SYLLABUS

OF

M. PHIL. **PHYSICS**

CHOICE BASED CREDIT SYSTEM (CBCS)

Revised as per Ministry of Human Resource Development, UGC New Delhi, Notification 5th May, 2016, (Minimum Standards and Procedure for award of M.Phil. / Ph.D. Degrees) Regulation – 2016

Accredited Grade 'A' by NAAC

DEPARTMENT OF PHYSICS
SAURASHTRA UNIVERSITY
RAJKOT – 360 005

M. PHIL. PROGRAMME IN PHYSICS

Effective from July 2018

1. The M. Phil. Programme in Physics and its syllabus of the Department of Physics, Saurashtra University is now revised as per the Ministry of Human Resource Development, UGC New Delhi, Notification 5th May, 2016, (Minimum Standards and Procedure for award of M.Phil. / Ph.D. Degrees) Regulation – 2016 (SU Ordinance Circular No. PGTR/PhD/1/254/2017, dated 25-1-2017)
2. M.Phil. Programme shall be for a duration of two (2) consecutive semesters / one year and a maximum of four (4) consecutive semesters / two years
3. The eligibility criteria , admission process, number of intake and all other details of this programme will be as per above Circular No. PGTR/PhD/1/254/2017, dated 25-1-2017
4. The M. Phil. research work for Dissertation / Thesis will be spread over all the semesters as prescribed in the Circular. Though the Dissertation work will commence in the beginning, it will be submitted after successful completion the course work and at the end of the M.Phil. programme.
5. M.Phil. Scholars shall present at least one (1) research paper in a conference / seminar before the submission of the dissertation/thesis for adjudication, and produce evidence for the same in the form of presentation certificate/reprints
6. The M.Phil. Dissertation submitted by a scholar shall be evaluated by his/her Research Supervisor and at least one external examiner who are not in the employment of the same University/College. The panel of the examiners shall consist of four Experts suggested by the research supervisor of which one shall be nominated by the Vice-Chancellor to evaluate dissertation. After receiving the acceptance of the dissertation for the award of M.Phil. degree from external examiner and the research supervisor, the open Viva-voce examination shall be conducted by the Research Supervisor and the external examiner.
7. The Marks for M.Phil. Dissertation will be jointly given by the Research Supervisor and the external examiner after completion of the viva-voce.

   Dissertation: out of 100 + Viva-voce : out of 100

   Total marks for dissertation: out of 200

Course work:

8. The M.Phil. course work credit shall be 08 which will be distributed as follows:

Total credit for the course work: 08

(i)	A course covering research methodology, computer applications , research ethics, writing research paper and research proposal , review of published research work in the relevant field	03 CREDIT	Assignment Marks Out of 100
(ii)	Essential experimental techniques in materials science and/or space & atmospheric physics	03 CREDIT	Assignment Marks Out of 100

(iii)	Laboratory training, library work/literature survey and preparation of assignments	02	Total Marks: 200

9. The students will submit assignment in each of the above theory paper in the form of detailed essay on any one topic giving relevant references. A student is required to score **minimum 55% of marks i.e. minimum 110 marks out of total marks 200** for successful completion of the course work. The assignments will be assessed by their respective dissertation supervisors
10. The mode of training shall include expert lectures/laboratory work and training/review of published research in the relevant field/data analysis/preparation of assignments and counselling in consultation with the dissertation supervisors. All these modes of training hours shall contribute to the earning of credits by the students for both the papers mentioned above.

11. The students shall take the course work during two semesters M.Phil. programme. Upon successful completion of the course work, the M.Phil. students shall be eligible to submit his/her dissertation.

The course structure of M.Phil. (PHYSICS) Programme (CBCS) to be implemented from July 2018

SEMESTER-1

COURSE	No. of hrs per week	Credits	TOTAL MARKS
Paper-1: Research Methodology in Physics	**04**	**04**	**100**
Laboratory Work & Dissertation: Part-1	**24**	**08**	**NIL** *
TOTAL:	**28**	**12**	**100**

SEMESTER-2

COURSE	No. of hrs per week	Credits	TOTAL
Paper-2: Advances in Physics	**04**	**04**	**100**
Laboratory Work & Dissertation: Part-2	**24**	**08**	**200**
TOTAL:	**28**	**12**	**300**

M.Phil. Programme:

- **Total marks: 400**

- **Credits: 24 (Excluding Course work)**
- **Credit: Course work: 08**

FACULTY OF SCIENCE

Syllabus

Faculty Code: 03 Subject (Paper) Code: RMP-1 Level Code: 03

Name of Programme: **M.Phil.**

Subject: **PHYSICS**

Course (Paper) Name & No.: **RESEARCH METHODOLOGY IN PHYSICS : PAPER-1**

Course (paper) Unique Code : **1603010103010100**

University Examination Time Duration: **3 hours**

Name of Exam	Semester	Course Group	Credit	Total marks
M.Phil.	1	Core	04	100

Course Objectives:

- Strengthening Foundations of research methodology in the subject of Physics
- Introducing thrust areas of research of the Department
- Fundamental course on prerequisites for higher studies in materials science and Space Physics

Course Content:

M.Phil (Physics) Semester – 1

Paper – 1: Research methodology in Physics

Credits:04 **Teaching Hours: 48**

Unit-1

Superconductivity

Historical background, Definition of superconductivity, Occurrence of superconductivity, characteristics of a superconductor-Meissner effect, Zero resistance, heat capacity, isotope effect, Critical magnetic field and critical current density, Type -I and type - II superconductors, Coherence length, Penetration depth, Families of conventional superconductors

Unit-2

CMR Manganites

Definition of Magnetoresistance (MR) and Types of MR, CMR Effects in Manganites
Structure of Manganites, Parameters and Effects in CMR Manganites,
Tolerance Factor (t), Size Variance ($\sigma 2$), Carrier Density (x)
Zener Double Exchange (ZDE) Mechanism, Jahn-Teller (JT) Effect
Properties of CMR Manganites, Electronic Structure, Transport and Magnetotransport
Charge and Orbital Ordering (CO and OO), Applications of Manganites

Unit-3

Essential Characterization techniques in Materials science

Fundamentals of X-ray diffraction, Powder X-ray diffractometry, Lattice parameter determination for cubic crystals, structure-factor calculation with examples, EDAX, Neutron Diffraction technique, TGA-DSC, Infrared Spectroscopy and FTIR, Particle size determination by dynamic light scattering and powder-XRD

Unit-4

Magnetic and electrical measurements
B-H loop tracer, Susceptibility measurements, Pulsed field magnetometer, vibrating sample magnetometer
Electrical resistivity measurements, two and four point probe measurement techniques, Dielectric measurements: Frequency dependence, dielectric loss, Ferroelectricity and P-E Loop

Unit-5

Experimental Techniques in Atmospheric and Ionospheric Research

Radiowaves in an ionized medium and radio propagation techniques Ionosonde, Ionogram and its interpretation, Absorption measurement techniques, Radars, incoherent and coherent backscatter radars, Trans ionospheric radio propagation, Faraday rotation and scintillation techniques, optical techniques (Air glow photometer), TEC measurements
Atmospheric aerosols: their properties, techniques of monitoring aerosol mass & size Distributions

Text and Reference Books

1. Elements of X-Ray diffraction
   B,D,Cullity , Addision Wisely
2. Magnetism and Balsalts,
   CRK Murty, GSI Bangalore, 1993.
3. Introduction to magnetic materials
   B D Culity, Addison Wesley Publishing Co. 1972
4. Semiconductor measurements and instrumentation
   W R Ranyan Mc Graw Hill ISE
5. Introduction to Ionosphere and Magnetosphere
   J. A. Ratcliffe CUP (1972)
6. The Solar terrestrial Enviornment
   J.K Hargrover CUP (1992)
7. Physics and chemistry of the upper Atmosphere
   M. H. Rees CUP (1980)
8. Ionospheric techniques and phenomena
   G.M. Petit D Riedel Publishing Co (1978)
9. Radars for Atmospheric research
   Rottger D Riedel Publishing Co (1990)
10. “VaK”- Saurashtra University Research Journal, Vol.4, Year 2009
11. Science for engineering Materials
    C.M. Srivastava and C. Srinivasan, John Wiley & Sons Publications
12. Introduction to Solid State Physics, 8th Edition
    C.Kittel Addision Wisely
13. Colossal Magnetoresistance, Charge Ordering and Related Properties of Manganese Oxides. C.N.R. Rao, World Scientific, Singapore (1998)
14. Nano Scale Phase Separation and Colossal Magnetoresistance (Physics of Manganites) E. Dagotto, Springer (2002)

FACULTY OF SCIENCE

Syllabus

Faculty Code: **03** Subject (Paper) Code**: AIP-2** Level Code: **03**

Name of Programme: **M.Phil.**

Subject: **PHYSICS**

Course (Paper) Name & No.**: ADVANCES IN PHYSICS** : **PAPER-2**

Course (paper) Unique Code : **1603010203020200**

University Examination Time Duration: **3 hours**

Name of Exam	Semester	Course Group	Credit	Total marks
M.Phil.	2	Core	04	100

Course Objectives:

- Strengthening Foundations of research methodology in the subject of Physics
- Introducing thrust areas of research of the Department
- Fundamental course on prerequisites for higher studies in materials science and Space Physics

Course Content:

M.Phil (Physics) Semester – 2

Paper – 2: ADVANCES IN PHYSICS

Credits:04 **Teaching Hours:48**

Unit-1

High-T_C Oxide Superconductivity

Different families of HTSC compounds, Structural features of YBa2Cu3Oz(1-2-3) superconductors, Role of Yttrium, Barium and Copper sites, Role of Oxygen, Synthesis methods of HTSC compounds, Substitutional studies in 1-2-3 superconductors. Structural characterization of 1-2-3 compounds using XRD, Electrical & Thermal properties of 1-2-3 compounds using resistivity, thermoelectric power and specific heat studies. Determination of
critical current density Jc of HTSC material by magnetic measurements, Concept of “hole filling”, “pair breaking” and “hole doping” mechanisms

Unit-2

Manganite Thin Films, Heterostructures and Devices

Introduction,,Synthesis Techniques, Pulsed Laser Deposition (PLD)
Chemical Solution Deposition (CSD),Sputtering, Thin Films,Structure and Morphology
Strain Effects (Interface Effects),Grain Boundary Effects (Surface Effects)
Heterostructures and Devices, Low and High Field MR
Tunneling Magnetotransport, Spin Polarized Tunneling (SPT)
Spin Dependent Scattering (SDS), Applications

Unit-3

Spinel Oxides

Oxide spinels, synthesis of polycrystalline materials, fine particle oxide materials, spinel structure, oxygen parameter, nearest neighbours, mixed ferrites, example of Ni-Zn ferrites, Variation of saturation magnetization with zinc content, Neel’s model, Yafet Kittel model , Swift heavy ion irradiation of Ferrites
X-ray diffractometry of ferrites, cell parameter determination, distribution of cation in interstitial sites, X- ray density, effect of particle size on XRD lines
Mössbauer spectroscopy of ferrites, introduction to Mössbauer effect and instrumentation, Hyperfine interactions, 57Fe Mössbauer spectroscopy, Intensity distribution, combined magnetic and electric hyperfine interaction

Unit-4

Crystal growth

Melt growth. Czochralski method. Bridgman method. Zone refining method. Solution growth Aqueous solution growth molten salt growth Hydrothermal growth. Growth from vapour phase. Reversible reactions and irreversible reactions
Non-linear optical effect: Basic theoty of NLO effect, applications of NLO materials, various NLO-parameters, NLO materials: crystals, inorganic, organic and semi-organic crystals

Unit-5

Atmospheric and Ionospheric Physics

Nomenclature of atmospheric vertical structure, Hydrostatic equilibrium, the exosphere, Gaseous escape, heat balance and vertical temperature profile, Heat transport, composition major species, water vapour, nitric oxide, atmospheric ozone
Photo ionization : Chapman's production function, ionization by energetic particles, loss processes, vertical transport diffusion chemical aeronomy of E and F1 regions f2 region processes and protonosphere D region; Airglow

Text and Reference Books

1. Oxide magnetic materials
   K J Standley, Clarendon press, Oxford
2. Mössbauer effect and applications
   V G Bhide, TMH 1973
3. The direct observations of dislocations
   Amelinckx, Academic press (1964)
4. "Crystal Growth - A tutorial Approach"
   Editors W Bardsky , D.T.J Hurle and J.B. Mullin.
   North Holland Publishing Co.
5. Introduction to Ionosphere and Magnetosphere
   J. A. Ratcliffe CUP (1972)
6. The solar terrestrial Environment
   J.K Hargrover CUP (1992)
7. Physics and chemistry of the upper Atmosphere
   M. H. Rees CUP (1980)
8. Ionospheric techniques and phenomena
   G.M. Petit, D Riedel Publishing Co (1978)
9. Radars for Atmospheric research
   Rottger, D Riedel Publishing Co (1990)
10. "VaK"- Saurashtra University Research Journal, Vol.4, Year 2009
11. CMR Manganites: Physics, Thin Films and Devices, A-M Haghiri-Gosnet and J-P Renard, Topical Review, J. Phys. D: Appl. Phys. 36 (2003) R127–R150
12. Ferromagnetic Manganites: Spin-Polarized Conduction versus Competing Interactions, Kathrin Dorr, Topical Review, J. Phys. D: Appl. Phys. 39 (2006) R125–R150
13. Spin Dependent Transport and Low Field Magnetoresistance in Doped Manganites,
14. J.Z. Sun and A. Gupta, Annu. Rev. Mater. Sci. 28 (1998) 45–78