

## Course Structure & Syllabus for Integrated Ph. D. Programme

### Course Structure

Course Code	Course Name	Maximum Marks	Min Pass %age
ELE-IPHD-01	Recent Advances in the Subject	100	50%
ELE-IPHD-02	Methodology	100	50%
ELE-IPHD-03	Specialized Paper	100	50%

### Detailed Syllabus – Paper I

Course Title: – Recent Advances in the Subject

Course Code: – ELE-IPHD-01

Duration of Examination: – 3 Hours

Maximum Marks: – 100

*Note: The question paper shall comprise of two (02) questions (each of 25 marks) from each unit. A candidate has to attempt four question from four different units from a single section of his/ her choice in 3 Hours duration.*

#### SECTION A

##### **Unit 1: Microelectronics and VLSI**

Microelectronic devices, characteristics, mathematical modelling, performance parameters, design aspects, parasitic, integration issues, layout rules, optimization techniques.

##### **Unit 2: Beyond CMOS VLSI (Evaluation criteria and challenges)**

Evolutionary advances beyond CMOS (Multiple-gate FET, SOI MOSFET)

Evaluation criteria: Scalability, performance, energy efficiency, on/off ratio for memory devices, gain for logic devices, CMOS technology compatibility and CMOS architectural compatibility.

Challenges: operational reliability, interconnects, fabrication defects, Analog and digital co-design

##### **Unit 3: Recent applications and developments in VLSI**

High-performance logic circuits, flexible electronic circuits, nanoscale integrated circuits, low power and dense memory devices, High performance integrated circuit design for fractional-order systems.

Conventional vs. tactile computing, molecular and biological computing, Mole electronics- molecular diode and diode-diode logic, Defect/fault tolerant computing.

##### **Unit 4: RFIC Design**

RF Amplifiers, characteristics, mathematical models, power relations, stability considerations, stability circles, unconditional stability, stabilization methods, designs, circles, circles.

##### **Unit 5: Nano Technology**

Present devices and materials, Advance materials such as Carbon nano tubes etc., advance devices as Single Electron Transistor etc., constraints, applications, Trade-offs.

##### **Unit 6: Mixed Signal Analysis**

Signal integrity, techniques, equivalent models, characteristics, limitations, mixed signal processing, simulation, physical parameters.

#### SECTION B

##### **Unit 1: RF Systems**

The techniques of RF amplifier, mixer and local oscillator designs, Advanced YIG and narrow band filters, amplifiers, Transmission line design, Design challenges in satellite frequency bands.

##### **Unit 2: Microwave and Antennae**

Microwave sources, Passive devices, MMIC, MMIC fabrication techniques, Thick and Thin film technologies and materials, Micro strips, Microwave antennae.

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## **Unit 3: Coding and Modulation Techniques in Communication**

Digital communication system architectures, Source coding, Channel coding, Performance measures of communication systems, Hamming and Reed Solmon coding techniques.

## **Unit 4: Mathematical theory of Wireless Communication Systems.**

Baseband receiver for ISI mitigation, Physical modelling of wireless channels, statistical channel models, fading-outage probability, average probability of error, Modelling of semi path-loss channels models.

## **Unit 5: Wireless & Broadband Communication**

IEEE/ITU/ ETSI communication standards and specifications, various trade-offs in functionality, implementation, Transmitter/Receiver architectures and related issues, Wireless embedded approach, Antennae and front end design issues.

## **Unit 6: Wireless Networks**

Cellular standards, Migration and advancement of GSM and CDMA architectures, Emerging WLAN standards, Various IEEE Standards, Trade-offs in functionality and implementations.

### SECTION C

## **Unit 1: Advanced Topics in Signal Processing**

Modelling different Signals and systems, various transforms, System design and Implementation issues, DSP architectures and related issues, Evaluation parameters for the various applications.

## **Unit 2: Image Processing & Biometrics**

Image representation formats, Noise Processing Techniques, Performance Measurements, Two dimensional orthogonal and unitary transform, DCT, DFT, DWT- properties and uses. K-L transform, Arnold Transform, Biometrics, Use of Biometrics for authentication and security.

