SADAKATHULLAH APPA COLLEGE

(AUTONOMOUS)

(Reaccredited by NAAC at an 'A' Grade with a CGPA of 3.40 out of 4.00 in the III cycle An ISO 9001:2008 Certified Institution)

RAHMATH NAGAR, TIRUNELVELI- 11.

Tamilnadu

PG AND RESEARCH DEPARTMENT OF PHYSICS

(Unaided)

MY LORD
VOUCHSAFE ME WISDOM

CBCS SYLLABUS

For

M.Phil. PHYSICS

(Applicable for students admitted in June 2017 and onwards)

(As per the Resolutions of the Academic Council Meeting held on 27.02.2017)

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SADAKATHULLAH APPA COLLEGE (AUTONOMOUS)

PG AND RESEARCH DEPARTMENT OF PHYSICS

M.Phil. Physics Syllabus (2017 - 2020)

(Applicable for students admitted in June 2017 and onwards)

COURSE STRUCTURE

S.No	Semester	Status of the Paper	Title of the Paper	Credit	H/W	Internal Marks	External Marks	Total	Marks				
									Maximum marks			Passing minimum	
									I	E	T	E	T
1	I	Core 1	Research Methodology	6	6	25	75	100	25	75	100	38	50
2	I	Core 2	Advanced Physics	6	6	25	75	100	25	75	100	38	50
3	I	Project	Preliminary Work	-	18	-	-	-	-	-	-	-	-
Total				**12**	**30**								
4	II	Elective	A. Nano Physics B. Physics of Materials C. Growth and Characterization of crystals	6	6	25	75	100	25	75	100	38	50
5	II	Project	Dissertation and Viva -voce	12	24	---	200	200	---	200	200		100
Total				**18**	**30**			**500**			**500**		**250**

Eligibility Norms : 55% marks in M.Sc., degree in Physics/ Applied Physics/ Bio Physics/ Material Science / any other equivalent master degree. For SC/ST candidates there will be 5% relaxation in marks.

Course Objectives: To provide students an opportunity to acquire or develop skills and expertise relevant to their research interests and to pursue research activities/ professional placements.

M. Phil. PHYSICS SYLLABUS (2017 - 2020)

(Applicable for students admitted in June 2017 and onwards)

I SEMESTER (2017 - 2020)		
C1	**RESEARCH METHODOLOGY**	**15MPHC11**
Hrs/Week: 6	**Hrs/ Sem: 90**	**Credits: 6**

Objective: To impart the knowledge on systems of equation, probability statistics, error analysis and programming concepts.

UNIT - 1: RESEARCH METHODOLOGY (22 Hrs)

Scientific research - Need and methods of research - Identification of research theme and problem - Literature survey - Current status – Collection of references - Abstraction of a research paper - Role of research supervisor and scholar - Drawing inferences from data – Actual investigation of data – Qualitative and Quantitative analysis of data - Results and Conclusions.

UNIT - 2: TOOLS FOR RESEARCH (12 Hrs)

Internet and its applications – inflibnet - e-journals - e-books - Power Point Presentation - Multimedia techniques in presenting a scientific paper in a seminar.

UNIT - 3: ART OF SCIENTIFIC REPORT WRITING (12 Hrs)

Scientific report writing – Significance – Art of writing a scientific paper, synopsis and thesis - General formation - Footnotes - Tables and figures - Referencing - Appendices - Review process - Editing and evaluation.

UNIT - 4: NUMERICAL METHODS (22 Hrs)

Curve fitting- Least squares method- Interpolation- Newton's forward and backward difference formulae - Numerical differentiation and integration: Trapezoidal rule, Simpson's rule and Monte-Carlo methods- Range-Kutta method: 2^{nd} and 4^{th} order - Simultaneous first order and second order differential equations – Eigen value problem.

UNIT- 5: MATHEMATICAL METHODS (22 Hrs)

Special functions: Generating function, Orthogonality, Recurrence relations for Legendre and Bessel functions - Laplace Transforms -Approximation methods and errors: Truncation and round off errors - Accuracy and precision.

