FACULTY OF ENGINEERING & TECHNOLOGY

SYLLABUS

FOR

Pre Ph.D Course in
ELECTRONICS TECHNOLOGY

(Credit Based Evaluation and Grading System)

Session: 2019-20

GURU NANAK DEV UNIVERSITY
AMRITSAR

Pre Ph.D Course in Electronics Technology
(Credit Based Evaluation and Grading System)

SCHEME

		CREDITS		
Subject Code	**Subject Name**	**L**	**T**	**P**
ECL-901	Research Methodology	4	0	0
	Department Elective	3	0	0
	Open Elective-I	3	0	0
ECL-920	Seminar	1	0	0
	Total Credit:	**11**	**0**	**0**

List of Department Electives: -

		CREDITS		
Subject Code	**Subject Name**	**L**	**T**	**P**
ECL-902	WDM Optical Networks	3	0	0
ECL-903	Optical Communication Systems	3	0	0
ECL-904	Computer Oriented Numerical Methods	3	0	0
ECL-905	Materials for Microwave Applications	3	0	0
ECL-906	Artificial Neural Networks	3	0	0
ECL-907	Fuzzy Logic	3	0	0
ECL-908	Information Theory and Coding Techniques	3	0	0
ECL-909	Optical Waveguide Analysis	3	0	0
ECL-910	Advanced Signal Processing	3	0	0
ECL-911	Advanced Wireless Communication System	3	0	0
ECL-912	Advanced Digital Communication System	3	0	0
ECL-914	Quantum Transport and Molecular Electronics	3	0	0
ECL-915	Material Technology	3	0	0
ECL-916	Surface Engineering	3	0	0

NOTE:

1. **Candidate will have to opt for one subject out of the list of Department Electives and one open elective from the lists of Pre- Ph.D. courses offered by outside departments as suggested by supervisor. In addition the candidate will have to give one seminar on the topic suggested by the supervisor.**

2. **Students are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.**

Pre Ph.D Course in Electronics Technology
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Course Name	**:**	**Research Methodology**
Course Code	**:**	**ECL-901**
Credits (L-T-P)	**:**	**4 (4-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the objectives of research.

- How to write a good technical paper, concept of copyright and plagrism.
- How to format research report.

Total No. of Lectures – 32

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Introduction to Research: Definition, Scope, Limitations and types, Nature and objective of research, Research topics.	7
	SECTION - B	
2	List of important journals in Electronics Technology, impact factor, research articles, research papers, reviews, scientific popular articles, process of reviewing, literature review, Identification and formulation of problem, Research design, Sampling techniques, Data Collection, Statistical and sensitive analysis of data, Interpretation of result.	8
	SECTION - C	
3	Research paper writing: Concept of title, author-line, address, abstract, summary, hypothesis, keywords, introduction, methodology, observations, recording of observations, statistical treatment, discussion, conclusion..	9
	SECTION - D	
4	Finding and citing relevant work of others, styles of references, Copyright Act (in brief), plagiarism, cheating/ academic frauds. Report Writing: Contents of report- Tabulation, Coding, Editing, Summary Writing, Bibliography Format.	8

Suggested / Reference Books:

1	National and International Journals in the related fields.

Pre Ph.D Course in Electronics Technology
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Course Name	**:**	**WDM Optical Networks**
Course Code	**:**	**ECL-902**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- The concept of WDM optical networks various multiplexing techniques.
- Various optical network architectures.

Total No. of Lectures – 32

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Introduction: Introduction to basic optical communication & devices, WDM optical Network evolution.	8
	SECTION - B	
2	Optical Multiplexing Techniques: Wavelength Division multiplexing, Time division multiplexing & code division multiplexing.	9
	SECTION - C	
3	Optical Networks: Why optical networks? Conventional optical networks, SONET/SDH, FDDI, IEEE 802.3, DQDB, Multiple access optical networks, WDM optical networks architectures and issues in wavelength routed networks.	9
	SECTION - D	
4	All Optical Networks: Amplification in all optical networks. All optical subscriber access networks, design issues.	6

Suggested / Reference Books:	
1	Uyless Black, 'Optical Networks', Pearson Education.
2	D.K. Mynbaeu & L. Scheiner, 'Fiber optic Communication Technology, Pearson Edu. Asia.
3	C. Siva Ram Murthy & M. Gurusamy, 'WDM Optical Networks' Pearson Education.
4	RG Gallager & D Bertsekas, 'Data Networks, PHI.

