GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)

(Deemed to be University, Estd. u/s 3 of UGC Act 1956)

VISAKHAPATNAM ∗HYDERABAD ∗BENGALURU

Accredited by NAAC with 'A+' Grade

REGULATIONS & SYLLABUS of

M.Phil / Ph.D course work

in

Electronics and Physics

(w.e.f 2018-19 admitted batch)

Website: www.gitam.edu

Department of Electronics and Physics
GITAM INSTITUTE OF SCIENCE
GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)
(Declared as Deemed to be University u/s 3 of the UGC Act, 1956)

M.Phil and Ph.D

1.M.Phil and Ph.D.

The Department offers M.Phil and Ph.D programs in Electronics and Physics

2 Duration of the Programmes

2.1 M.Phil. (Full time -FT) programme shall be for a minimum of one year and a maximum of two years.

2.2 M.Phil. (Part Time -PT) programme shall be for a minimum of two years and a maximum of four years.

2.3 Ph.D. (Full time -FT) programme shall be for a minimum of three year (two years for M.Phil. Degree holders) and a maximum of six years.

2.4 Ph.D. (Part Time-PT) programme shall be for a minimum of four years (three years for M.Phil. Degree holders) and a maximum of six years.

Part time candidates are required to work for at least eight weeks (in one or more than one spell) each year including the period of course work in the concerned department.

2.5 Women candidates and persons with disability (more than 40% disability) be allowed a relaxation of one year for M.Phil and two years for Ph.D. in the maximum duration prescribed for the program.

In addition, women candidates may be provided Maternity Leave / Child Care Leave once in the entire duration of M.Phil./Ph.D. for up to 240 days.

3. Course work

3.1 Course work is mandatory for M.Phil. and Ph.D. scholars. However, Ph.D. Candidates with M.Phil. degree are exempted.

3.2 Candidates have to put in a minimum of **75% attendance** per course to be eligible to appear for the examinations.

3.3 The Course Work comprises the following:

Course. No	Course Code	Name of the Paper	Max.Marks
I	SRM 901	Research Methodology	100
M.Phil /Ph.D program in Electronics one to be chosen			
II	SEL 901	Non-Destructive Testing and Evaluation of Materials	100
II	SEL 902	Biomedical Instrumentation	100
M.Phil /Ph.D program in Physics one to be chosen			
II	SPH 901	Photonics	100
II	SPH 902	Solid State Physics	100
II	SPH 903	Nanophotonics and Raman Spectroscopy	100
II	SPH 904	Theoretical Physics	100
M.Phil /Ph.D program in Electronics			
III	SEL 999	Comprehensive Viva-voce	50
M.Phil /Ph.D program in Physics			
III	SPH 999	Comprehensive Viva-voce	50

3.3.1 - Each course shall have 40 contact hours. Classes for Course - I shall be arranged by the Institute and that of Course - II by the concerned Research Supervisor.

3. 4. The Scheme of Course Work

Course. No	Course Code	Course Title	Credits-C
I	SRM 901	Research Methodology	4
M.Phil /Ph.D program in Electronics one to be chosen			
II	SEL 901	Non-Destructive Testing and Evaluation of Materials	4
II	SEL 902	Biomedical Instrumentation	4
M.Phil /Ph.D program in Physics one to be chosen			
II	SPH 901	Photonics	4
II	SPH 902	Solid State Physics	4
II	SPH 903	Nanophotonics and Raman Spectroscopy	4
II	SPH 904	Theoretical Physics	4
M.Phil /Ph.D program in Electronics			
III	SEL 999	Comprehensive Viva-Voce	2
M.Phil /Ph.D program in Physics			
III	SPH 999	Comprehensive Viva-voce	2

3.5 M.Phil. candidates have to qualify in the prescribed courses within 6 months and the Ph.D. candidates within 12 months from the date of registration.

3.6 Candidates have to secure at least a "P" grade in each of all the three courses simultaneously to be declared to have completed the course work.

