



Re-Accredited 'B++' 2.86 CGPA by NAAC

VEER NARMAD SOUTH GUJARAT UNIVERSITY

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉદ્ધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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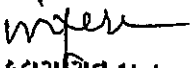
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-:પરિપત્ર:-

યુનિવર્સિટીના વિજ્ઞાન વિદ્યાશાખા હેઠળના તમામ શૈક્ષણિક વિભાગોના વડાશ્રીઓ અને યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોનાં આચાર્યશ્રીઓને જણાવવાનું કે, પીએચ.ડી. કોર્સવર્કના અભ્યાસક્રમને The University Grants Commission(Minimum Standards and Procedures for Award of Ph.D. Degree) Regulations, 2022 ની જોગવાઈઓને અનુરૂપ અદ્યતન કરવા / સુધારા કરવા અંગે વિચારણા કરતાં ફિઝિકલ વિષયની Research and Recognition Committee ની તા.૨૩/૦૮/૨૦૨૫ ની સભાના ઠરાવ ક્રમાંક:૦૧ થી તૈયાર કરેલ અભ્યાસક્રમ એકેડેમિક કાઉન્સિલની તા.૨૭/૧૧/૨૦૨૫ ની સભાના ઠરાવ ક્રમાંક:૦૮ થી અભ્યાસક્રમને સુધારા વધારા માટે ભૌતિકશાસ્ત્ર વિષયની અભ્યાસ સમિતિ સમક્ષ રજૂ કરવા જણાવેલ જે સંદર્ભે પીએચ.ડી. કોર્સવર્કના અભ્યાસક્રમને ભૌતિકશાસ્ત્ર વિષયની અભ્યાસ સમિતિના ચેરમેનશ્રીએ અભ્યાસ સમિતિવતી મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૦૪/૦૬/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંક:૩૯ થી મંજૂર કરવા એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૧૮/૦૬/૨૦૨૬ ની સભાના ઠરાવ ક્રમાંક:૨૮ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

(બિડાણ:ઉપર મુજબ)

ક્રમાંક:ઓથો./પરિપત્ર/૧૩૬૫૭/૨૦૨૬
તા.૧૮/૦૬/૨૦૨૬


કુલસચિવ ધ્વજ

પ્રતિ,

- (૧) યુનિવર્સિટીના વિજ્ઞાન વિદ્યાશાખા હેઠળના તમામ શૈક્ષણિક વિભાગોના વડાશ્રીઓ.
- (૨) યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોનાં આચાર્યશ્રીઓ.
... આપશ્રીના વિભાગ/કોલેજના સંબંધિત શિક્ષકો/વિદ્યાર્થીઓને જાણ કરી અમલ કરવા સારૂ.
- (૩) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
- (૪) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
- (૫) અનુસ્નાતક વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.

.....તરફ જાણ તેમજ અમલ સારૂ.

DEPARTMENT OF PHYSICS,

VEER NARMAD SOUTH GUJARAT UNIVERSITY SURAT -395007

Name of Program	PhD (Physics)
Abbreviation	PhD
Duration	3 Years
Eligibility Criteria	M.Sc. Physics
Objective of Program	<ol style="list-style-type: none"> 1. Develop a deeper understanding of their area of expertise. 2. Conduct and assess research in their area of specialty and adjacent fields by mastering analytical and methodological capabilities. 3. Produce novel research in the area of expertise. 4. Demonstrate the capacity to clearly and effectively convey the findings of their study. 5. Demonstrate an ability to work effectively with other people from various ethnic, educational, and work experience backgrounds. 6. Demonstrate an awareness of and concern for high ethical standards in business research, education, and service. 7. Demonstrate your competence to teach college-level courses in your field of expertise.
Program Outcome	<ol style="list-style-type: none"> 1. Demonstrate a thorough understanding of a substantial body of knowledge with expertise that is at the forefront of an academic discipline or area of professional practice. 2. Demonstrate awareness of the limitations of one's own work and discipline, the complexity of knowledge, and the potential contributions of other interpretations, methods, and disciplines. 3. Awareness of the complexity of knowledge and of the potential contributions of other interpretations, methods, and disciplines. 4. Conceptualize, design and implement advanced level research for the generation of new knowledge, applications, or understanding. 5. Demonstrate personal accountability, initiative, and decision-making in complex situations.

