RAJAH SERFOJI GOVT. COLLEGE (AUTONOMOUS)

(Re-accredited with A Grade by NAAC)

THANJAVUR - 613 005.

PG and Research Department of Physics

Board of Studies: 2018-2019

(Under CBCS Pattern)

[For the Candidates admitted from 2018 -2019 onwards]

PG AND RESEARCH DEPARTMENT OF PHYSICS
RAJAH SERFOJI GOVERNMENT COLLEGE (Autonomous)
THANJAVUR 613005

BOARD OF STUDIES MEETING
18.04.2018

The meeting of Board of Studies (BoS) in physics was held on 10.30 am on 18.04.2018 (Wednesday) at the department of physics under the chairmanship of Dr.T.Arivudainambi, Head, PG and Department of physics. The following members are present in the meeting

Internal Members

1. Prof.S.Dhandapani -
2. Dr. A.Santhanam -
3. Dr.G.Rani -
4. Dr.S.Sakthivel -
5. Dr.S.Rosepriya -
6. Prof.S.Senthilkumari -
7. Prof.B.Shanmugapriya -
8. Dr. S.Nilavazhagan -
9. Dr.S.Veera Rethina Murugan -
10. Dr.T.Ganesh -
11. Prof.N.Chidambaram -
12. Prof.D.Anbuselvan -
13. Dr.P.Jagdish -
14. Dr. P.Paramansivam -

HEAD,
DEPARTMENT OF PHYSICS,
RAJAH SERFOJI GOVT. COLLEGE
THANJAVUR-613 005.

CONTROLLER OF EXAMINATIONS,
RAJAH SERFOJI GOVT. COLLEGE (AUTONOMOUS)
THANJAVUR-613 005.

External Members

1. Dr.B.Ravikumar -
2. Dr. S.Rajasekar -
3. Dr.P.Philominathan -
4. Dr.P.Thilagan -
5. Dr. V.Senthamizh selvi -

18/4/18

18/4/2018

18/4/2018

The Syllabi for B.Sc. Physics (Major and Allied), M.Sc. Physics, and M.Phil. Physics under CBCS system was discussed and correction/changes were made and finalized for the academic year 2018-2019 onwards. The finalized syllabus is approved in the meeting which is appended herewith.

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THANJAVUR-613 005.

Dr.T.Arivudainambi

(Chairman BoS - Physics)

RAJAH SERFOJI GOVT COLLEGE (AUTOMONOUS), THANJAVUR-5

C.B.C.S PATTERN FOR ALL M.Phil. COURSES

SUBJECT:PHYSICS

(Applicable to the Students admitted from the academic year 2018-2019 onwards)

PART	CODE	COURSE	TITLE	MARKS		TOTAL	EXAM HOURS	CREDIT
			I SEMESTER	**IA**	**WE**		3	
III	**S1MPH1**	**CC1**	Research Methodology	40	60	100	3	4
III	**S1MPH2**	**CC2**	Advanced Physics	40	60	100	3	4
III	**S1MPH3**	**CC3**	Nano Science	40	60	100	3	4
III		**CC4**	Guide Paper*	40	60	100	3	4
		TOTAL				**400**		**16**
			II SEMESTER					
				V.V	**Dis**	**TOTAL**		
III	**S2MPHD**	**CC5**	Dissertation and viva voce	50	150	200		**8**
	GRAND TOTAL					**600**		**24**

Guide Paper*	
S1MPH4A	Advances in Crystal Growth and Application to Nano Materials
S1MPH4B	Thin Film Physics
S1MPH4C	Liquid State and Thin Film Physics
S1MPH4D	Physics of Dielectric Materials
S1MPH4E	Chemical Physics
S1MPH4G	Perpectives of Nano Science
S1MPH4H	Nano Materials and Applications

	No of papers
Core courses	**4 (each of 4 credits)**
Project	**1 (8 credits)**
Total	**5 (24 credits)**

a) The Passsing minimum for CIA shall be 40% out of 40 Marks(ie 16 Marks)

b)The Passing minimum for Autonomous Examinations shall be 40% out of 60 marks (ie 24 Marks)

c) The Passing minimum not less than 50% in the aggregate

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M.Phil-Physics **Code: S1MPH1**

Credits :4

RESEARCH METHODOLOGY

UNIT :1 RESEARCH TECHNIQUES

Problem identification – Determining the mode of approach-literature survey-various sources-current status of the problem –impact and usefulness of the research topic-role of guide and scholar – Use of internet e-mail and www browsing-use of software packages MS office – Introduction to MATLAB.