REFERENCE BOOKS:

1. S. Rajasekar, P. Philominathan and V. Chinnathambi, "Physics" ed - ph 25, Jan 2006.
2. C.R. Kothari "Research Methodology Methods and Techniques", (New Age International Publishers, New Delhi), 2004.
3. J. Anderson, B.H. Durstan and M. Phoole "Thesis and Assignment Writing", (Willey Eastern New Delhi), 1977.
4. J.B. Scarborough "Numerical Mathematical Analysis", (Oxford and IBH), 1971.
5. H.K. Dass, "Mathematical Physics", (S. Chand and company, New Delhi), 1997.
6. P. Devadas, "A Hand book of Research Methodology" - SRK Press.
7. K.P.N. Murthy, "Monte - Carlo Methods" - University Press, 2004.
8. P. Rajammal and P. Devadass, "A Hand Book of Methodology of Research", R.M.M Vidya Press, 1976.

I SEMESTER (2017 - 2020)		
C2	**ADVANCED PHYSICS**	**15MPHC12**
Hrs/Week: 6	**Hrs/ Sem: 90**	**Credits: 6**

Objective:

- To impart knowledge on theoretical aspects and the applications of Superconductors, Nanomaterials, Thin Films and Nuclear Physics.
- To make them to understand the various necessary techniques used for analyzing the materials.

UNIT - 1: HIGH TEMPERATURE SUPERCONDUCTORS (18 Hrs)

Introduction - Y-123 superconductors and substitution at Y-Sites - Bi-based superconductors - Types - Synthesis methods - Solid state reaction method- Characterization- Crystal structure- Effect of oxygen vacancy ordering- Physical properties- Applications.

UNIT - 2: NANOMATERIALS (14 Hrs)

Introduction- Quantum well - Wires- Dots - Fullerenes - Carbon nanotubes - Different methods of fabrication- Physical and Chemical methods - Characterisation - Effect of size on various physical properties- Applications.

UNIT - 3: THIN FILMS (18 Hrs)

Fundamentals and salient features- Different methods of preparation- Chemical Vapour Deposition (CVD): Solution growth - Spray pyrolysis - Electrochemical deposition - Physical Vapour Deposition (PVD): Thermal evaporation- Flash evaporation- Electron beam evaporation - Thickness measurement - Applications of thin films.

UNIT - 4: NUCLEAR PHYSICS (18 Hrs)

Nuclear models: Nilsson model - Collective model - Vibrational and Rotational contributions - Large Hadron collider - Introduction - Standard model - Prospects for Higgs Bosons.

UNIT - 5: CHARACTERIZATION TECHNIQUES (22 Hrs)

X-ray diffraction (XRD)- Particle size determination - Fourier Transform Infrared Spectroscopy (FTIR) – UV-Visible Spectroscopy - Raman Spectroscopy- Differential Thermal Analysis (DTA) - Differential Scanning Calorimetry (DSC) - Vibrating Sample Magnetometer (VSM) – D.C. Electrical conductivity measurements (Two Probe and Four Probe).

REFERENCE BOOKS:

1. S.V. Subramanyam and E.S.R Gopal, “High Temperature Superconductors”, Wiley Eastern Ltd. 1989.
2. G. Cao, “Nanostructures and Nano materials: Synthesis, Properties”, Imperial College Press, 2004.
3. A.K. Bandyopadhyay, “Nano Materials”, New International Publishers, New Delhi, First edition 2007.
4. A. Goswami, “Thin Film Fundamentals”, New Age International Pvt. Ltd, New Delhi, 2006.
5. Milton Ohring, “Materials Science of Thin Films”, Academic Press, Indian Edition 2006.
6. Bohr and Mottelson, “Nuclear Structure”, Volume 1, Benjamin Publications, London, 1975.
7. J.A. Belk Electron, “Microscopy and Micro Analysis of Crystalline Materials” - Applied Science Publishers, 1979.
8. B.D. Cullity, “Elements of X-ray diffraction”, Addison-Wesley, London, Second edition, 1977.

II SEMESTER (2017 - 2020)		
E A	**NANO PHYSICS**	**15MPHE2A**
Hrs/Week: 6	**Hrs/ Sem: 90**	**Credits: 6**

Objective: To make the students to understand the importance of Nanotechnology and the fundamental aspects of properties leading to technology.