Pre Ph.D Course in Electronics Technology
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Optical Communication Systems**
Course Code	**:**	**ECL-903**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the irregularities in optical fiber.

- Various coding techniques.
- Various receivers and transmitters used in optical fiber communication.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Optical Fibers & Signal Degradation: Basics of optical fibers. Attenuation and dispersion effects in single mode and multimode optical fibers. Control of dispersion in single mode & multimode fibers. Non linear effects in single mode fibers and their control.	7
	SECTION – B	
2	Digital Transmission Systems: Point to Point link, system considerations, link power, budget & rise time budget analysis. Line coding techniques, NRZ, RZ, Manchester etc. eye pattern analysis.	7
	SECTION - C	
3	WDM Base Optical Communication System: Introduction to wavelength division multiple access. Receiver & transmitter requirements in WDM networks. Repeaters & amplifiers, Erbium doped fiber amplifier (EDFA).	8

SECTION - D		
4	Passive Components for WDM Based Systems: Couplers & splitters, FBT couplers, WDM multiplexer & demultiplexers fixed & tunable filters, isolators, circulators & attenuators. Optical switches & wavelength converters.	8

Suggested / Reference Books:	
1	G. Keiser, Optical Fiber Communications, McGraw Hill
2	D.K. Myanbaev & Lowell L. Scheiner," Fiber Optic Communication Technology, Pearson Education Asia
3	G.P. Agrawal, " Nonlinear Fiber Optics , Academic Press
4	J.M. Senior, Optical Fiber Communications, Prentice Hall, India

Course Name	**:**	**Computer Oriented Numerical Methods**
Course Code	**:**	**ECL-904**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- How to apply various iterative methods for numerical data.
- Concept of interpolaration.
- Concept of differentiation and integration towards solution of differential equations.

Total No. of Lectures – 30

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	Computer Architecture: Floating point representation of numbers, arithmetic operations with normalized floating point representation of numbers consequences of normalized floating point representation of numbers some pitfalls in computing, errors in numbers.	6
	SECTION - B	
2	Iterative Methods: The methods of successive bisector, false position, Newton-Raphson, secant and successive approximations. Comparison of iterative methods, solution of polynomial equation using Graffee's method. Solution of Simultaneous Algebraic Equations: The gauss elimination method, the gauss seidel iterative method. Comparison of direct and interactive methods.	8

	SECTION - C	
3	Interpolation: Lagrange interpolation, Difference tables and spline interpolation. Least squares Approximating of Function: Linear regression, polynomial regression, Fitting, Exponential and trigonometric functions.	8
	SECTION - D	
4	Differentiation and Integration: Formulae for numerical differentiation, Numerical Integration, Simpson's rule, Trapezoidal rule. Numerical Solution of Differential Equations: Euler's Method, Taylor series method, Runge kutta method, Runge kutta fourth order method, Predictor, corrector method.	8

Suggested / Reference Books:	
1	V. Rajaraman, "Computer Oriented Numerical methods", Eastern Economy Edition, Prentice
2	Hall of India Private Limited, New Delhi-110001 2002 (3rd Edition)

Pre Ph.D Course in Electronics Technology
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Course Name	**:**	**Materials for Microwave Applications**
Course Code	**:**	**ECL-905**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Classification of materials.
- Bend theory
- Ceramic materials and their applications.
- Magnetic materials and their applications.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Electronics of Materials: - Crystal structure: Lattice type, Defects, reciprocal lattice, Miller indices.	9
	SECTION - B	
2	Introduction to materials: types-semiconductor, conductor, dielectric and magnetic materials. Band theory, band structure of Si and III-V	8
	SECTION - C	
3	Ceramic materials- introduction, types of ceramics, properties and its applications.	7
	SECTION - D	
4	Magnetic materials- different types, properties and applications.	6

Suggested / Reference Books:

1	Microwave electronics by L.F. Chen, C.K. Ong and CP Neo, John Wiley & Sons Ltd.

Course Name	**:**	**Artificial Neural Networks**
Course Code	**:**	**ECL-906**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Concept of artificial neural networks.
- Various ANN models.
- Pattern recognition and more applications.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Neural networks characteristics, History of development in neural networks principles, Artificial neural net terminology, Model of a neuron, Topology, Learning, types of learning, supervised, Unsupervised, Re-enforcement learning, Knowledge representation and acquisition.	8
	SECTION - B	
2	Basic Hop field model, Basic learning laws, Competitive learning.	7
	SECTION - C	
3	Architecture of Back propagation network, single perceptron and multilayer perceptron, Back propagation learning, BP algorithm.	8
	SECTION - D	
4	Applications of neural nets such as pattern recognition, Associative memories.	7

