UTTARANCHAL
UNIVERSITY

UTTARANCHALUNIVERSITY

ArcadiaGrant,P.O.Chandanwari, Premnagar,Dehradun, Uttarakhand-

248007,INDIA

Detailed Course Structure & Syllabus

of

Pre Ph.D. (Physics)

Course Work

(As per CBCS system)

W.E.F Session 2022-23

Course Structure of the Pre-Ph.D (Physics) Course Work:
Applicable for Batch: 2022-23

SCHEME OF EXAMINATION

Ph.D(Physics)
(Effective from Academic Year 2022-23)

Under Choice Based Credit System (CBCS)

Course Structure of the Pre-Ph.D (Physics) Course Work:
Applicable for Batch: 2022-23

Scheme of Pre-Ph.D. Course Work

S.No	Course Code	Subject	Credits	Evaluation – Scheme							
				Period			Sessional			Examination	
				L	T	P	CT- I	CT-II	Total	ESE	Sub. Total
Courses											
1.	RM-101	Research Methodology	4	4	0	0	20	20	40	60	100
2.	RM-102	Computer & Stats Application in Research	2	2	0	0	20	20	40	60	100
3.	RPE-103	Research & Publication Ethics	2	2	0	0	20	20	40	60	100
4.	DSE-104	Discipline Specific Electives	3	3	0	0	20	20	40	60	100
5.	RS-105	Seminar Presentation	2	0	0	4	20	20	40	60	100
		Total	**13**	**11**	**0**	**4**	**100**	**100**	**200**	**300**	**500**

List of Electives

S. No.	Course Code	Course Name
1	AR-104	Advanced Research &Instrumentation Techniques
2	PH-104 (i)	Spectroscopic Study, Thin Film Technology And Experimental Techniques
3	PH-104 (ii)	Solar Energy Fundamentals And Applications
4	PH-104 (iii)	Condensed Matter Physics & Material Science

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SYLLABUS

of

Ph.D(Physics)

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	RM-101	Credit	4
Year/Sem	1/1	L-T-P	4-0-0
Course Name	Research Methodology		

Objectives of the Course:

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.

UNIT I (Total Topics- 7 and Hrs-12)

Introduction to Research: Definition, Nature and significance, Role and Objectives; Types of Research: exploratory, descriptive, experimental and diagnostic research, social and legal research and traditional, analytical, empirical & fundamental research, Doctrinal and non-doctrinal research methods; Various Research Designs; Scientific Research Process: Overview, Problem identification and formulation of research statement.

UNIT II(Total Topics- 7 and Hrs- 12)

Data Collection: sources, primary and secondary methods, significance of Primary and Secondary Data, 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 and Interviews.

UNIT- III (Total Topics- 5 and Hrs- 10)

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, Concept of Permutation, Combination & Probability for research analysis.

UNIT-IV(Total Topics- 5 and Hrs- 10)

Interpretations and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Steps in Report Writing, Layout of Report and Precautions in Writing Research Reports. Limitations of RM: Ethics in Research, Philosophical Issues in Research.

CO1. Acquire in-depth knowledge of various fundamentals, theories and principles related to the research and apply the acquired knowledge in carrying out research studies in the area of interest.

CO2. Identify, formulate and critically investigate research problems by applying research-oriented knowledge and analyze relevant data to reach certain conclusions in the form of alternative solutions to these problems.

CO3. Apply the acquired knowledge and skills to develop minds to think out of the box while carrying out research operations to conclude something.

CO4. Apply parametric and non-parametric statistical tests to verify the developed hypothesis to suggest innovative solutions to the problem being investigated.