UNIT - 1: QUANTUM CONCEPTS (10 Hrs)

Infinite and Finite wells - Low dimensional systems - Two and Three dimensional potential wells - Quantum well structure - Quantum dots and wires – Carbon nanotubes – Types.

UNIT - 2: SYNTHESIS METHODS (20 Hrs)

Introduction – Classification - Top-down and Bottom-up approaches - Physical techniques: Ball milling - Laser ablation - Physical Vapour Deposition (PVD) - Chemical techniques: sol-gel method - Co-precipitation method – Chemical Vapour Deposition (CVD) - Sonochemical method- Microwave assisted method – Gas-Phase Condensation method.

UNIT - 3: CHARACTERIZATION TECHNIQUES (20 Hrs)

X- ray diffraction analysis - Impedance analysis - Scanning Electron Microscopy (SEM) with Energy Dispersive Analysis of X-ray (EDAX) - Transmission Electron Microscopy (TEM) - High Resolution TEM - Atomic Force Microscopy (AFM).

UNIT - 4: BASIC PROPERTIES (20 Hrs)

Size effect on properties of nanomaterials- Influence of nanostructuring on mechanical, optical, electrical, electronic, magnetic and chemical properties - Grain size effects on strength of materials - Optical properties of quantum dots and wires - Electronic transport in quantum wires and carbon nanotubes.

UNIT - 5: APPLICATIONS (20 Hrs)

Basic principles and applications: Molecular and nanodevices – Nanodots - Molecular recognition - Quantum dot wells - Antimicrobial activity - Nanooptics - Nano DNA devices - Drug delivery system - Cancer treatment- nanosensors- Food and Cosmetic applications- CNT based transistors - Nanolithography.

REFERENCE BOOKS:

1. Koch C.C, "Nanostructures Materials processing, properties and potential applications", Andrew Publishing, Noyes, 2002.
2. Jackie Y. Ying, "Nanostructured Materials", Academic Press, USA, 2001.
3. Charles P. Voile Jr & Frank J. Owens, "Introductions to Nanotechnology", John Wiley and Sons (Asia) Pvt. Ltd., New Delhi, 2006.
4. D. Bimerg, M. Grundmannand N.N. Ledentsov, "Quantum Dot Heterostructures", John Wiley and sons, 1998.
5. T. Pradeep, "Nano: The Essential", Tata MC Grew – Hill Pvt. Ltd., New Delhi, 2007.
6. Willard, Merritt, Dean and Settle, "Instrumental Methods of Analysis", CBS Published Distributors, Delhi, 1986.
7. J. Ross, Macdonald, "Impedance Spectroscopy Emphasizing Solid Materials and Systems", New York, 1996.

II SEMESTER (2017 - 2020)		
E B	**PHYSICS OF MATERIALS**	**15MPHE2B**
Hrs/Week: 6	**Hrs/ Sem: 90**	**Credits: 6**

Objective: To teach the students about ceramic materials, polymeric materials and new materials.

UNIT- 1: PHASE DIAGRAMS & PHASE TRANSFORMATIONS (12 Hrs)

Solid solutions phase rule – Equilibrium and binary phase diagrams – Typical phase diagrams - Free energy and equilibrium phase diagram - Nucleation and growth – Kinetics - Martenstic transformation - Strengthening mechanism - Iron carbon system – Other typical systems.

UNIT- 2: MATERIALS AND PROPERTIES (20 Hrs)

Types of materials – conductors – Free electron theory – Semiconductors – Fabrication of integrated circuits – Magnetic materials and classification – Soft and Hard magnetic materials – Domain Structure and Hysteresis Loops – Dielectric materials – Temperature and frequency effects – Ferroelectric Materials – Properties – Mechanical Properties of materials – Stress-strain curve – Deformations – Fracture – Other properties of materials.

UNIT- 3: CERAMICS AND GLASSES (18 Hrs)

Structure of ceramics and glasses – Production: Raw materials, forming and post forming processes - Melting of glass, glass forming and annealing - Physical properties of ceramics and glasses -Wear and erosion resistance -Thermal shock - Silica Alumina system - commercial systems: Zirconia, sialones, cement and concrete – Ferrites and garnets – Ceramic superconductors.