Program Specific Outcomes	<ol style="list-style-type: none"> 1. Following admittance, every researcher may conduct his or her study using appropriate research methodologies and direction. 2. A researcher may finish his Ph.D. research work in a set amount of time (usually three years) and be granted a Doctor of Philosophy degree once his work has been evaluated. 3. This kind of thesis may be classified as a work of intellect. It might also have significant literary significance. 4. Any language or any literature is asses by such a unique research work. 5. It becomes a distinct consequence for every researcher to obtain a Ph.D. degree.
Medium of Instruction	English

**DEPARTMENT OF PHYSICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY SURAT -395007**

Faculty Code: **SCI**Subject (Paper) Code: **PH**Name of Program: **Ph.D.**Subject: **Physics**Course (Paper) Name & No.: Paper-I: **PH-601 RESEARCH METHODOLOGY**Course (paper) Unique Code: **PAPER-I : PH-601**External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	Core	04	50	50	---	100

Course Objectives:	<ul style="list-style-type: none"> • To understand some basic concepts of research and its methodologies. • To identify appropriate research topics. • To identify the overall process of designing a research study.
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PH-601: Research Methodology

- UNIT: 1** Research Methodology: An Introduction, meaning, objectives and purpose of research. Types of research, significance and characteristics of research, criteria of good research, Research Methods and methodology, scientific methods, Distinction to scientific Methods.
- UNIT: 2** Research process and problems, Research design, Concepts and type of research design, important of Experimental design and limitation of research. Data collection and its Analysis.
- UNIT: 3** Report writing, Structure of scientific report, Types of report, Significance of the report, characteristics of report, report heading and body of the report, References/Bibliography.
- UNIT: 4** Research evaluation methods, various index (h-index, I-index, etc....) index and abstracting service and their calculations. Plagiarism, its significance and effects. Components of IPR, Patent Laws.

Recommended Books

- (1) Research Methods of Science, Michael M. Marda, First Edition, (2011), Cambridge University Press, New York.
- (2) Research Methodology, C.C. Kothari and Gourav Garg, Third Edition, (2014), New Age International Publication, Delhi.
- (3) Probability and Error for Physical Science, S.K. Muthu Orient Lougman, (1982).
Research Methodology, Dr. P.R. Majhi and Dr. P.K. Khatua Himalaya Publication House.

Course Outcomes: Having completed this course, the learner will be able to	
1.	Demonstrate the ability to choose methods appropriate to research aims and objectives. Learn about research methods, their criteria and problems.
2.	To learn about journals and patents. To understand monographs and treatises on specific areas and to grab information about Literature search, citation index and locate journals.
3.	To understand general aspects of research article writing. To learn about publishing, manuscript writing and importance of the author and how the reviewer interprets the article. To know about poster presentation and how to present it.
4.	To learn the importance and significance of laboratory safety and proper regulation of laboratory

**DEPARTMENT OF PHYSICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY
SURAT -395007**

Faculty Code: **SCI**Subject (Paper) Code: **PH**Name of Program: **Ph.D.**Subject: **Physics**

Course (Paper) Name & No.: Paper-II: **PH-602 : Numerical & Computational
Techniques**

Course (paper) Unique Code: **PAPER-II: PH-602**External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	Core	04	50	50	----	100

Course Objectives:	<ul style="list-style-type: none"> • To expose the Students with the theoretical concepts of Research • To expose the Students with various mathematical methods for numerical analysis and use of computational tools
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PH-602: Numerical & Computational Techniques

- UNIT-I:**
- Curve-Fitting:** Least-square Methods, Spline Methods.
Integration: Simpson's 1/3rd rule, Romberg integration, Richardson extrapolation techniques.
Ordinary Differential equation: Euler method, 2nd and 4th order Runge-Kutta Methods.
- UNIT-II:**
- Computer Programming:** Review of FORTRAN-77 through problems.
Introduction to FORTRAN-90: additional features different from FORTRAN 77.
Introduction to parallel computing: Essentials of parallel computation; need for high speed computing and parallel computers.
Introduction to FORTRAN-95: features for parallel computing, FORALL. Etc.