Reference Books

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 ChavaNachmias, "Research Methods in the Social Sciences", New York: St.Marlia's Press.
5. Bhattacharya, D. K. (2004) Research Methodology, New Delhi, Excel Books.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	RM-102	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	Computer & Stats Application in Research		

Objectives of the Course:

1. To appraise computational skills for research application.
2. To assess statistical method for research analysis.

UNIT I

Characteristics of Computers, Evolution of computers, computer memory, computer generations, Basic computer organization; System software, Application software, introduction to operating system, single user, multi-user, multi-tasking single tasking, application of computer for business and research, MS-windows, Linux .Application of Internet in research : INFLIBNET, Use of Internet, sights (DOAJ), Use of E Journals, Use of E library, use of EBSCO HOST online database of Academic Libraries. Subject/field specific tools on www.freeware.com

UNIT II

Computer Application in Research,. Basic concept of Computer, Use of Internet for Research Purpose: E-mail, WWW, Web browsing, technical skills, drawing inferences from data, Research publishing tools-MS Word, Adobe acrobat, Graphics tool-MS Excel, Presentation tool-MS Power, Data Analysis Software and Analysis Techniques point. Creating presentation and adding effects, Introduction to Data analysis software-SPSS: Definition, objectives and features, data analysis using SPSS.

UNIT- III

Statistical methods for research application in analysis of data,Measurement in Research , data interpretation, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), std deviation, Measures of Relationship, Simple Regression Analysis, Correlation and Regression, Partial Correlation.

UNIT-IV

Statistical Tools-Hypothesis and Hypothesis Testing: Parametric & Non-Parametric Tests, Important Parametric Tests ,Hypothesis Testing of Correlation Coefficients ,U Test, Chi Square Test, ,T-Test.Analysis of Variance (ANOVA) , The Basic Principle of ANOVA ,ANOVA Technique, Setting up Analysis of Variance Table, Short-cut Method for One-way ANOVA, Coding Method, Two-way ANOVA .

Course Outcomes:

CO1. Acquire knowledge of concept of computer with application in Research.
CO2. Apply acquired knowledge of computer for presentation skills.
CO3. Acquire knowledge of statistical methods for Research.
CO4. Apply acquired knowledge to describe the inductive nature of quantitative data analysis.

Reference Books

1. C. R. Kothari, "Research Methodology: Methods and techniques", New Delhi: Vishwa Prakashan.
2. Brymann, Alan and Carmer, D. (1995) Qualitative data analysis for social scientist, New York, Routledge Publication.
3.Jain, Satish: "Introduction to Computer Science and basic Programming." BPB Publications, New Delhi, 1990. • Rajaraman, V., "Fundamental of Computers", Prentice Hall of India, New Delhi, 1996.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	RPE-103	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	Research& Publication Ethics		

Objectives of the Course:
Its objectives to provide knowledge about ethics and code of research publication with concept of plagiarism.

UNIT I (Total Topics- 2 and Hrs-8)
1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

UNIT II(Total Topics- 5 and Hrs- 5)
1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

UNIT- III (Total Topics-7 and Hrs-7)
1. Publication ethics: definition, introduction and importance
2. Best practices/ standards setting initiatives and guidelines: COPE, WAME,etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

UNIT- IV (Total Topics-4and Hrs-4)

Practice

Open Access Publishing
1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/ Journal suggestion tools viz. JANE, Elsevier Journal finder, Springer Journal Suggester, etc.

CO1. Recognize the basics of philosophy of science & ethics, research integrity, publication ethics and theories of research ethics.
CO2. Familiarize with important issues in research ethics, research integrity, scientific misconduct and misinterpretation of data.
CO3. Analyze the best practices for publications, publication ethics and identify the predatory publishers & journals.
CO4. Demonstrate &use plagiarism software tools, open-source software tools, citation databases and

research metrics.

CO5. Publish credible & scholarly publications in reputed peer-reviewed journals.

References-

Research and Publication Ethics, Dr Sumanta Dutta, Bharti Publications,2021
Research and Publication Ethics, Dr Santosh kumar Yadav, Anne Publications,2020

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	RS- 105	Credit	2
Year/Sem	1/1	L-T-P	0-0-4
Course Name	Seminar Presentation		

Objectives of the Course:
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 for utilisation in their research work.

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 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.

- First presentation will be required in DRC/FRC for review of literature with concerned Department focus on area of research. It will be evaluated and assessment sheet will be sent from Department to Dean Research & Studies office.
- Similarly second presentation will be required by research scholar with extension of first presentation and more number of references would be added.

