. Diode Rectifiers:

Single-Phase Diode Rectifiers, Three-Phase Diode Rectifiers, Filtering Systems in Rectifier Circuits, High-Frequency Diode Rectifier Circuits

4. Transformers:

Introduction, Mutual inductance, The iron-core transformer, the air-core transformer, Types of transformer, tapped and multiple load transformers.

5. Dc - Dc convertors:

Introduction, DC Choppers, Step-Down (Buck) Converter, Step-Up (Boost) Converter, Buck-Boost Converter

6. Regulator:

Introduction, Linear Series Voltage Regulator, Linear Shunt Voltage Regulator, Integrated Circuit Voltage Regulators, Switching Regulators.

7. **Power Supplies.**

Optical Signal Processing

Fourth Year	First Semester	Elective
2 hrs Theoretical		2 Units

- Study the Fourier transform
- Fourier optics
- Fourier of Lenses
- Franhofer diffraction
- Fresnal diffraction
- Holograph
- Propagation of signal in medium
- Optical modulations

Renewable Energy

Fourth Year	First Semester	Elective
2 hrs Theoretical		2 Units

- Model and analyze electrical power systems and electrical machines by applying energy systems concepts of generation, transmission, distribution and protection of electrical power systems;
- Select, analyze and control appropriate driving systems for different energy applications;
- Model, analyze and design energy systems by applying energy concepts of Thermal-fluid Mechanics, solid Mechanics, Material Properties and processing, Measurements, Control Systems, Dynamics and Vibrations;
- Design of mechanical energy systems using appropriate materials via both traditional and computer-aided tools;
- Select proper mechanical equipment according to the required specification;
- Adopt suitable standards and codes to design, build, operate, inspect and maintain mechanical energy systems;
- Identify, analyze and evaluate the energy's conversion processes and management techniques;
- Indicate and relate smart applications for energy systems;
- Test and evaluate the performance and suitability of energy systems
- Distinguish the layout and the key parameters to the field of the concentration as listed below

Course Syllabus

Stage: Fourth

Second Semester

Optical Communications

Fourth Year	Second Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- Introduction to Optical Fiber Communication
- Optical Sources: LED
- Optical Sources: Semiconductor Lasers
- Multimode Fiber
- Single – mode Fiber
- Fiber Silicates and Connectors
- Optical Detectors: PIN
- Optical Detectors: APD
- Receiver Noise Calculation
- Optical Amplifiers
- Non Coherent Optical Communication
- Coherent Optical Communication.
- WDM and TDM Techniques
- Advanced Optical Communication Systems

Computer Interface

Fourth Year	Second Semester	Compulsory
2 hrs Theoretical	2 hrs Applied	3 Units

- Review to the 8086-Memory and I/O Interfaces.
- (Hardware Specifications, Pin Out, Minimum and Maximum Modes, and the System Clock)
- Bus Cycle and Timing States, Memory Interface Circuits
- (Types of I/O, their Instructions and Bus Cycle), Isolated I//O Interface and Data Transfers.
- Output/Input Ports using Isolated I/O, and I/O Handshaking and Parallel Printer Interface.
- 82C55A Programmable Peripheral Interface, 82C55A Implementation of Parallel I/O Ports, and Memory Mapped I/O.
- 82C54 Programmable Interval Timer, and Serial Communications Interface.
- Programmable Communication Interface Controllers, Keyboard and Display Interface.
- 8279 Programmable Keyboard/Display Controller.
- Interrupt Instructions, and Enabling / Disabling of Interrupts.
- External Hardware-Interrupt Interface Signal, and External Hardware-Interrupt Sequence.
- 82C59A Programmable Interrupt Controller, and its Interrupt Interface Circuits.
- Software and Nonmaskable Interrupts, Reset and Internal Interrupt Functions.