## **Unit 3: Speech Processing**

Speech recognition and synthesis techniques, modelling the speech signal, various algorithms, trade-offs and implementation issues.

## **Unit 4: Programmable Architectures and Memories**

VHDL programming, PLDs, floating point arithmetic, multipliers, modelling a sequential machine, FPGA design flow, FPGA Architectures, Interconnect Technology.

## **Unit 5: Multimedia Compression**

Various Compression Standards: JPEG & JPEG 2000, Quantization Matrix and Quality Factor, Wavelet Families and Wavelet Coding, Lempel-ziv coding, Run length Coding, Qualitative and Quantitative performance measurements.

## **Unit 6: Non-Linear Dynamics and Chaotic Theory**

Chaos, Chaotic Models, Strange Attractors, Autonomous Dissipative Systems, Logistic Maps and their properties, Poincare Sections, Bifurcation and Invariant Density function plots, Largest Lyapunov exponent, Fractals, Fractal Image Compression

### SECTION D

## **Unit 1: Processor Architectures**

Design philosophy of RISC, CISC, Multi-core, Parallelism, Pipelining, Various processor architectures, Design of microcontroller CPU.

## **Unit 2: Programming**

Procedural and Object-Oriented paradigm, Inheritance, Object, Class, Encapsulation, Message Passing, Polymorphism, Abstraction, Method Overloading and Overriding Advanced trends: Generic functions, Class Templates, Singleton Classes. Low Level Programming.

## **Unit 3: Network Security**

Network Threats, Attacks and Security Services, Security Protocols, Elliptic Curve Cryptography, Public and Private Key, Digital Signatures, Public Key Infrastructure.

## **Unit 4: Data Structures**

Data structure operations; Stacks; Arrays; Queues; Linked list; Binary search tree (BST); AVL trees; searching and sorting algorithms.

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### Unit 5: Advanced Database Management Systems

Distributed DBMS Architecture-Client-Server systems, Collaborating Server System, and middleware system, Storing data in DDBMS-Fragmentation and replication.

### Unit 6: Embedded Systems

Embedded system project development, Design issues and co-design issues in system development process, The Embedded Design Life Cycle, Embedded OS - Tasks, Processes and Threading, Multi-processes and Multithreading, Process Management, Embedded system security requirements and issues.

### Reference Books:

1. Bernd Hoefflinger, "Chips 2020, A guide to the future of nanoelectronics", Springer publication.
2. Kevin F. Brnann, "Introduction to semi-conductor device", Cambridge publications.
3. Eugene D. Fabricius, "Introduction to VLSi design", McGraw-Hill International publications.
4. The International Technology Roadmap for semiconductors (ITRS)
5. M.J. Roberts, "Signals and Systems", Tata McGraw Hill Publications, 2003.
6. M. Burns, "Introduction to Mixed Signal IC Test and Measurement", Oxford University Press Publications, New York.
7. Yedidyah, Langsain and Teanenbuam, "Data Structures Using C and C++", 2<sup>nd</sup> Edition
8. Xilinx, "The Programmable Logic Data Book", Xilinx, California.
9. Hu, Yu Hen, "Handbook of Neural Network Signal Processing", CRC Press Publications.
10. Yacoub M.D., "Wireless Technology", CRC Press Publications.
11. Gold B., "Speech and Audio Signal Processing", John Wiley Publications.
12. Kuo B.C., "Digital Control System", Sounders College Publications, New York.
13. Comer "Digital Logic and State Machine Design", Sounders College Publications, New York.
14. Prokis J.G., "Digital Signal Processing", PHI Publications.
15. Alley, Charles L, "Micro Electronics", McGraw Hill Publications.
16. Ha, Tri T., "Digital Satellite Communication", McGraw Hill Publications.
17. Peebles, "Probability and Random Signals", McGraw Hill Publications.
18. Balanis, "Antenna Theory analysis and Design", John Wiley Publications.
19. Gray R.P., "Analysis and Design of Analog ICs", John Wiley Publications.
20. Tompkins J.W., "Biomedical Digital Signal Processors", PHI Publications.
21. Ramez Elmsari and Shankant B. Navathe, "Fundamentals of Databases Systems", Pearson, 2<sup>nd</sup> Edition.
22. Collin E.R., "Foundations for Microwave Engineering", McGraw Hill Publications.
23. Freeman R.L., "Radio System Design for Telecommunication", John Wiley Publications.
24. Kronsjo L., "Advances in Parallel Algorithm", Blackwell Scientific Publication, London.
25. Maureen, Sprankle and Tim Habbard, "Programing and Problem Solving Concepts", PHI.
26. Xavier, Eugene S.P., "Statistical Theory of Communication", New Age International Publication.
27. Baker R.J., "CMOS: Circuit Design, Layout and Simulation", IEEE Press Publication.
28. McGillen C.D., "Continuous and Discrete Signal and System Analysis", Oxford University Press.
29. Russ J.C., "The Image Processing Handbook", CRC Press Publications.
30. Franssila S., "Introduction to Micro fabrication", John Wiley Publications.
31. Park J., "Practical Embedded Controllers", Elsevier Publications, Amsterdam.
32. Kabatiansky G., "Error Correcting Coding and Security for Data Network", John Wiley Publications.
33. Lee K., "Semiconductor Device Modeling For VLSI", PHI Publications.
34. Maxfield C.M., "The Design Warriors Guide to FPGA", Elsevier Publications, Amsterdam.
35. Algorithms and Applications", Wiley-VCH, Weinheim Publications.
36. Simon Haykin, "Neural networks and learning machines", 3<sup>rd</sup> Edition, PHI publication.
37. Strogatz and Dichter, "Non-Linear Dynamics and Choas", 2<sup>nd</sup> Edition, Westveiv press.