UNIT: III Software Package: Mathematica

Introduction: Notebook Interfaces, Text-Based Interfaces

Numerical calculations: Arithmetic, Exact and Approximate Results, Some Mathematical Functions, Arbitrary-Precision Calculations, Complex Numbers, Getting Used to Mathematica, Mathematical Notation in Notebooks

Algebraic calculations: Symbolic Computation, Values for Symbols, Transforming Algebraic Expressions, Simplifying Algebraic Expressions, Advanced Topic: Putting Expressions into Different Forms, Advanced Topic: Simplifying with Assumptions, Picking out Pieces of Algebraic Expressions, Controlling the Display of Large Expressions, The Limits of Mathematica, Using Symbols to Tag Objects

Symbolic mathematics: Basic Operations, Differentiation, Integration, Sums and Products, Equations, Relational and Logical Operators, Solving Equations, Inequalities, Differential Equations, Power Series, Limits, Integral Transforms, Recurrence Equations, Packages for Symbolic Mathematics, Advanced Topic: Generic and Non-Generic Cases, Mathematical Notation in Notebooks

Numerical mathematics: Basic Operations, Numerical Sums, Products and Integrals, Numerical Equation Solving, Numerical Differential Equations, Numerical Optimization, Manipulating Numerical Data, Statistics

UNIT: IV

Spreadsheets/Worksheets packages: SIGMAPLOT

Introduction: SigmaPlot at a Glance, New Features in SigmaPlot, Installing SigmaPlot, SigmaPlot Basics, Viewing Toolbars, Positioning Toolbars, Undoing Mistakes, Anatomy of SigmaPlotGgraphs, SigmaPlot Help

Notebook Manager Basics:

Notebook Manager Overview, Opening and Closing Notebooks in the Notebook, Manager Protecting Notebooks, Setting a Password, Working with Sections in the Notebook Manager, Creating New Items in the Notebook Manager, Opening Files in the Notebook Manager

Worksheet Basics: Using the Worksheet Shortcut Menu, Setting Worksheet Display Options, Moving Around the Worksheet, Entering Data into a SigmaPlot Worksheet, Importing Files from Other Applications, Exporting Worksheet Data, Descriptive Statistics for Worksheets, Displaying Worksheet Data, Formatting Worksheets, Cutting, Copying, Pasting, Moving, and Deleting Data, Entering and Promoting Column and Row Titles, Removing Outliers and Other Data, Using Excel Workbooks in SigmaPlot, Additional Features With Excel, Excel Toolbars, Using Transforms on Data in Excel Workbooks, Printing Worksheets, Configuring Printer Settings

Recommended Books:

- (1) S.C. Chapra, R.P. Canale, Numerical methods for Engineers, 5th ed.,(2006), McGraw Hill
- (2) K. SankarRao, Numerical Methods for Scientists and Engineers, (2001), PHI
- (3) V. Rajaraman, Computer Programming in FORTRAN 77, 3rded, (1994), PHI
- (4) V. Rajaraman, Computer Programming in FORTRAN 90 and 95, (1994), PHI
- (5) V. Rajaraman and C Siva Ram Murthy, Parallel Computers: Architecture and Programming, (2004), PHI
- (6) S. Wolfram, Mathematica book, 5th ed. (2003).
- (7) SIGMAPLOT 11.0 users guide, systat software, inc, (2008).

DEPARTMENT OF PHYSICS,

VEER NARMAD SOUTH GUJARAT UNIVERSITY SURAT -395007

Faculty Code: **SCI**Subject (Paper) Code: **PH**Name of Program: **Ph.D.**Subject: **Physics**

Course (Paper) Name & No.: Elective-I: **PH-603(M) : Advanced Materials
Science**

Course (paper) Unique Code: **ELECTIVE-I : PH-603(M)**External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	Core	04	50	50	----	100

Course Objectives:	<ul style="list-style-type: none"> • Introducing thrust areas of research of the Department • Fundamental course on prerequisites for higher studies in Materials Science,
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ELECTIVE –I : PH-603 (M) Advanced Materials Science

- Unit –I** Materials Science and Civilization, Classification of Engineering Materials, Modern materials needs, Metals and Alloys, Semiconductors, Ceramics, Composites, Quantum Dots, Spintronics, Nanomaterials, Biomaterials, Biophysics, Origin and Evolution of life – Prebiotic Earth, Theories of origin and Evolution of Life, Laboratory Experiments of the Formation of Molecular.
- Unit –II** Phase Diagram, Basic concepts, one component diagrams, two component diagrams, Solid Solution Phase Diagrams, Eutectic Phase Diagrams, Peritectic Phase Diagrams, Multicomponent diagrams, Spinodal Curves, Practical aspects of Phase diagrams, Applications of phase diagrams, Applications of Phase Diagrams
- Unit –III** Surface of Crystalline Solids, General features observable on surface, Techniques for the observation of surface, Growth spirals and hillocks. Growth patterns due to dislocations, movement of dislocations, Micromorphology of anisotropic opposite facets. Dissolution Process, Surface Morphology of crystalline materials
- Unit –IV** Mechanism of Solidification of Metals, Nucleation, Crystal Growth, Dendrite Growth, Effects of Super cooling or under cooling on critical Radius of Nuclear, Solid Solutions, Hume Ruther's Rule,

