UTTARANCHAL
UNIVERSITY

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Arcadia Grant, P.O. Chandanwari, Premnagar, Dehradun,
Uttarakhand-248007, INDIA

Detailed Course Structure & Syllabus

of

Pre Ph.D. (Physics)
Course Work
(As per CBCS system)

Session: 2019-20 (Odd Semester)

EVALUATION SCHEME
Pre Ph.D. (Physics)
Course Work

Course Structure & Syllabus of Pre Ph.D. (Physics)
Session: 2019-20 (Odd Semester)

Scheme of Pre-Ph.D. Course Work

S. No	Course Code	Course Name	Credits	Evaluation – Scheme							
				Period			Sessional			Examination	
				L	T	P	CT-I	CT-II	Total	ESE	Sub. Total
1.	RM-101	Research Methodology & Computer Application	7	6	1	0	20	20	40	60	100
2.	PHY-102	Discipline Specific Electives (Physics)	7	6	1	0	20	20	40	60	100
3.	RLS-103	Review of Literature & Seminar Presentation	6	0	0	10	20	20	40	60	100
		Total	**20**	**12**	**2**	**10**	**60**	**60**	**120**	**180**	**300**

List of Electives

S. No.	Course Code	Course Name
1	PHY-102 (i)	Advances in Physics
2	PHY-102 (ii)	Spectroscopic Study, Thin Film Technology and Experimental Techniques

RM 101: RESEARCH METHODOLOGY

Course Objectives:

1. To Equip the Students with the Concept and Methodology of Research.
2. To provide knowledge about type of research, preparation of reports and thesis, designing of Research using Scientific Methods like statistical methods and computer skills.

UNIT-I

Introduction to Research: Definition, Nature and significance, Role and Objectives; Types of Research: Doctrinal and non-doctrinal research methods; Scientific Research Process: Overview, Problem identification and formulation of research statement. Types and nature of various research design, Research design decisions, Types and nature of various research designs. Structures of experimental research designs.

UNIT-II

Data Collection: sources of secondary data methods of primary data collection: personal interview, questionnaire method, observation method questionnaire Vs. schedules; Data Processing: Editing, Coding Organization and Presentation; Attitude Measurement and scaling: Measurement Scales, Sources of Errors in Measurement, Techniques of Developing Measurement Tools, Classification and Testing (Reliability, Verification and Validity) Scales, Designing Questionnaires. Data collection methods in qualitative research.

UNIT-III

Sampling, Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions: Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors. Sampling design process. Sample size determination, Sampling design process, Sample size determination.

UNIT-IV

Statistical Tools / Methods for research – Univariate and Bivariate Analysis. Hypothesis and Hypothesis Testing: Parametric & Non-Parametric Tests, Use of Various Statistical Tools on SPSS F-Test, t-Test, z-Test, ANOVA, Kruskal-Wallis Test, Chi Square Test, Run Test, Wilcoxon's signed rank test, Man Whitney's U-test, K-S median test

UNIT-V

Interpretations and Report Writing: Meaning, Techniques, Precautions and Significance of Report Writing & interpretation, Precautions in Writing Research Reports. Limitations of RM: Ethics in Research, Philosophical Issues in Research. Use of Internet for Research Work and Exploring Various Websites and Search Engines for Collecting Quality Literature Review and Secondary Data.

Text Readings

1. William G. Zikmund, "Business Research Methods", Orlando: Dryden Press.
2. C. William Emory and Cooper R. Donald, "Business Research Methods", Boston, Irwin.
3. Fred N Kerlinger, "Foundations of Behavioural Research", New Delhi: Surjeet Publications.
4. Naresh Malhotra, Marketing Research : An Applied Orientation, Pearson publication David Nachmias and Chava Nachmias, "Research Methods in the Social Sciences", New York: St.Marlia's Press.
5. C. R. Kothari, "Research Methodology: Methods and techniques", New Delhi: Vishwa Prakashan.

PHY-102 (i)- ADVANCES IN PHYSICS

Course Objectives:

1. The objective of this course is to learn about nanotechnology and its applications.
2. The course also covers the Preparation and characterization techniques required for nanotechnology.

UNIT-I

Introduction to Nanoscience & Technology; Carbon Nanotube (Quantum Dot), Properties of Nanomaterials, Renewable Energy, Solar Cells, Solar Photo Thermal and Photovoltaic Devices. Fundamental concepts and applications of Ferroelectric, Polymer and Ferrimagnetic Materials. Compound nucleus hypothesis, Theoretical studies of Nuclear and Astroparticle.

UNIT - II

Experimental Studies and Preparation: Synthesis of materials by Solid State Reaction method, Sol-gel method, Citrate precursor technique, Thin-film technique, Combustion and Co-precipitation method, Mechanical Ball milling, Plasma synthesis, Low-Temperature water-chiller synthesis etc.

UNIT - III

Characterization and Measurements: Introduction and Working Principle of X-ray Diffractometer, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Vibrating Sample Magnetometer (VSM), Vector Network Analyzer (VNA), Impedance Analyzer (Four-Probe Technique), Thermogravimetric Analyzer (TGA), Fourier Transform Infrared Spectroscopy (FTIR), IR and UV-Visible Spectroscopy, etc.

UNIT - IV

Scientific Presentation: Presentation of research work in power point (which includes text subjected to research work with graphs, picture, tables, reference etc.), Literature survey of the

previous works and search for articles, Review of an article in the relevant field and preparation of a short report, Steps of research; Paper, article, Synopsis and Thesis writing.