Suggested / Reference Books:	
1	Artificial Neural networks by B. Yegnatoarayana.
2	Neural Networks & Fuzzy Logic by Bart Kosko.
3	Neural Computing theory & Practice by P.D. Wasserman (ANZA PUB)
4	Introduction to artificial neural systems- by J.M. Zurada (Jaico Pub)
5	Architecture of Back propagation network, single perception and multilayer perceptron Back propagation learning, BP algorithm.

Course Name	**:**	**Fuzzy Logic**
Course Code	**:**	**ECL-907**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Concept of fuzzy logic and its applications.
- How to process the fuzzy information.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Introduction to Fuzzy sets and Fuzzy Logic: The uncertain and inexact nature of the real world, ideas and examples, fuzzy membership function, fuzzy numbers and fuzzy arithmetic, basic concept and properties of fuzzy logic versus classical two valued logic.	8
	SECTION - B	
2	Fuzzy Information Processing: Basic concept and techniques for fuzzy information processing.	7
	SECTION - C	
3	Fuzzy Interface: Fuzzy inference principles, fuzzy decision making, approximate reasoning.	8
	SECTION - D	
4	Fuzzy Rule Base: If-Then rules, general format of fuzzy rules base, establishment of fuzzy rule base.	7

Suggested / Reference Books:

1	Introduction to fuzzy systems, by Guanrong Chen and Trung Tat Pham, Chapman &Hall,2007
2	Fuzzy Logic and Neuro Fuzzy Applications explained by C Van Altrock, Printice Hall,2007

Course Name	**:**	**Information Theory and Coding Techniques**
Course Code	**:**	**ECL-908**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Concept of information theory.
- Channel capacity for information transfer.
- Various coding and decoding techniques.

Total No. of Lectures – 29

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Information Theory, Information Rate and Coding to increase average information per bit.	6
	SECTION - B	
2	Mutual information, entropy for discrete ensembles, Shannon's noiseless coding theorem.	7
	SECTION - C	
3	Calculation of channel capacity and bounds for discrete channels.	7
	SECTION - D	
4	Techniques of coding and decoding; Huffman codes uniquely detectable codes; Cyclic codes, convolution arithmetic codes.	9

Suggested / Reference Books:	
1	R.B. Ash, Information Theory, Prentice Hall India, 2006
2	Modern Analog & Digital Communication System by BP Lathi, 4th Edition, Oxford University Press, 2008
3	Communication Systems by Singh and Sapre PHI, 2007
4	Digital Communication Systems by Simen Hakins TMH, 2006
5	Principles of Digital Communication by J Das, SK Mullick and PK Chatterjee, PHI, 2006

Course Name	**:**	**Optical Waveguide Analysis**
Course Code	**:**	**ECL-909**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Concept of optical waveguides.
- Type of optical waveguides.
- Propagation methods.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Types of Optical Waveguides and Analytical Techniques, Basics of optical waveguide analysis optical waveguide mode.	7
	SECTION - B	
2	Approximate solution of 2D& 3D optical waveguides, finite element analysis of 2D & 3D optical waveguides.	8
	SECTION - C	
3	First element analysis of Axisymmetrical and Non-Axisymmetrica optical fibers, Finite element analysis of non linear optical waveguides.	8
	SECTION - D	
4	Bean prorogation method of analysis of optical waveguide.	7

Suggested / Reference Books:

1	Optical waveguide Analysis by Masanori Koshiba, Tata McGraw Hill Inc.

Course Name	**:**	**Advanced Signal Processing**
Course Code	**:**	**ECL-910**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Various transformation approaches in DSP.
- Design of various types of filters and their applications.