Laser Design Technology

Fourth Year	Second Semester	Compulsory
2 hrs Theoretical	2 hrs Applied 1 hr Tutorial	3 Units

- Optical Considerations
- Material considerations
- Mechanical Considerations
- Cooling Considerations
- Electrical Considerations
- Types of Lasers
- Laser System Design
- Resonator Geometry

Image Processing

Fourth Year	Second Semester	Compulsory
3 hrs Theoretical	2 hrs Applied	3 Units

- **Introduction to Digital Image Processing:**
  Digital Image Processing Origins and Fields (Gamma-Ray Imaging, X-ray Imaging, Imaging in Ultraviolet-Visible-Infrared-Microwave-Radio Bands), Fundamental Steps in Digital Image Processing, Components of Digital Imaging System.
- **Digital Image Fundamentals:**
  Image Sensing and Acquisition (using a Single Sensor, Sensor Strips, Sensor Arrays with Image Formation Model), Image Sampling and Quantization (Concepts in Sampling and Quantization, Presenting Digital Images, Spatial and Gray-Level Resolution), Relationships Between pixels (Neighbors of a Pixel, Adjacency, Connectivity, Regions, Boundary, Distance Measures, Image Operations on a Pixel Basis), Linear and Nonlinear Operations.
- **Image Enhancement in the Spatial Domain:**
  Gray Level Transformations (Image Negatives, Log Transformations, Power-Law Transformation, Piecewise-Linear Transformation Functions {Contrast Stretching, Gray-level slicing, and Bit-plane slicing}), Histogram Processing and Equalization, Enhancement using Arithmetic/Logic Operations (Image Subtraction and averaging), Basics of Spatial Filtering, Smoothing Spatial Filters (Smoothing Linear Filters , Order-Statistic Filters), Sharpening Spatial Filters (Use of Second Derivatives for Enhancement-The Lapacian, Use of the First Derivatives for Enhancement-The Gradient).
- **Color Image Processing:**
  Color Fundamentals, Color Models (The RGB Color Model, The CMY and CMYC Color Model, The HIS Color Model {Converting Color from RGB to HIS, Converting Color from HIS to RGB}), Pseudocolor Image Processing (Intensity Slicing, Gray Level to Color Transformations), Basics of Full-Color Image Processing.

Nanotechnology

Fourth Year	Second Semester	Elective
2 hrs Theoretical		2 Units

- **CHAPTER ONE (Introduction to Nanotechnology)**

Nanotechnology & Nanoscale, History of Nanoscience. Atomic structure. Effective mass theory. Semiconductor Nanostructures. Excitons.

- **CHAPTER TWO (Quantum Mechanics & Nanotechnology)**

Quantum Mechanics. Wave Mechanics.Quantum confinrmrnt in semiconductor nanostructures. Quantum Well, Wire and Dots Plasmonic effect in metallic nanoparticles.

- **CHAPTER THREE (Fabrication of Nanomaterials)**

Methods of preparation. Synthesis Approaches. Top-Down & Bottom-Up. Chemical & physical Vapor Deposition (CVD & PVD). Plasma Sputtering. Electron Beam Evaporation. Thermal Spraying. Electochemical Deposition.

- **CHAPTER FOUR (Lasers in Nanotechnology)**

Features of nanomaterials produced by Lasers. Methods of using lasers in Nanotechnology, Laser Lithography. Microrlithography Nanolithography. Laser-induced Etching. Laser Vaporization. Laser Annealing.

- **CHAPTER FIVE (Characterization of Nanomaterials)**

Characterization techniques. Surface Morphology. Optical Microscope. Scanning Electron Microscopy (SEM). Transmission Electron Microscopy (TEM). Scanning Probe Microscope (SPM, AFM).

- **CHAPTER SIX (Applications of Nanomaterials)**

Energy storage, Data Storage (Flash Ram), Nanoparticles & Metals, Coating with nanomaterials, Nanomedicine, Nanofilters, Health care, Vehicle manufacture.

Fiber Sensors

Fourth Year	Second Semester	Elective
2 hrs Theoretical		2 Units

- **General introduction about optical sensor**
- **Special Types of optical fibers for sensing applications**
- **Fiber Sensor**
  - Definitions
  - Method for sensing
  - Why optical technique?
  - Classification of optical fiber sensors
- **Interferometers**
  - Interference
  - How do interferometers work?
  - Types of interferometers
  - Examples of all fiber sensor.
- **Sensor Terminology**
  - Resolution
  - Resolution error
  - Accuracy
  - Sensitivity
  - Dynamic range
  - Precision
- **Applications**