3.7 Unsuccessful candidates shall be provided only two more chances to complete the course work.

4. Evaluation

4.1 Grading System.

S.No	Grade	Grade Points	Absolute Marks
1.	O (Outstanding)	10	90 and above
2.	A^+ (Excellent)	9	80 to 89
3.	A (Very Good)	8	70 to 79
4.	B (Good)	7	60 to 69
5.	P (Pass) 5	5	55 to 59
6.	F (Fail)	0	Less than 55
7.	Ab. (Absent)	0	-

4.2 The Comprehensive Viva-Voce shall be conducted and assessed by the Research Advisory Committee (RAC).

Syllabus

Course-I : SRM901 RESEARCH METHODOLOGY

(Common to all Science Research Programs)

Max.Marks:100 Credits-4

Unit I

Research Methodology: Introduction- Meaning of Research- Objectives of Research-Types of Research- Research Approaches-Significance of research- Research Methods Vs Methodology-Research and Scientific Methods-Research Process – Criteria for good Research- Problems encountered by researchers in India.

Unit II

Defining Research Problem, Hypothesis. What is a Research problem- Selecting Research Problem-Necessity of Defining the problem- Techniques involved in defining a problem
Research Design Meaning-Need for Research Design-Features of Good Design- Concepts related to Research Design-Different Research Designs.

Unit III

Data Collection and Data Preparation - Data Collection: Introduction-Experiments and Surveys-Collection of Primary Data-Collection of Secondary data- Secondary data-Selection of Appropriate methods for Data collection-case study methods-Data Preparation process.

Unit IV

Statistics: Measures of Central Tendency- Measures of Dispersion-Measures of Skewness- kurtosis-Measures of Relationships Associations in case of Attributes-Index numbers measure-Time series Measures**.**

Unit V

Interpretation and Report Writing: Meaning of interpretation-techniques on interpretation-precautions in interpretation-Significance of Report writing- Different steps in report writing-Layout of report research-types of reports-oral presentation- mechanics of writing a research report-Plagiarism and Research Ethics.

Reference Book:

1. Research Methodology by C R Kothari, Gaurav Garg, New Age International Publishers Ltd., 2014.

Department of Electronics & Physics
GITAM Institute of Science
GITAM (Deemed to be University)
M.Phil. /Pre-Ph.D. Syllabus

SEL 901 Non-Destructive Testing and Evaluation of Materials

UNIT –I **8 hours**

Structure of Metals and Defects

Classification of Materials: Metals, Ceramics, Primary and secondary bonding in solids, Basic Crystal Structures: FCC, BCC, HCP (structures only). Dislocations, Point Defects, Volume Defects. Fundamentals of Fracture, atmospheric corrosion, galvanic corrosion, stress corrosion cracking.

UNIT – II **8 hours**

Introduction to NDT and Surface Methods

Introduction: What Is NDT, Scope Applications, And Limitations Of NDT. Visual Inspection Method: Basic principle, direct and indirect methods, Baroscope. Liquid Penetrant Method: Liquid penetrant test basic concepts, Testing Procedure. Magnetic Particle Method: Magnetic materials, magnetization and demagnetization of materials, Magnetic particle test equipment.

UNIT – III **8 hours**

Eddy Current Testing (ECT)

Introduction, Technical Overview, Potential of the Method, Magnetic Induction (Self and Mutual), Coil Impedance, Eddy Current Density and Skin Depth, Impedance Plane Diagrams, EC Transducers (Probes), Measurement Equipment, advantages, limitations.

UNIT – IV **8 hours**

Ultrasonic Testing (UT)

Principle of wave propagation, Reflection, Refraction Diffraction, Ultrasonic transducers, Ultrasonic Testing Equipment, A,B,C-Scan Presentation, Test indication and inspection, Advantages and limitations of Ultrasonic testing.

UNIT – V **8 hours**

Radiography Testing (RT)

X-Ray radiography principle, equipment and methodology, Types of industrial radiation sources and Application, Gamma Ray equipment, Radiographic procedure, Film Processing methods, Precautions against radiation hazards.

Text Books:

1. William D. Callister, Materials Science and Engineering An Introduction, 7th Edition, John Wiley & Sons, Inc.
2. C. Hellier, Handbook of Non-Destructive Evaluation, McGraw-Hill Professional, 1st edition (2001).
3. Jayamangal Prasad, C. G. Krishnadas Nair, Non-Destructive Test And Evaluation Of Materials, 2nd Edition, Tata Mcgraw-hill.
4. P.J. Shull, Nondestructive Evaluation - Theory, Techniques, and Applications, Marcell Decker Inc., NY 2002.