Internal & end term examination marks will be as per scheme. Each presentation is to be assessed by the department as per instructions from Dean-Research & Studies.

Final presentation would be required at the time of end term/sem. examination on proposed synopsis. General guidelines would be issued by Dean-Research for seminar presentation.

Course outcomes
CO1. Research Scholar would be able to develop & explore the review of literature in concerned area.
CO2. Analyze review of literature critically for finding the research gap.
CO3. Apply acquired knowledge in making systematic seminar presentations.
CO4. Apply acquired knowledge for improving development of all-round research.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	AR-104	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	**Advanced Research &Instrumentation Techniques**		

Objectives of the Course:

1. To learn & apply concept of Thermogravimetric techniques in research.
2. To provide knowledge about spectroscopic techniques for research.

UNIT I (Total Topics-12 and Hrs-12)

UV-Visible spectroscopy

Basic principle, Various electronic transitions Beer-Lambert law, effect of solvent on electronic transitions, molar extinction coefficient, concept of chromospheres and auxochromes, bathochromic, hypsochromic, hyperchromic and hypochromic, UV spectra of conjugated enes and enones, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Woodward-Fiesher rules for conjugate dienes and carbonyl compounds.

Infrared spectroscopy

Infra-red spectroscopy: Basic principle, Instrumentation Selection rules, fundamental modes of vibration, overtones, combination bands, Fermi resonance, Factors affecting IR spectra. Effect of hydrogen bonding, solvent effect on IR of gaseous, solids and polymeric Interactions with molecules: absorption and scattering. Means of excitation (light sources), detection of the signal (heat differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR).Interpretation of IR spectra of aliphatic, aromatic hydrocarbons, amines, amides, carbonyl compounds etc

UNIT- II(Total Topics- 12 and Hrs-12)

NMR spectroscopy

Principle, Instrumentation, Factors affecting chemical shift, Uses of TMS equivalent and non-equivalent protons, chemical shifts, factors affecting chemical shifts, shielding of magnetic nuclei, deshielding, anisotropic effects in alkene, alkyne, aldehydes and aromatics, spin-spin coupling, coupling constant, chemical exchange,Simple applications, Interpretation of NMR spectra of aliphatic, aromatic hydrocarbons, carbonyl compounds etc.

Thermal methods of analysis:

Thermal methods: Principle & application of Thermogravimatric analysis; TGA, DTA & DSG , DSC : Principle instrumentation and applications.

UNIT-III (Total Topics- 12 and Hrs- 12)

Microscopic Techniques: Preparation of Thin-films, Physical vapor deposition, Evaporation Techniques-Sputtering (RF & DC), Spin Coating, Pulsed Laser deposition, Working Principle of X-ray Diffractometer, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning tunneling microscopy (STM), Introduction & application of Bio analytical techniques

UNIT-IV (Total Topics- 12 and Hrs-12)

Physical instrumentation techniques: Physical Properties: Introduction, & applications of different physical Characteristics: Viscosity, optical activity & conductivity, Instrumentation: Viscometer, pH meter, Refractometer, Polarimeter.

CO-1: Inculcate knowledge about advanced techniques for physical parameters of materials.
CO-2: Apprcise UV visible&Spectroscopic techniques.
CO-3: Learn interpretation of data used in spectroscopy analysis.
CO-4: Learn principle and method of microscopic & thermogravimatric techniques for characterisation of material for research.

Reference Books:

1. Spectroscopy of Organic Compounds, New Age International Publishers; PS Kalsi
2. Spectrometric Identification of Organic Compounds, John Wiley; Silverstein, Robert M.; Webster, Francis X.; Kiemle
3. Practical NMR Spectroscopy, ML Martin, JJ Delpeach and GJ Martin, Heyden.
4. Fundamentals of Molecular Spectroscopy Colin N. Banwell and Elaine M. Mc Cash Tata McGraw Hill.
5. Introduction to NMR Spectroscopy: RJ Abraham, J Fischer and P Loftus, Wiley.
6. Spectroscopic Method in Organic Chemistry: DH Williams, I Fleming, Tata MacGraw Hill.
7. Instrumental Method of Analysis: Seventh Edition, Willard Merritt, Dean, Settle. CBS

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	PH-104 (i)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	**Spectroscopic Study, Thin Film Technology And Experimental Techniques**		

Objectives of the Course:

1. To understand the fundamentals of molecular fluorescence, UV-visible and visible spectroscopy.
2. To illustrate the characteristics of fluorescence emission spectra.
3. To understand different techniques of thin film deposition and working principle of instruments used in the analysis of experimental results.