UNIT - 4: POLYMERS AND PLASTICS (20 Hrs)

Molecular structure: monomers and polymers, synthesis, molecular weight measurement, branching and tacticity, copolymers and blend -Mechanics of polymer chain - Thermo plastic melts: Viscosity, shear thinning, processing, extrusion – Amorphous and

crystalline polymers - Cross-linked polymers: Elastomers and thermosets - Liquid crystal polymers - Mechanical properties: Stress - Strain behaviour- Chemical properties – Plastic – PVC – Fibres – Rubbers – Natural and synthetic – Leather.

UNIT - 5: CRYSTAL GROWTH AND DEFECTS (20 Hrs)

Types of crystals – Comparison of characteristics - Crystal growth from solution - Melt growth technique: Bridgeman method, Czochralski crystal pulling technique, crystal growth from vapour phase - crystal imperfections - Point defects: Vacancies, interstitials, impurities, electronic defects - Line defects: Dislocations- Types -Surface defects: Grain boundaries, Twin boundaries, Stacking faults - Volume defects: Cracks and voids – Creep.

REFERENCE BOOKS:

1. C. Anderson, K.D. Leaver, P.Leevers and R. V. Rowlings: "Materials science for Engineers", Nelson Thomas Ltd, First Indian Reprint, 2010.
2. M. Arumugam," Material Science", Anuradha agencies, Publishers, Second Edition, 2005.
3. V. Raghavan, "Materials science and Engineering", Prentice Hall of India Pvt. Ltd, New Delhi, IVth Edition, 2003.
4. Krishan Lal, "Synthesis, Crystal Growth & Characterization" - North-Holland, Amsterdam, 1982.
5. Reynolds and M.Pomeranty, "Electroresponsive molecules and polymeric systems" Ed. by Skotheim T. Marcel Dekker New York 1991.

II SEMESTER (2017 - 2020)		
E C	**GROWTH AND CHARCTERIZATION OF CRYSTALS**	**15MPHE2C**
Hrs/Week: 6	**Hrs/ Sem: 90**	**Credits: 6**

Objective: To expose the students with theories of nucleation & crystal growth, crystal growth by from solution, melt and vapour phase and their characterization.

UNIT - 1: NUCLEATION AND KINETICS OF CRYSTAL GROWTH (18 Hrs)

Theories of nucleation – Types - Classical theory of nucleation - heterogeneous nucleation - Singular and rough faces - Modes on surface roughness - Kossel, Stranski, Volmer (KSV) theory - Burton, Cabrera, Frank (BCF) theory - Periodic bond chain theory – Muller - Krumbhaar model.

UNIT - 2: MELT GROWTH (18 Hrs)

Growth from the melt - Bridgeman and related techniques - Crystal pulling - Convection in melts - Simulation of bulk crystal - Melt growth of oxide crystals - Czochralski technique - Zone melting technique - Skull melting process - Verneuil process - Heat exchanger method.

UNIT - 3: SOLUTION GROWTH (20 Hrs)

Low temperature solution growth - Crystal growth system - Non-linear phenomena in KDP family crystals - Solubility of KDP and ADP - Seed preparation - High temperature solution growth - Growth of potassium titanyl phosphate - Practical aspects.

UNIT - 4: MODERN CRYSTAL GROWTH (12 Hrs)

Vapour growth (physical and chemical) - Hydrothermal growth - Electro crystallization - Gel growth - Liquid crystals - Technology of Epitaxy - Practical aspects.

UNIT - 5: STRUCTURAL CHARACTERIZATION (22 Hrs)

Structural Characterization: Different probes for structure analysis – Single, double, triple and four crystal diffractometers - Determination of unit cell and space group – X-ray topography (XRT). Crystalline perfection: Volume, Area, Line and point defects - Threshold concentration of defects in crystals - Methods of detecting imperfections.