References:

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-destructive Testing, 2nd edition, Woodhead Publishing, 2002,
2. B.P.C. Rao, Practical Eddy Current Testing, Alpha Science International Limited (2006).
3. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010.
4. Elements of Metallurgy and Engineering Alloys , edited by Flake C. Campbell, ASM International, 2008.
5. Non-Destructive Examination and Quality Control, ASM International, Vol.17, 9th edition (1989).

Department of Electronics & Physics
GITAM Institute of Science
GITAM (Deemed to be University)
M.Phil. /Pre-Ph.D. Syllabus

SEL 902 Biomedical Instrumentation

UNIT-I
Biomedical signals & Physiological transducers **8 Hours**

Source of biomedical signal, Origin of bioelectric signals, recording electrodes, Electrodes for ECG, EMG and EEG, Physiological transducers: Pressure, Temperature, Photoelectric and Ultrasound transducers.

UNIT-II
Recording Systems **8 Hours**

Basic recording system, General considerations for signal conditioners, Preamplifiers, Main amplifiers, Signal processing techniques. **Writing Systems**: Direct writing recorder, ink-jet recorder, Potentiometric recorder, Digital recorders. **Biomedical recorders**: ECG, EEG and EMG.

UNIT-III
Patient Monitoring systems **8 Hours**

Cardiac monitor, Bedside patient monitor, measurement of heart rate, Blood pressure, temperature, Respiration rate, Arrhythmia monitor, Methods of monitoring fetal heart rate.

UNIT-IV
Introduction to Embedded Systems **8 Hours**

Introduction, Application areas, Categories of Embedded Systems, Overview of Embedded system architecture, Specialties of Embedded systems, Recent trends, Hardware architecture, Software architecture, Development tools, Communication Interfaces.

UNIT-V
ARM Microcontrollers **8 Hours**

Introduction to 32- bit Microcontrollers, ARM9TDMI Architecture, Registers, Modes, Exception handling, Instruction sets. Thumb instruction set, Jazelle processor, Use of microprocessors and Microcontrollers in medical instruments, PC based medical instruments.

Text Books:

1. Electronics in Medicine & Biomedical Instrumentation by Nandini K.Jog, 2nd Edition, 2013
2. Handbook of Bio medical Instrumentation by R.S. Khandhapur, TMH, 2nd Edition,2002
3. Biomedical Engineering by S.N. Sarbadhikari

Reference Books:

1. Textbook of Biomedical Instrumentation by K.N. Scott & A.K. Mathur
2. Embedded/Real- Time System: Concepts, Design & Programming, Black Book by K. V. K. Prasad.

Department of Electronics & Physics
GITAM Institute of Science
GITAM (Deemed to be University)
M.Phil. /Pre-Ph.D. Syllabus

SPH 901 Photonics

UNIT – I **8 hours**

Electromagnetic fields and waves

Maxwell's equations and boundary conditions; Monochromatic fields and complex-function formalism; Wave equation; Chromatic dispersion and group velocity; Wave equation in quadratic index media and beams; Gaussian beams in homogeneous media – fundamental and higher order modes; Beam propagation and diffraction integral

UNIT – II **8 hours**

Guided waves in dielectric slabs and fibers

Slab waveguides; TE and TM modes in Symmertric and assymetric slab waveguides; Linearly polarized modes in step-index circular dielectric waveguides

UNIT – III **8 hours**

Optical resonators

Fabry-Perot etalon; Modes in a generalized resonator; Resonance frequences of optical resonators; Losses in optical resonators; Ring resonators

UNIT – IV **8 hours**

Wave propagation in periodic media

Bloch waves; Bragg reflectors; Coupled wave analysis; Periodic waveguides; Photonic crystals

UNIT – V **8 hours**

Fundamentals of numerical methods for electromagnetism

Eigenmodes and eigenfrequencies of a planar waveguide; Matrix methods: Characteristic matrix, scattering matrix, transfer matrix and their equivalence; Finite difference methods: discretization in one dimension; Finite difference analysis of planar waveguides.

Textbooks:

1. Photonics, Yariv and Yeh, Oxford University Press-New Delhi
2. Numerical Techniques in Electromagnetics with MATLAB, Mathew N O Sadiku, CRC Press.