UNIT I (Total Topics - 07 and Hrs - 15)

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 (Total Topics - 20 and Hrs - 20)

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 (Total Topics - 23 and Hrs - 20)

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 (Total Topics - 21 and Hrs - 20)

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 tunneling microscopy (STM), Fourier Transform Infrared Spectroscopy (FTIR), IR and UV-Visible Spectroscopy.

Course Outcomes (CO):

1. Illustrate the difference between luminescence, fluorescence and phosphorescence along with the concept of probe and resolution.
2. Illustrate the fundamentals of UV-Visible and Visible Spectroscopy along with their important applications or utilizations.
3. Demonstrate and analyse the significant characteristics of fluorescence emission along with quantitative analysis of important parameters.
4. Demonstrate and incorporate the acquired expertise of thin film deposition and experimental techniques for the applications in, real-world situations and problems.

References:

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

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	PH-104 (ii)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	**Solar Energy Fundamentals And Applications**		

Objectives of the Course:

1. To understand the fundamentals of solar radiation concepts along with its analytical analysis and measurement.
2. To illustrate the conversion of solar radiation by means of solar energy collectors.
3. To understand the mechanism of conversion of solar energy by means of different solar energy systems along with the comprehensive study of solar crop drying.

UNIT I (Total Topics - 21 and Hrs - 15)

Solar Radiation and its Measurement: Introduction, Solar spectrum, solar radiation; Terrestrial and Extraterrestrial Regions, Solar Time, Instruments; Pyrheliometer, Pyranometer, Sunshine recorder, Sun-earth angles, solar radiation on an inclined surface, monthly average daily radiation on sloped surfaces, estimation of average solar radiation, distribution of clear and cloudy days and hours, estimation of beam and diffuse components of hourly radiation, estimation of beam and diffuse components of daily radiation, estimation of the monthly average of daily total radiation on a horizontal surface, estimation of the monthly average of daily diffuse radiation on a horizontal surface, estimation of hourly radiation from daily data.

UNIT II (Total Topics - 17 and Hrs - 15)

Heat Transfer Concepts: Introduction, **conduction; temperature field, Fourier's law, thermal conductivity, differential equation of conduction, solution of heat conduction in a medium, Boundary conditions, overall heat transfer, Convection, Radiation; radiation involving real surfaces, Kirchoff's law, laws of thermal radiation, radiative heat transfer coefficient, radiation shape factor, heat and mass transfer.**

UNIT III (Total Topics - 12 and Hrs - 15)

Solar Energy Collectors: Introduction, Physical principles of the conversion of solar radiation into heat, flat plate collectors, Flat Plate Collectors; a typical liquid collector, Heat transport system, Typical air collectors or solar air heaters; non porous absorber plate type collectors, collectors with porous absorbers, applications of solar air heaters, advantages of flat plate collectors, Transmissivity of cover system, Energy balance equation and collector efficiency.

UNIT IV (Total Topics - 14 and Hrs - 15)

Application of Solar Energy: Introduction, solar water heating, Space heating, space cooling, solar thermal electric conversion, solar electric power generation; solar photo-voltaic, agriculture and industrial process heat, solar distillation, solar pumping, solar furnace, solar cooking, solar green houses and solar crop drying.

UNIT V (Total Topics - 15 and Hrs - 15)

Solar Crop Drying: Introduction, Working principle; open sun drying, direct solar drying, indirect solar drying, Thermal modelling of open sun drying, computational procedure for convective heat transfer, prediction of crop temperature and moisture evaporation, analysis for steady state condition, experimental setup for open sun drying, methodology and input parameters for computation, thermal analysis of cabinet dryer, energy balance for reverse absorber cabinet dryer; thin layer drying, deep bed grain drying, Energy balance for indirect solar drying system; solar air heater, drying chamber.

