Ph.D. student shall be required to undertake course work of **16 credits/ 600 marks** of one semester, for which he/she has to deposit a prescribed fee. The course work shall be treated as Pre – Ph. D. preparation. All courses prescribed for Ph. D. course work shall be in concomitance with the credit hour instructional requirement and shall specify content, instructional and assessment method. The examination scheme of credit/marks is as approved by the university. The course work comprises of:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Title of Paper</th>
<th>Max. Marks</th>
<th>Min. Passing Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Research Methodology</td>
<td>100</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>Review of Published Research in the relevant field</td>
<td>100</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Computer Application</td>
<td>100</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Advance course in the relevant subject (Any one)</td>
<td>100</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Comprehensive Viva</td>
<td>100</td>
<td>50</td>
<td>3</td>
</tr>
</tbody>
</table>

A candidate shall have to obtain minimum 50% passing marks or equivalent grade (c) in all the papers separately.

The candidate has to obtain a minimum of 55% of marks or its equivalent grade point in aggregate in the course work in order to be eligible to continue in the Ph.D. programe.

If a student obtains F or Ab grade in a course/ subject, he/she will be treated to have failed in that course. He/she have to reappear in the examinations of the course as and when conducted or arrange by the UTD in next semester. If the student fails in aggregate then he can opt upto, maximum of any two papers to re appear in the examination. Marks obtained earlier in continuous assessment may be carried forward and added to the marks obtained in repeat end semester examination to decide the grade in the repeat course. If he/she further fail in the course, he/she shall not be given another chance and he/she shall be out of the Ph. D. programme. No students shall be allowed to repeat the course to improve the grade if he/she pass the course.

**PAPER – I**

**100 Marks; 5 Credits**

**Research Methodology, Quantitative methods and Experimental Techniques**

**UNIT – I**

Research Methods and Design: Nature and objectives of research, Methods of research: historical, descriptive and experimental research process. Research Approaches and types of research. Research and the scientific Methods, Criteria of good research, Defining the research problem.
Research Design: Meaning and need for research design. Features of good design, Different research designs. Basic principles of experimental design. Limitations of experimentation.

UNIT – II

UNIT-III
Quantitative Methods-II: Solution of coupled differential equation by Runge Kutta methods. Application to solution of Schrödinger equation for one dimensional box, one dimensional potential barrier and one dimensional harmonic oscillator. Solution of partial differential equation by the lattice method. Application to the solution of laplace equations(using BASIC).
General idea of mathematical modeling and simulations. Monte Carlo technique. Simulation of radioactive decay and random walk problem(using BASIC).

UNIT – IV

UNIT – V
Experimental Instruments, Design and Measurement Techniques:

**Reference Books:**
6. Instrumental Methods of Analysis – Willard
11. Electronic Instruments and Instrumentation Technology – M.M.S. Anand, PHI
12. A course in Electronic Measurement A K Swahbey
13. Semiconductor Devices modeling and Technology – Dasgupta & Dasgupta PHI.

PAPER-II 100 Marks; 3 Credits

REVIEW OF PUBLISHED RESEARCH IN THE RELEVANT FIELD

This includes report writing evaluation and presentation/Viva Voice each of 50 marks

PAPER-III 100 Marks; 3 Credits

COMPUTER APPLICATION

UNIT-I

UNIT-II
Introduction to UNIX/Linux operating system : Command cells, special character, command path and syntax, Directory layout, Commands for files systems and finding things, Pipe lining and re-direction, Information commands and other utilities, Concepts of PYTHON with simple examples.

UNIT-III
Advanced concept of Mathematica : Commands and variables, Symbolic computations with example, Manipulation of matrix, Plot of data and function, Use of import and export commands, Reading of data with special examples.

UNIT-IV
Introduction to Multisim Software : Commands, Wiring the schematic, Simulating the circuit, Transferring to PCB layout, Introduction to LAB VIEW : Environment basics,
graphical programming, Basic commands and debugging tools, Introduction of exp EYES with computer control data acquisition system.