Reference books:

1. Principles of Optics, Born and Wolf, Cambridge University Press
2. Optics, A Ghatak, Mcgraw Hill Education
3. Optics, Hecht and Ganesan, Pearson India.

Department of Electronics & Physics
GITAM Institute of Science
GITAM (Deemed to be University)
M.Phil. /Pre-Ph.D. Syllabus

SPH 902 Solid State Physics

UNIT I **8 hours**

Materials processing

Conventional ceramic method, ballmilling, PVD, RF sputtering, sol-gel, chemical co-precipitation, auto-combustion. Heat treatment: calcination, green body density, sintering, annealing, bulk density and porosity.

UNIT II **8 hours**

Characterization-I

X-ray diffraction- Bragg's law, powder X - ray diffractometer - construction and working, crystalline phase analysis, fundamentals of transmission electron microscopy and scanning electron microscopy, study of crystal structure using TEM, study of microstructure using SEM - scanning electron microscopy with EDS - construction and working, grain size and chemical analysis.

UNIT III **8 hours**

Characterization-II

Infra-Red spectrometer- analysis of spectra. Impedance Spectroscopy- Impedance-Related Functions, Measurement Systems-Impedance Analyzers. Magnetic resonance methods - Electron spins resonance- A simple EPR spectrometer Vibrational Sample Magnetometer-Hysteresis and Related Properties P-E hysteresis measurements- Hysteresis and Related Properties.

UNIT IV **8 hours**

Dielectric properties

Introduction, fundamental definitions, local field, Claussius - Mossotti relation, different types of electric polarizations - electronic, ionic, and dipolar polarizations (qualitative and quantitative), temperature and frequency dependence of polarization, dielectric loss, hopping mechanism, piezoelectricity and ferroelectricity; spontaneous polarization in $BaTiO_3$.

UNIT V **8 hours**

Magnetic Properties

Introduction, fundamental definitions, Weiss theory of ferromagnetism, domain theory of ferromagnetism, hysteresis, Eddy current losses; ferrites (structure) - normal, inverse and mixed ferrites, superexchange interaction (Neel model), initial permeability, effect of frequency on permeability- domain wall relaxation and spin resonance.

Textbooks:

1. Materials Characterization Techniques, Sam Zhang, Lin Li, Ashok Kumar, 92008) CRC press
2. "Introduction to solid state Physics 8the edition" by Charles Kittel; Wiley India.
3. "Impedance Spectroscopy Theory, Experiment, and applications", 2nd ed. Edited by Evgenij Barsoukov, J.Ross Macdonald, (2005) John Eiley & Sons.

Reference Books:

1. "Ceramic Processing and Sintering", by Mohamed N. Rahaman, (2003) CRC Press.
2. "Electron paramagnetic resonance : elementary theory and practical applications"2nd ed./John A. Weil, James R. Bolton (2007) John Wiley & Sons.
3. "Handbook of Nanophase and Nanostructured Materials: Volume I: Synthesis" by Z.L. Wang, Yi Liu, Ze Zhang (2002) Springer.

Department of Electronics & Physics
GITAM Institute of Science
GITAM (Deemed to be University)
M.Phil. /Pre-Ph.D. Syllabus

SPH 903 Nanophotonics and Raman Spectroscopy

UNIT - I **8 hours**

Fundamentals of Nanoscience

Historical background, nanotechnology and nanoscience, significance of nanoscale quantum confinement, size dependent properties, length scales, quantum size effects in nanoparticles, nanocluster types of nanomaterials, fullerenes, nanowires, nanotubes

UNIT-II **8 hours**

Synthesis of Nanomaterials

Various methods used for synthesis of nanomaterials, Physical methods-Mechanical-Ball milling, evaporation-Ion sputtering, laser ablation, Physical layer deposition, Chemical methods- sol-gel technique, precipitation method, colloidal synthesis and capping of nanomaterials,

UNIT-III **8 hours**

Properties of Nanomaterials

Metal nano clusters, magic numbers-theoretical modeling, geometric structure, electronic structure, reactivity, fluctuations, magnetic clusters, transition from bulk to nanomaterial, semi conducting nanoparticles, optical properties-photo fragmentation and coulomb explosion, electrical , mechanical, chemical, thermal and elastic properties of carbon nanotubes.