Reference Books:

1. Nanoparticles and Nanostructured Films-Preparation, Characterization and Applications: J.H. Fender (Wiley).
2. A Text Book of "Engineering Physics" by N.Gupta.
3. Solid State Physics by S.O.Pillai, New Age International, 5rd Ed.
4. Introduction to "Nuclear and Particle Physics", 3rd Edition, by Mittal, Verma, and Gupta.
5. The Renewable Energy Handbook by William H. Kemp.
6. Thermal Energy Storage: Systems and Applications by Ibrahim Dincer, Marc A. Rosen.
7. Thin Films Phenomena by K.L. Chopra.
8. Sol-gel Science: The Physics and Chemistry of Sol-gel Processing by C.Jeffrey Brinker and George W. Scherer.
9. Experimental X-Ray Diffraction, B.D. Cullity, Prentice Hall India, 3rd Ed., 2001.
10. Microstructural Characterization of Materials, D.BramdonWiley, 1999.
11. Experimental Techniques in Condensed Matter Physics at Low Temperatures, Robert C. Richardson and Eric N. smith, Addison Wesley Longman, Inc., 1998.
12. Measurement, Instrumentation Experiment design in Physics and Engineering, M. Sayer and Abhai Mansingh, Prentice Hall India, 2000.

PHY-102 (ii)- SPECTROSCOPIC STUDY, THIN FILM TECHNOLOGY AND EXPERIMENTAL TECHNIQUES

Course Objectives:

1. To familiarize student with the concept of Spectroscopy and characteristics properties of emission.
2. To develop the concepts of various techniques of thin film deposition.

UNIT-I: Molecular Fluorescence: luminescence, fluorescence and phosphorescence, Fluorescence and other de-excitation processes of excited molecules, Fluorescent probes, Ultimate spatial and temporal resolution: femtoseconds, femtoliters, femtomoles and single-molecule detection.

UNIT-II: UV-Visible and Visible Spectroscopy: Introduction, The absorption laws, Measurement of absorption intensity, Instrumentation, Formation of absorption bands, theory of electronic spectroscopy, Types of electronic transitions in polyatomic molecules, Probability of transitions, Oscillator strength, Selection rules, The Franck–Condon principle, the chromophore concept, absorption and intensity shifts, types of absorption bands, solvent effect, effect of temperature and solvent on the fineness of absorption band, fluorescence and phosphorescence, applications of ultra-violet spectroscopy, important features in electronic spectroscopy, important terms and definitions in ultraviolet spectroscopy.

UNIT-III: Characteristics Of Fluorescence Emission: Radiative and non-radiative transitions between electronic states, Internal conversion, Fluorescence, Intersystem crossing, and subsequent processes, Intersystem crossing, Phosphorescence versus non-radiative de-excitation, Delayed fluorescence, Triplet–triplet transitions, Lifetimes and quantum yields, Excited-state lifetimes, Quantum yields, Effect of temperature, Emission and excitation spectra, Steady-state fluorescence intensity, Emission spectra, Excitation spectra, Stokes shift, Effects of molecular structure on fluorescence, Extent of p-electron system. Nature of the lowest-lying transition, Environmental factors affecting fluorescence, Homogeneous and inhomogeneous broadening. Red-edge effects.

UNIT-IV: Thin Film Technology and Experimental Techniques: Preparation of Thin-films, Physical vapor deposition, Evaporation Techniques-Sputtering (RF & DC), Spin Coating, Pulsed Laser deposition, Liquid Phase Epitaxy, Vapour Phase Epitaxy, Molecular Beam Epitaxy, Film growth and measurement of thickness, Thermodynamics and Kinetics of thin-film formation, Deposition parameters, and grain size, structure of thin films, Ellipsometry, and interferometers, Measurement of the rate of deposition using rate meter, cleaning of the

substrate. Working Principle of X-ray Diffractometer, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning tunnelling microscopy (STM), Fourier Transform Infrared Spectroscopy (FTIR), IR and UV-Visible Spectroscopy.

Reference Books:

1. Measurement, Instrumentation Experiment design in Physics and Engineering by M. Sayer and Abhai Mansingh, Prentice Hall India, 2000.
2. Handbook of Thin Film Technology By Leon I. Maissel and Reinhard Glang, McGraw-Hill Handbooks.
3. Molecular Fluorescence: Principles and Applications by Bernard Valeur, Wiley, 2001.
4. Thin Film Fundamentals by A. Goswami, New Age international (P) Ltd. Publishers, New Delhi (1996).
5. L. C. Feldman and J.W. Mayer, Fundamentals of surface and Thin Films Analysis, North Holland, Amsterdam, 1986.
6. Fundamental of molecular spectroscopy by Colin N Banwell and Elaine M Mc Cash, McGraw-Hill Publication.
7. Elementary organic spectroscopy; Principles and chemical applications by Y R Sharma, S Chand Pub.

RLS-103: REVIEW OF LITERATURE AND SEMINAR PRESENTATION

Course Objectives:

Main objective of this course is to develop presentation skills in the scholars and knowledge about review of literature so that they can review properly in the concerned field.

Review of Literature and Seminar

Presentation-Candidate/Research Scholar has to go through the review of literature in the concerned field of research. Review of literature guidelines will be given by the concerned faculty/Dean of Department/School/College. Research Scholar has to give prepare presentation on review of literature in the concerned field/ topic assigned by the department (DRC) periodically during course work.

There will be minimum 3 presentations of review of literature during pre-Ph. D course work. Final presentation would be required at the time of end term/semester examination on proposed synopsis. General guidelines would be issued by Dean-Research for seminar presentation.