Reference Books:

- (1) S.K. Kakani, AmitKakani
Materials Science – New Age International Publishers (2005)
- (2) V. Raghavan, Materials Science and Engineering. A First Course (Fifth Edition)
Prentice- Hall of India Publisher – New Delhi (2005)
- (3) Manes Ghande, Science and Engineering Materials Vol.3
McMillian Publisher, India (1980)
- (4) Materials Science – An Intermediate Text – William F. Hosford
Cambridge University Press. First Edition (2007)
- (5) Materials Science and Metallurgy U.C. Jindal,
Pearson, Dorling Kindersely (India) Ltd, First Impresion (2012)
- (6) Biophysics – VasanthaPattabhai, N. Gautham, Narosa Publishing House, First Reprint
(2003)
- (7) KeshraSangwal and RafaelRodrials Trans Tech Publications.
- (9) Material Science and Metallurgy, Parashivamurthy K.I.(2012), Pearson
DoringKindersely (India) Pvt.Ltd. First Impression

**DEPARTMENT OF PHYSICS,
VEER NARMAD SOUTH GUJARAT UNIVERSITY
SURAT -395007**

Faculty Code: **SCI**Subject (Paper) Code: **PH**Name of Program: **Ph.D.**Subject: **Physics**

Course (Paper) Name & No.: **Elective-II: PH-603(T): Theoretical Condensed Matter
Physics and Nuclear Collision
Theory**

Course (paper) Unique Code: **ELECTIVE-II: PH-603 (T)**External Examination Time Duration: **02 Hours**

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	Core	04	50	50	----	100

Course Objectives:	<ul style="list-style-type: none"> • Introducing thrust areas of research of the Department • Fundamental course on prerequisites for higher studies in Theoretical Physics
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ELECTIVE -II

**PH-603(T): Theoretical Condensed Matter Physics and Nuclear
Collision Theory**

UNIT: I Density Functional Theory (DFT)

Examples of DFT in Action: Ammonia Synthesis by Heterogeneous Catalysis, Embrittlement of Metals by Trace Impurities, Materials Properties for Modelling Planetary Formation, The Schrodinger Equation, Density Functional Theory—From Wave Functions to Electron Density Exchange–Correlation Functional, Localized and Spatially Extended Functions, Wave-Function-Based Methods, Hartree–Fock Method, Beyond Hartree–Fock, What DFT cannot do, Density Functional Theory in Other Fields,

Periodic Structures, Supercells, and Lattice Parameters, Face-Centered Cubic Materials, Hexagonal Close-Packed Materials, Crystal Structure Prediction, Phase Transformations

UNIT: II DFT Calculations

Reciprocal Space and k Points: Plane Waves and the Brillouin Zone, Integrals in k Space, Choosing k Points in the Brillouin Zone, Metals—Special Cases in k Space, Energy Cutoffs: Pseudopotentials, Numerical Optimization: Optimization in One Dimension, Optimization in More than One Dimension, What we really need to know about Optimization, DFT Total Energies—An Iterative Optimization Problem Geometry Optimization, Geometry Optimization with Constrained Atoms, Optimizing Supercell Volume and Shape

Importance of Surfaces, Periodic Boundary Conditions and Slab Models, Choosing k Points for Surface Calculations, Classification of Surfaces by Miller Indices, Surface Relaxation, Calculation of Surface Energies, Symmetric and asymmetric Slab Models, Surface Reconstruction, Adsorbates on Surfaces, Accuracy of Adsorption Energies, Effects of Surface Coverage

UNIT: III Introduction of Heavy Ion Collisions Introduction of Heavy ion induced reactions. Classification of Heavy Ion Collisions: Elastic and Inelastic scattering, Nucleon Transfer reactions, Fusion of Heavy Ions.