UNIT-IV **8 hours**

Methods and Measuring Properties

Introduction, structure- particle size determination and surface structures, Microscopy-transmission electron microscopy, scanning electron microscopy, Atomic force microscopy, Diffraction techniques-X Ray diffraction, Intensities in X –Ray scattering and particle size effects

UNIT V **8 hours**

The Theory of Raman Spectroscopy and Surface Enhanced Raman Spectroscopy (SERS)

Introduction, Absorption and scattering, the nature of polarizability and the measurement of polarization, the basic selection rule, the mutual exclusion rule, Introduction and theory, SERS localized surface plasmons and propagating surface plasmons, Electromagnetic and charge transfer enhancement, Applications of SERS (Biological, medical, defenses etc..)

Text Books

1. Nano the essentials-by T. Pradeep, Mc. Graw Hill Education, 2008
2. Introduction to nanotechnology by Charles P. Poole and Frank J.Owens, Wiely publishers
3. Modern Raman spectroscopy, A practical approach, Ewen Smith, Geoffrey Dent, Willey publishers

Department of Electronics & Physics
GITAM Institute of Science
GITAM (Deemed to be University)
M.Phil. /Pre-Ph.D. Syllabus

SPH 904 Theoretical Physics

UNIT – I **8 hours**

Foundations of Molecular Orbital Theory

Quantum Mechanics and the Wave Function ,The Hamiltonian Operator ,General Features ,The Variational Principle ,The Born–Oppenheimer Approximation Construction of Trial Wave Functions ,The LCAO Basis Set Approach ,The Secular Equation , H¨uckel Theory Fundamental Principles ,Many-electron Wave Functions ,Hartree-product Wave Functions,The Hartree Hamiltonian Electron Spin and Antisymmetry ,Slater Determinants and the Hartree-Fock Self-consistent Field Method.

UNIT – II **8 hours**

Molecular Mechanics

History and Fundamental Assumptions , Potential Energy Surfaces, Potential Energy Functional Forms ,Bond Stretching, Valence Angle Bending ,Torsions ,van der Waals Interactions , Electrostatic Interactions, Cross Terms and Additional Non-bonded Terms and Parameterization Strategies.

UNIT - III **8 hours**

Optimisation Analysis

Geometry Optimization -Specifying Molecular Geometry and Building the Geometry, Coordinate Space for Optimization,Z-Matrix for a Diatomic Molecule and poly atomic molecules. Basis sets -Contraction Schemes, Notation and Common Basis Sets. Population Analysis-orbital based and Topological Electron Density Analysis

UNIT – IV **8 hours**

Computational Methods

Semi empirical Methods: Philosophy, Chemically Virtuous Approximations, Extended H¨uckel Theory , CNDO Formalism ,INDO Formalism and Gaussian Theory.

Ab Initio Basis Sets ,Functional Forms ,Contracted Gaussian Functions Single-ζ , Multiple-ζ , and Split-Valence Polarization Functions and Diffuse Functions . General Performance Overview of *Ab Initio* HF Theory-Energetics, geometries and charge distribution

UNIT – V **8 hours**

Density Functional Theory

The Hohenberg–Kohn Existence Theorem ,The Hohenberg–Kohn Variational Theorem,Exchange-correlation Functionals ,Local Density Approximation ,Advantages and Disadvantages of DFT Compared to MO Theory Densities vs. Wave Functions ,Computational Efficiency AND Limitations of the KS Formalism
General Performance Overview of *DFT* Theory-Energetics, geometries and charge distribution

Reference Books

1. **Essentials of Computational Chemistry-**Theories and Models **Christopher J. Cramer** Second Edition John Wiely &Sons Inc. Publication
2. **Computational Organic chemistry**. Steven M. Bachrach, John Wiely &Sons Inc. Publication
3. **Computational Chemistry** David C. Young,Cytoclonal Pharmaceutics Inc.,John Wiely &Sons Inc. Publication

Course – III : SEL 999 Comprehensive Viva-Voce

Max.Marks:50 Credits-2

Candidates appearing for Comprehensive Viva-Voce shall give a presentation on relevant research area. The candidate should also submit a copy of presentation (soft & hard copies) to the department. The presentation will be evaluated for 50 marks.

The presentation should emphasize on the aspects enlisted below:

a) Review of literature

b) Gaps identified in the literature

c) Framing a Hypothesis

d) Research Methodology Proposed

e) Timeline of the Research Work

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