REFERENCE BOOKS

1. Dr. P. Santhanaraghavan and Dr. P. Ramasamy, "Crystal growth process and methods" KRU Pub, Kumbakonam, 2000.
2. J.C. Brice , " Crystal growth processes" John Wiley and sons, New York, 1986.
3. H.E. Buckley, "Crystal Growth" John Wiley and sons, New York, 1986.
4. J.Gilman, "The Art and Science of growing crystals", John Wiley and sons, New York, 1965.
5. M H Willard, L.L. Merritt, J.A. Dean, P.A. Settle, "Instrumental Methods of Analysis", (7th Edit.), CBS Publishers and Distributors, New Delhi, 1986.
6. Synthesis, Crystal growth and characterization – Krishan Lal, North- Holland, Amsterdam (1982)
7. X-ray diffraction – L.A. Azarof et al, McGraw Hill Book company (1974)
8. Elements of X-ray crystallography – L.Z. Azarof, Mc Grow- Hill Book company (1938)

II SEMESTER		
D	**DISSERTATION**	**15MPHD21**
Hrs/Week: 24	**Hrs/ Sem: 90**	**Credits: 12**

The following guidelines have to be followed by every candidate while preparing his/her M. Phil. Dissertation:

- The Dissertation should be typed in English.
- The first page, declaration and certificate of the dissertation should be according to the model given at the end of this.
- Dissertation text should be typed in LaTeX with size 12 / 13 on A4 size Executive bond quality paper with double line spacing. Each page should contain at least 20 lines.
- The dissertation should be submitted in duplicate.
- The number of pages in M. Phil. Dissertation should be not less than 80 pages inclusive of bibliography and Annexure.
- Two bound copies of the M.Phil. Dissertation duly signed by the Guide and Head of the Department should be submitted through the Controller of Examinations along with the CD containing the softcopy of the Dissertation in PDF format.
- Candidates shall submit the dissertation to the Controller of Examinations through the Supervisor and Head of the Department within 6 months but not earlier than 5 months from the date of start of the second semester.
- The M. Phil. scholars should attend at least one of the following -training programmes, Workshops, Seminars, Symposiums, etc., and that they should also have a paper either published or received for acceptance in an ISSN / Reputed Journal before submitting the Dissertation. Scholars who fail to comply with the above are not eligible for the submission of their Dissertation. Photo copy of the publication/ Letter of acceptance for publication should be given as Annexure at the end of the Dissertation.
- Both the Internal as well as External Examiner award 200 marks each for the Dissertation. The distribution of mark will be 120 marks for the Dissertation and 80 marks for the Public Viva-voce Examination. In the Public Viva-voce Examination, the M. Phil. Scholars should present their dissertation work with PowerPoint Presentation. The division of marks for the Dissertation is as mentioned below.

Particulars	Internal Examiner	External Examiner
Wording of Title	10	10
Objectives/ Formulation including Hypothesis	10	10
Review of Literature	20	20
Relevance of Dissertation to Social Needs	10	10
Methodology/ Technique/ Procedure Adopted	30	30
Summary/ Findings/ Conclusion	10	10
Bibliography/ Annexure/ Foot notes	20	20
Training/ Seminar/ Workshop	10	10
	120	**120**

The average marks of Internal and External examiners is considered as marks of project report.

SCHEME OF EXAMINATIONS UNDER CBCS (2015 - 2018)

The medium of instruction in M.Phil courses is English and students shall write the CIA and Semester Examinations in English.

DISTRIBUTION OF MARKS FOR CIA AND SEMESTER EXAMINATIONS

M.PHIL COURSES

SUBJECT	TOTAL MARKS	CIA TEST	SEMESTER EXAM.	PASSING MINIMUM		
				CIA EXAM.	SEM. EXAM.	OVER ALL
Theory	100	25	75	Nil	38	50
Project	200	Nil	Report - 120 marks Viva - 80 marks	Nil	---	100

DIVISION OF MARKS FOR CIA

SUBJECT	MARKS	SEMINAR	Attendance	TOTAL MARKS
Theory	20	5	--	**25**

1. The duration of CIA theory examination is **ONE** hour and the semester examination is **THREE** hours.
2. **Three CIA tests of 20 marks each will be conducted** and the average marks of the best two tests out of the three tests will be taken.
3. The I test will be based on the first 1.5 units of the syllabus, the II test will be based on the next 1.5 units of the syllabus and the III test will be based on the next 1.5 units of the syllabus.
4. Two seminars for M.Phil. Courses.