UNIT: IV Heavy Ion Collision Theory: Heavy-ion potentials, Compound Nuclear Formation in Heavy Ion Collisions, Different Models for Heavy Ion Collisions simulation and calculations: Time dependent HartreeFock Coupled Channel Methods, Classical and semi classical methods.

Text Book:

- (1) Density Functional Theory: A Practical Introduction by David S Sholl and Janice A Steckel
- (2) Nuclear Physics-Experimental and Theoretical, H. S. Hans, New Age International Pub. 2001
- (3) The Nuclear Many-Body Problem, Peter Ring and Peter Schuck, Text and Monographs in Physics, Springer-Verlag.

Reference Book:

- (1) Density Functional Theory of atoms and Molecules by Robert G Parr and Weitao Yang
- (2) Materials Modelling using Density Functional Theory: Properties and Predictions by Feliciano Giustino
- (3) Proc. Of the Winter College on Fundamental Nuclear Physics, Vol. 2, Ed. K Dietrich, M. Di. Toro, H. J. Mang, World Scientific (1985).
- (4) Heavy Ions and Nuclear Structure, ed. B. Sikora and Z. Wilhelmi, Harwood Academic Pub. (1981).
- (5) Treatise on Heavy-ion Science, Vol. 3, Ed. D. A. Bromley, Plenum Press, NY (1984).

DEPARTMENT OF PHYSICS,

VEER NARMAD SOUTH GUJARAT UNIVERSITY SURAT -395007

Faculty Code: SCI

Subject (Paper) Code: PH

Name of Program: Ph.D.

Subject: Physics

Course (Paper) Name & No.: Elective-III: PH-603(E) Thin Film, Microelectronics,
Linear IC, Microcontroller
And Embedded Systems

Course (paper) Unique Code: ELECTIVE-III : PH-603 (E)

External Examination Time Duration: 02 Hours

Name of Exam	Course Group	Credit	Internal Assessment: Assignment	External Marks	Practical / Viva Marks	Total Marks
Ph.D.	Core	04	50	50	---	100

Course Objectives:	<ul style="list-style-type: none"> • Introducing thrust areas of research of the Department • Fundamental course on prerequisites for higher studies in Electronics
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ELECTIVE -III

PH-603(E): Thin Film, Microelectronics, Linear IC, Microcontroller and Embedded Systems

- Unit-1** Gas flow vacuum system, Vacuum Pump (rotary, Diffusion) Gauges (Pirani, ionization etc.), Theories of Nucleation, Growth Processes, Physical and Crystallography structure of films, and epitaxial growth. Basic device technology, and approximate doping profile across p-n junction, Metal-semiconductor contacts, solar cell, LED and semiconductor Laser
- Unit-2** Device Technologies, NMOS, CMOS, ECL, BIFET, BICMOS, BIMOS, CCD, I²L Technologies, Monolithic Integrated Circuit Fabrication.

- Unit-3** Applications of linear Integrated Circuits:
PLL and its applications, Positive and Negative voltage regulators, IC LM series adjustable voltage regulators, LM 380 Power Amplifier, IC 8038 function generator. Binary weighted type DAC, R-2R ladder type DAC Parallel Comparator type ADC, successive approximation type ADC, counter type ADC, Dual slop type ADC.
- Unit-4** Comparison of microprocessor and microcontroller, 8051-Architecture, Special Function Registers, Microcontroller programming model, Instruction set, Data transfer Instructions and related Assembly language programs.

Books:

- (1) Vacuum Science and Technology V.V.Rao, T.B.Ghosh and K.I.Chopra, Allied Publishers Limited (India).
- (2) Vacuum Technology, A. Roth, North-Holland, (1986).
- (3) "Hand book of thin film technology" L.I.Maissel and R.I.Glang, McGraw Hill Book Co. New York, (1970).
- (4) "The Material Science of Thin Films" M. ohring, Academic press, New York (1992).
- (5) Hand Book technologies of Films and Coatings, R.F.Bunshah, Novyes publication, (1996).
- (6) Microelectronics J.Millman and A.Gable, McGraw Hills Publication (1987).
- (7) Ramakant Gayakwad, Operational amplifier and integrated circuits by PHI learning Publishing Company (2004).
- (8) Kenneth J. Ayeala, The 8051 microcontroller, Architecture, programming and application, Penram International publishing (I) Pvt. Ltd.
- (9) M.A. Mazidi, Microcontroller and Embedded Systems, Pearson India Publishing Company,