Course Outcomes (CO):

1. Demonstrate and analyse solar radiation intensity along with the operating skill of measuring instruments.
2. Illustrate and apply the fundamentals of heat transfer concept in the field of solar energy applications.
3. Appraise the knowledge of design, working principle and evaluation of efficiency of solar collector to design and its best utilization.
4. Illustrate the mechanism, importance and applications of renewable energy systems in compare to conventional energy systems.
5. Incorporate the fundamental and analysis/operational techniques of solar crop dryers in practical, real-world situations and problems.

References:

1. Tiwari, G. N., Solar Energy fundamental, Design, Modelling and application, Narosa Publishing house, New Delhi, 2002.
2. Tiwari G N and Sangeeta Suneja, Solar Thermal Engineering System, Narosa Publishing House, New Delhi, 1997.
3. Rai G D, Non-Conventional sources of Energy, Khanna Publishers, New Delhi, 2000.
4. ASHRAE, Handbook of fundamentals American society of heating refrigerating and air conditioning Engineers, New York, 1967, 1974, 1977.
5. Duffie J A and Beckman W A , Solar Engineering of thermal processes , John Wiley and Sons, New York, 1991
6. Garg H P, Treatise on solar Energy, Fundamentals of solar energy, Vol.- 1, John Wiley and Sons, New York, 1982.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	PH-104(iii)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	**Condensed Matter Physics & Material Science**		

Objectives of the Course:

1. To understand the fundamentals of crystal structure and concepts concern with semiconductor and superconductors.
2. To understand the concepts of thermodynamics and interpretation of statistical methods.
3. To understand the perception of field theory
4. To understand the models and methods for polymeric systems.

UNITS I (Total Topics - 11 and Hrs - 20)

Basic Structures: Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Phonons, lattice specific heat. Free electron theory and electronic specific heat. Drude model of electrical and thermal conductivity. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity.

UNITS II (Total Topics - 05 and Hrs - 20)

Thermodynamics and Statistical Physics: Basics of thermodynamics, review of statistical methods, spatial correlations in classical systems, ordered systems, symmetry and order parameters, and functional derivatives.

UNITS III (Total Topics - 13 and Hrs - 20)

Mean-Field Theory: The ising and n-vector model, Landau theory, extension to first - order transitions, applications to magnetism, liquid crystals and multiferroics, variational mean- field theory, density functional theory and its applications to ordered systems Breakdown to mean-field theory, mean-field transitions revisited, self-consistent field approximation, critical exponents, universality and scaling, Kadnoff construction, Momentum shell renormalization group

UNITS IV (Total Topics - 03 and Hrs - 15)

Models and methods for Polymeric Systems: Continuous models, lattice models, renormalization group approach and its application to polymeric systems

Course Outcomes (CO):

1. Illustrate lattices, phonons and many more concepts related to semiconductors and superconductors.
2. Illustrate the basic concepts of thermodynamics and statistical parameters and functional derivatives.
3. Illustrate and interpret different concepts and parameters involving in filed theory.
4. Illustrate different models, renormalization group approach and its applications to polymeric systems

References:

1. Chaikin P.M. and Lubensky T.C., Principle of Condensed Matter Physics, Cam.Univ.Press, 1998
2. Hansen J.P. and McDonell I.R. Theory of Simple Liquids, Elsevier Inc, 2006.
3. de Gennes P.G. Scaling Concept in Polymer Physics, Cornell Univ Press, 1979.
4. Cloizeanx J.D. and Jannink G., Polymer in Solutions: Their modelling and structure, Oxford Univ. Press, 1990.

5. Singh S. Liquid Crystals: Fundamentals, World Scientific, 2002.
6. Mahan G.D., Many, Particle Physics, Springer, 1990.
7. Goldennfeld Nigel, Lectures on Phase Transitions and the renormalization group, Addison-Wisley, 1992.
8. Puri S. and Wadhawan V.K. Kinetics of Phase Transitions, World Scientific, 2010.