Total No. of Lectures – 30

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	Review of Discrete Time Signals Systems: Review of Signals & Systems, Z and Inverse, Z Transformation and their properties.	7
	SECTION - B	
2	Digital Filter Structures: Structure of Digital Filter realizations. Basic FIR &IIR Structures (Direct form I & II) Cascade and parallel forms.	8
	SECTION - C	
3	Design of FIR Filter Digital Filters: Basic design steps Advantages & Disadvantages, Design Techniques, Windowing & frequency sampling. Design of IIR Digital Filter: Design from Analog Filter, impulse invariant & Bilinear Transformation Techniques.	9
	SECTION - D	
4	Multirate Signal Processing: Sampling rate conversion, Decimation and Interpolation filter structure, Digital Filter banks.	6

Suggested / Reference Books:	
1	Digital Signal Processing-by Proakis & Manolaki, Pearson Education Society,2007
2	Speech and Audio Processing for Multimedia PC's by Iain Murray
3	Digital Image Processing by Keenneth R Castleman, Pearson Education Society,2007
4	Digital Image Processing by Rafact Gonzalez and Richard E.Woods, Pearson Education Society, 2007.
5	Related IEEE/IEE Publication.

Course Name	**:**	**Advanced Wireless Communication System**
Course Code	**:**	**ECL-911**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Concept of cellular communication.
- Multiple access techniques.
- Irregularities in propagation of signal and how to improve signal strength.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Cellular Communication, Signal Strength and Cell parameters, Capacity of cell, cochannel interference.	7
	SECTION - B	
2	Cell splitting, cell sectoring and reuse cellular system operation and planning.	8
	SECTION - C	
3	Multiple Access schemes in Mobile communications: TDMA, FDMA, CDMA.	7
	SECTION - D	
4	Multiple Propagation: Fading, Interference, Diversity Schemes, Interference Suppression, Improving Signal Strength, Power Control.	8

Suggested / Reference Books:	
1	Mullett, 'Introduction to Wireless Telecommunication Systems & Networks, Cengage Learning, 2008.
2	Theodore S. Rappaport, 'Wireless Communications Principles & Practice', PHI,2007
3	J. Schiller, ' Mobile Communications', Pearson Education,2007
4	J.W. Mark & W. Jhuang, 'Wireless Communications & Networking', PHI,2006
5	WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill International Editions 1990.
6	WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
7	Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
8	AJ Viterbi, CDMA: Principal of Spread Spectrum Communications, Addison Wesley New York, 1995.
9	VK Garg and JE Wilkes, Wireless and personal Communication Systems, Prentice Hall, 1996.

Course Name	**:**	**Advanced Digital Communication System**
Course Code	**:**	**ECL-912**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Digital communication.
- Modulation techniques and how to apply these techniques in evaluation of network performance.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Review of probability leay, Correlation between random variables, Autocorrelation.	7
	SECTION - B	
2	Power spectral density of random sequences, Noise, spectral components of noise, Noise bandwidth, Quadrature components of noise.	8
	SECTION - C	
3	Representation of noise using orthonormal components.	7
	SECTION - D	
4	Sampling Theorem, Quantization, pulse code modulation, Digital modulation schemes, PSK, QPSK, FSK, QASK, MPSK.	8

Suggested / Reference Books:	
1	Tanb Scuilling- Communication System, Tata McGraw Hill, 2006
2	Digital Communication System- Simon & Haykin, John Wiley & Sons, 2004
3	Communication Systems-RPSingh & Sapre,Tata McGraw Hill, 1995
4	Salvatore Gravano-Error Correcting codes, Oxford Press, 2008
5	J.Das: Principals of Communication System, Wiley eastern Limited, 1986

Course Name	**:**	**Quantum Transport and Molecular Electronics**
Course Code	**:**	**ECL-914**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Various nanoelectronics structures.
- Concept of electron transport.
- Various phenomena of nanometer-scale.

Total No. of Lectures – 30

	Lecture wise breakup	**Number of Lectures**
	SECTION - A	
1	1. The foundation of Nanoelectronics heterostructures, nanocrystals, nanotubes and nanowires First introduction of concepts: low dimension transport, quantum confinement, Coulomb blockade and quantum dot, Self assembly 2. The future of Nanoelectronics: beyond the MOSFET. - New materials (beyond silicon) - New architectures and New ideas: Spintronics and Quantum information.	7
	SECTION - B	
2	3. Introduction of Electron Transport: Concepts and new phenomena - Hamiltonian description of Electron in a lattice, Bloch waves - Band structure and Density of states - Effect of confinement on the density of states. a) Semiclassical Transport: - effect of disorder and geometry, notion of elastic/inelastic mean free path, localization of electrons, Phase coherence and mesoscopic effects b) Quantum transport - Ballistic transport and Quantum interferences - Landauer formuls, quantization of conductance, example of Quantum point contact.	8