**Unit-V**

1. Writing a program in BASIC for single Numerical Integration of a function by Trapezoidal rule and Gaussian quadrature. Verification by MATHEMATICA/MATLAB /SCILAB.
2. Writing a programme in BASIC for plotting a function. Verification by MATHEMATICA/MATLAB /SCILAB.
3. Writing a programme in BASIC for Fourier Analysis/ Fourier synthesis of periodic signals Verification by MATHEMATICA/MATLAB /SCILAB.
4. Study the behavior of RC circuits using exp EYES.
5. Development of programme to read data in a .DAT file and calculate value of micro hardness and creates plots of micro hardness vs load using EXCEL.
6. Writing a programme in BASIC for least square fitting of data to a state line. Verification by MATHEMATICA/MATLAB /SCILAB.
7. PYTHON code to solve simple Physics problem and creating icon.

**References:**

2. IBM PC and Clones : Govindraju, McGraw Hill Education
5. Introduction to LINUX command : Victor Gedris.
6. Manual of Mathematica
7. Manual of Multisim by National Instruments
9. e-Manual of exp EYES

**PAPER IV**

**100 Marks; 3 credits**

ADVANCE SUBJECTS IN THE RELEVANT FIELD (ANY ONE)

**IV (a) – Digital Image Signal Processing**

UNIT I

**Digital Image Fundamentals**

formation; Sampling and quantization, some basic relationships among pixels-neighbor, Connectivity, Regions, Boundaries, distance measures.

UNIT II

Image Transformation and Enhancement

UNIT III

Image Restoration and Image Compression

UNIT IV

Color Image Processing, Recognition and Interpretation
Color fundamentals, Color Models, The RGB, CMY, CMYK, HSI model, Pseudo color Image processing, Color Transformations, Smoothing and sharpening, color segmentation. Recognition and Interpretation - Elements of image analysis, Patterns and Pattern Classes, Decision - Theoretic Methods

UNIT V

Image Segmentation, Representation and Description

Reference Books –
3. Digital Image Processing Analysis - B. Chandra, D. Dutta and Majumdar, PHI Publication

IV (b) – Electronic Instrumentation

UNIT-I

Electronic Instrument Design
Development cycle of an Electronic Instrument – System engineering, architecting, concept development, documentation, teamwork, design development, validation, verification and integration, Rapid prototyping, Field testing, failure, iteration and judgment. Circuit design, Circuit lay-out, power supplies, power, distribution, Cooling – heat transfer, thermal management, cooling choices-heat sinks, heat pipes and thermal pillows, fans and forced air cooling, liquid cooling, evaporation and refrigeration,
Tradeoffs in design. Instrument-human interface, user centered design, ergonomics, utility, principles of appropriate operation. Packaging and enclosures-design for manufacturing, assembly and disassembly, Wiring, temperature, vibration and shock, rugged systems. Grounding and shielding design, safety and noise. Integration, production and logistics. Test leads, shielded cables-cable impedance, cable insulation, problems, flat cables, low capacitance probes, high voltage probes, current probes, binding posts, BNC connectors, N-type connectors, OSM connectors,

UNIT-II
Introduction to Electronic Instrumentation and Measurements
Significant figures, scientific notation, units and physical constants, Averages, decibel etc, measurement accuracy, precision, resolution, repeatability, reproducibility, hysteresis, sensitivity, range etc., Errors in measurement theoretical, static, dynamic, instrument insertion.

Power supplies using ICs: General purpose regulators, precision regulators (IC723,317, 337) fixed voltage regulators(78XX,&79XX) Switch mode regulators. Protection techniques: Protection against transients, RFI suppression, current limiting, voltage limiting,

Transducers - classification, requirements, basic physics, design considerations, Mechanical, thermal, optical, electrical, magnetic, chemical sensors, displacement, strain, vibration, pressure, flow, force and torque, temperature transducers. Actuators, electromechanical, electro thermal, electro optical and electrochemical actuators, working principles, specifications and application examples, relays, motors, heaters. Electronic components, modern package like SMDs, application circuits of sensors with electronic components, Signal conditioning circuits.

UNIT-III
Advanced Test & Measurement Instruments

UNIT-IV
Microprocessor Based Instrumentation
Introduction to A/D and D/A Converter, ADC 0808, DAC 0809 and their interfacing with microprocessor, Data equaisation system. Design of microprocessor based frequency counter and signal generator, microprocessor based temperature measurement and control system, D.C. and Stepper motor control, Turbine monitors, Washing machine control system, Automation control systems.