QUESTION PAPER PATTERN FOR CIA TEST (THEORY)

Duration: 1 Hr **Maximum Marks: 20**

Section	Question Type	No. of Questions & Marks	Marks
A	No Choice Answer should not exceed 75 words	2 Questions - 2 mark each	2 x 2 = 4
B	Internal choice (Either or type) Answer should not exceed 200 words	2 Questions - 4 marks each	2 x 4 = 8
C	Open Choice (Answer ANY ONE out of Two) Answer should not exceed 400 words	1 Question - 8 marks each	1 x 8 = 8
		TOTAL	**20 MARKS**

QUESTION PAPER PATTERN FOR SEMESTER EXAMINATION (THEORY)

Duration: 3 Hrs **Maximum Marks: 75**

Section	Question Type	No. of Questions & Marks	Marks
A	No Choice Answer should not exceed 75 words	10 Questions - 2 marks each (2 Questions from each unit)	10 x 2 = 20
B	Internal choice (Either or type) Answer should not exceed 200 words	5 Questions with internal choice. Each carries 5 marks (Two questions from each unit)	5 x 5 = 25
C	Open Choice (Answer ANY THREE out of FIVE) Answer should not exceed 400 words	3 Questions out of 5 - 10 marks each (1 Question from each unit)	3 x 10 = 30
		TOTAL	**75 MARKS**

(Model for the Title Page of the Dissertation)

TITLE OF THE DISSERTATION

Dissertation Submitted to the Sadakathullah Appa College (Autonomous) in partial fulfillment of the requirements for the award of the degree of

MASTER OF PHILOSOPHY IN XXXXXX

Submitted by

NAME OF THE CANDIDATE

(REGISTER NO. XXXXXXXX)

Under the guidance of

NAME OF THE GUIDE

Designation of the Guide
Sadakathullah Appa College (Autonomous)
Tirunelveli – 627011

PG & RESEARCH CENTRE IN (MAJOR)
SADAKATHULLAH APPA COLLEGE (AUTONOMOUS)
TIRUNELVELI – 627011
MONTH, YEAR

(Model for the Declaration by the Candidate)

Name of the candidate

M.Phil. Scholar, (Register No.: XXXXXXX)
PG & Research Centre in XXXXXXXX,
Sadakathullah Appa College (Autonomous)
Rahmath Nagar, Tirunelveli – 627011

DECLARATION BY THE CANDIDATE

I hereby declare that, the dissertation entitled, ***"TITLE OF THE DISSERTATION"*** submitted in partial fulfillment of the requirements for the award of the degree of **Master of Philosophy in XXXXXXXX** at **the PG & Research Centre in XXXXXXXX , Sadakathullah Appa College (Autonomous)**, **Tirunelveli** is my original work carried out under the guidance of **Name of the Guide, Designation of the Guide, Sadakathullah Appa College (Autonomous), Tirunelveli – 11** and this work has not been submitted elsewhere for the award of any other Degree or Diploma.

Tirunelveli – 627011
DD-MM-YEAR **(Signature of the Candidate)**

(Model for the Certificate of the Dissertation)

Name and Qualification of the Guide

Designation of the Guide

Sadakathullah Appa College (Autonomous)

Rahmath Nagar

Tirunelveli – 627011

CERTIFICATE

Certified that the dissertation work entitled, **"TITLE OF THE DISSERTATION"** submitted by **NAME OF THE CANDIDATE** (Register number XXXXXXX) in partial fulfillment of the requirements for the award of the degree of **Master of Philosophy in (Major) at PG & Research Centre in (Major), Sadakathullah Appa College (Autonomous), Tirunelveli** is original work done by the candidate during the period 20XX-XX, under my guidance and this dissertation or any part thereof has not been submitted elsewhere for the award of any other Degree or Diploma.

Tirunelveli – 627011
DD-MM-YEAR **(NAME OF THE GUIDE)**

SIGNATURE OF H.O.D

The viva-voce Examination is held on _____
1. External Examiner
2. Internal Examiner