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## Detailed Syllabus – Paper II

Course Title: – Methodology

Course Code: – ELE-IPHD-02

Duration of Examination: – 3 Hours

Maximum Marks: – 100

*Note: The question paper shall comprise of 8 questions (two questions from each unit) of 25 marks each. A candidate has to attempt one question from each unit in 3 Hours duration.*

### Unit-1

**Research Methodology:** Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Methods.

**Defining the Problem:** What is research problem? Selecting the Problem, Necessity of defining the Problem, Techniques involved in Defining a Problem.

### Unit -2

**Research Design:** Meaning of Research Design, need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs.

**Literature Survey and Presentation of Results:** Reference, Awareness of current status, Possible ways of updating Internet and its applications, Email, WWW – Web browsing, Assessing the status of problem, Guidance from the supervisor, Actual investigation, Presentation of data, Symbols, Results and Conclusion, Presenting a scientific paper in a seminar, Thesis writing.

### Unit -3

**Numerical Methods and Techniques:** Solution of Algebraic and transcendental equation (Bisection Methods, Iteration Methods and its Convergence, Methods of False Position, Newton-Raphson Method).

**Numerical Integration and Differentiation:** Simpson's 1/3 Rule, Simpson's 3/8 Rule, Solution of Differential equations, Euler and Runge-Kutta Methods.

### Unit -4

**Statistical Techniques:** Definition and genesis of Binomial, Random Variables, Probability Density Function, Normal Distribution, Binomial & Poisson Distribution, Gamma(2-Parameter), Moments and Moment generating functions, Methods of moments, Expected value and estimation of Mean & Variance, Maximum likelihood estimation (MLE) method and their properties. Introduction to Finite Element Method (FEM).

### References:

1. A handbook of Methodology of Research by P. A. Rajammal
2. Numerical Methods by E. Balaguruswamy.
3. Mathematical Statistics by S. P. Gupta
4. Introduction to Finite Element Method by J.N. Reddy

## Detailed Syllabus – Paper III

Course Title: – Specialized Paper

Course Code: – ELE-IPHD-03

Duration of Examination: – 3 Hours

Maximum Marks: – 100

### Notes:

1. The question paper shall comprise of 8 questions (two questions from each unit) of 25 marks each. A candidate has to attempt one question from each unit in 3 Hours duration.
2. The syllabus of this paper shall be unique to a particular scholar which shall be devised by the supervisor and get approved by the DRC.