Pre Ph.D Course in Electronics Technology
(Credit Based Evaluation and Grading System)

Pre Ph.D Course in Electronics Technology
(Under Credit Based Continuous Evaluation Grading System)

SECTION - C		
3	4. Single electronics, Introduction to Coulomb blockade and tunneling phenomena - The single electron box (and its superconducting counterpart) - The single Electron Transistor and its applications 5. The Quantum dot: an artificial and tunable atom - Theory of the quantum dot: definition of the addition energy - Spectroscopy of a quantum dot. - electron/electron interactions. - spin effects (Kondo resonance, Zeeman splitting)	7
SECTION - D		
4	6. From Organic Electronics to Single Atom transistors - Notions of Quantum Chemistry - Theory of the molecular junction. - strong and weak coupling. - analogies with the previously introduced concepts (single electron devices and quantum dots) - Links between chemical structure/functions and electron properties - diodes, molecular transistors, memories and switches - Introduction to Molecular Spintronics	8

Suggested / Reference Books:	
1	Fundamentals of Nanoelectronics: George W. Hanson Pearson Education
2	Introduction to Nanoscience: Stuart Lindsey, Oxford University press
3	Electron transport in Mesoscopic Systems: Supriyo Datta, Cambridge University press
4	Nanotechnology applications to Telecommunication and Networking: Daniel Miroli, Wiley India

Course Name	**:**	**Materials Technology**
Course Code	**:**	**ECL-915**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Types of materials and their applications.
- Properties of materials.
- Testing of materials.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Materials: Introduction, types of materials for power plant and electronic industry, structureproperty relationship and phase diagrams.	7
	SECTION - B	
2	Materials Properties: Thermal, Electrical, Electronic and Mechanical properties of materials.	8
	SECTION - C	
3	Biomaterials: Introduction, types of biomaterials, properties and application. Nano-structured materials: Introduction, properties and applications.	8
	SECTION - D	
4	Material Testing: ASTM standards for materials testing and sample preparations.	7

Suggested / Reference Books:

1	Materials Science and Engineering by WD Callister Jr. (John Wiley & Sons Inc., Eighth Edition)
2	Materials Science and Engineering: A First Course by V Raghvan (Prentice-Hall of India Pvt. Ltd.).

Pre Ph.D Course in Electronics Technology
(Credit Based Evaluation and Grading System)

Course Name	**:**	**Surface Engineering**
Course Code	**:**	**ECL-916**
Credits (L-T-P)	**:**	**3 (3-0-0)**
Total Marks	**:**	**100**
Mid Semester Examination	**:**	**20% weightage**
End Semester Examination	**:**	**80% weightage**

Instructions for the Paper Setters:
Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each Section. The fifth question may be attempted from any Section.

Course Objectives:

At the end of this course, the student should be able to understand the

- Concept of material degradation.
- Concept of surface treatment and their characterization techniques.

Total No. of Lectures – 30

	Lecture wise breakup	Number of Lectures
	SECTION - A	
1	Material Degradation: Defects and deterioration of materials in low and high temperature applications such as: power plants and electronic industry.	7
	SECTION - B	
2	Surface Treatment: Introduction, surface properties, thermal barrier coatings (TBC) and conducting coatings.	7
	SECTION - C	
3	Material Preparation: Preparation of nano-sized powders by ball milling, Materials manufacturing techniques, Additive Manufacturing, Types of surface coating methods.	8
	SECTION - D	
4	Characterization Techniques: Scanning Electron Microscopy (SEM), TEM, AFM, XRD, EDS Analysis, Elemental Mapping Analysis/EPMA.	8

Suggested / Reference Books:	
1	Materials Science and Engineering by WD Callister Jr. (John Wiley & Sons Inc., Eighth Edition)
2	Materials Science and Engineering: A First Course by V Raghvan (Prentice-Hall of India Pvt. Ltd.)
3	Standardisation of Thermal Cycling Exposure Testing, edited by M Schütze, M Malessa, ISSN 1354-5116, European Federation of Corrosion Publication No.53, Woodhead Publishing in Materials.
4	Draft Code of Practice for Discontinuous Corrosion Testing in High Temperature GaseousAtmospheres, EC project SMT3-CT95-2001, TESTCORR. UK: ERA Technology, 2000.