Text / Reference Books:
1. Electronic Instrument Design H.R. Fowler, Oxford
2. Principles of Instruments and systems R.G. Gupta, TMH
3. Industrial Electronics T.E. Kissell, PHI
IV (c) : Nano-Electronics

UNIT I

Introduction to Nanostructures
Definition and importance of nanostructured materials, emergence of nanotechnology, classification of nanostructures, nanoporous materials, reasons of size dependent properties. Energy bands and concept of quantum confinement, electronic structure and density of states in 3D, 2D, 1D and 0D structures. Top down and bottom up approaches for preparation of nanostructures.

UNIT II

Thin semiconductor Heterostructures
Quantum well energy levels, excitons and shallow impurities in QW. Tunneling structures, coupled quantum wells and superlattices, modulation doping of heterostructures, carrier and exciton dynamics. Non-linear and electro-optic effects. Electrical conductivity in low dimensional systems, mobility in parallel transport and perpendicular transport, tunneling junction and tunneling, quantum transport, ballistic transport, transport of spin and spin transport. General idea about spintronics.

UNIT III

Application of Quantum Semiconductor Structures
Models of FETs, performance analysis, variants of heterojunction FETs. Two terminal and three terminal electronics devices based on perpendicular transport, quantum well lasers, single QW laser, multiple QW lasers, temperature dependence of threshold current, specific features of QW lasers, material systems for QW lasers.

UNIT IV

1D and 0D Structures
Fullerene, carbon nanotubes and their applications, Micro and mesoporous materials, core shell structures, nano-grained structures, polymer nanocrystals and nanocomposites, supramolecular structures. Band-gap engineered quantum devices. Electrical devices based on 1D and 0D structures: resonant tunneling devices, single electron transistor etc. Optical devices based on 1D and
0D structures: luminescence, QD phosphors, AC power electroluminescence and display devices, QD lasers photovoltaic effect, nanostructured solar cells.

Reference/Text Books
2. Introduction to Nanotechnology; by Charles P. Poole, Jr. and Frank J.Owens, Wiley India 2007

IV (d): Data Communication

UNIT I

The OSI Model and TCP/IP Protocol suite: The OSI model, layers in the OSI model, TCP/IP protocol suite, addressing-physical logical and port addressing.

IP Addressing: Introduction, classful addressing-recognizing classes, classes and blocks, network addresses, sub-netting and super netting

UNIT II

ARP: ARP-Packet format, Encapsulation, operation, ARP over ATM, ARP Package

Internet Protocol: Datagram, Fragmentation, Checksum, IP package, Message Protocol: Types of messages, message format, error reporting, Query, Debugging tools, ICMP package.

UNIT III

Data gram Protocol(UDP): Process to process communication , User datagram, Checksum, UDP operation, uses of UDP, UDP package, Transmission control protocol: TCP services, TCP features, segment, TCP connection, state transmission diagram, flow control, congestion control, TCP timers, TCP package

UNIT IV

Routing protocol: Intra and Inter domain routing, distance vector routing, RIP protocol, link state routing, open shortest path first areas. Types of links, ospf packets, path vector routing, multicast and broadcast routing 1.

File transfer protocol (FTP): Connections, communication processing, file transfer, Trivial File Transfer protocol (TFTP): Message, connection, data transfer, UDP ports, and TFTP examples, World Wide Web: Artitecture, Web documents, HTTP.

BOOKS FOR STUDY:
1. TCP/IP PROTOCOL SUITE by Behrouz A. Forouzan. Third edition

Reference Books –
2. Data Communication and Networks - Achyut S. Golbole, TMH, 2002

IV(e) VHDL

UNIT I
Introduction to VHDL: History, capabilities, hardware abstraction, Overview, basic terminology, entity declaration, architecture body, Configuration declaration, Package declaration, Model analysis, Simulation

UNIT II
Basic language elements: Data objects, classes and Data types, Operators, Identifiers, logical operators, Assignments and sequential statements and process, resolution functions.

UNIT III
Modeling style: Behavioral Modeling, data flow modeling, structural modeling with examples, component declaration, structural layout and generics.

UNIT IV
Subprograms and overloading, packages and libraries, concurrent statements, Application of functions and procedures, Model Simulation, Test bench generation. Design of microcomputer system, basic components, architecture and implementation of simple microcomputer system using VHDL.

Reference/Text Books
1. A VHDL Primer; by J.Bhaskar, II Edition, Pearson Education Asia

Note: Any other paper of similar standard can be added as advance course in the subject as and when necessary

PAPER V 100 Marks (3 credits)

COMPREHENSIVE VIVA VOCE