UNIT :2 PREPARATION AND PRESENTATION OF SCIENTIFIC REPORTS

Writing a paper and preparing a poster-art of writing synopsis, dissertation and thesisIllustrations and analysis of results.

UNIT :3 NUMERICAL ANALYSIS

Curve fitting –Least squares method –solution of equations :Graphical Method , simple iterative method-Jacobi's method-Gauss Serial method- Regula falsi method-Newton-Raphson method-Numerical Integration: Simpson's rule - Gaussian's integration- Differential equation: Taylor's series solution- Predictor corrector method-Eulers method - Runge-Kutta method.

UNIT :4 BASICS OF C PROGRAMMING

Introduction to C –Character set– Identifiers and keywords – Data types – constants – symbolic constants – Expressions – statements –Arithmetic, Relational, Logical and assignment operators, increment and decrement operators, conditional operators – Bitwise operator, special operator, library functions- input and output functions Control statements – while, do-while, for, nested for, if – else, switch, break, continue and go to statements- arrays.

UNIT :5 RESEARCH EQUIPMENTS

Working principles and applications of UV, VIS, IR, FTIR, XRD, SEM, TEM, STEM,ESR, and NMR.

REFERENCES:

1. J. Anderson, and M. Poole. Assignment and Thesis Writing. 4th Edition. John Wiley and Sons Inc. (2002)
2. M.K. Venkataraman. Numerical Methods in Science and Engineering. The National Publishing Company, Madras. (1999).
3. M.K. Jain, S.R.K. Iyengar and R.K. Jain , Numerical Methods for Scientific and Engineering Computation. 4th Edition. New Age International Publishers. New Delhi,India. (2005).
4. E. Balagurusamy. Programming in ANSI C. 6th Edition. Tata McGraw Hill Education Private Limited, New Delhi, India. (2012).
5. K. Ravichandran, K. Swaminathan, and B. Sakthivel. Introduction to Thin Films. Research India Publications. New Delhi. (2013).

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks:60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)

Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M. Phil-Physics
Credits :4

CODE: S1MPH2

ADVANCED PHYSICS

UNIT :1 IMPERFECTION IN ATOMIC PACKING

Defects in solids-point defects-plane defects-dislocation-diffusion and ionic conductivitycolor centers-photoconductivity-luminescence-types of luminescence-thermo and electro luminescence Glow curve-absorbtion and emission spectra.

UNIT :2 PREPARATION TECHNIQUES

CHEMICAL METHODS: Electroplating-ion plating-Chemical reduction plating-vapour phase growth. Anodisation-Vacuum evaporation-Evaporation theory-Sputtering methodsReactive sputtering-RRF Sputtering-preparation technique of semiconducting Chalcogenide binary compounds.

High vacuum Technology: Vacuum Pump-Oil-sealed rotary pumps-Diffusion pump pressure measurement-Thermal conductivity-Gauge-pressure gauges for high to ultra high vacuum.

UNIT :3 ULTRASONICS

Ultrasonic waves-different methods of production-behaviour - reflection and transmission at normal incidence-stationary waves and resonance. Detection of Ultrosonic waves-Measurment technique of ultrasound-pulse echo overlap method –cross corelation method-phase slope method.

UNIT :4 ELECTRONICS AND CONTROL CIRCUITS

Electronics control circuits-Introduction to automatic control system open loop control system-closed loop control system-basic elements of servo mechanism-advantages of electronic control of devices-dc motor speed control-temperature control-illumination control-automatic water level indicator using SCR-Battery operated inverter circuit using power transistor.

UNIT :5 NON CONVENTIONAL ENERGY

Principle of conversion of solar radiation into heat-Green house effect-flat plate collectors- general characteristics-solar concentrators- parabolic and spherical systems-solar cells-characteristics –peak power point photovoltaic cell-types of solar cell applications -indirect sources of solar energy conversion- wind energy-Horizontal axis type wind mill.

REFERENCES:

1. Introduction to Solid state physics, Charles Kittel, Wiley International,6th Edition,(1986)
2. Ultrasonics-Benson Carlin Tata McGraw Hill Company,3rd Edition,(1949)
3. Hand Book of Thin film technology, L.T.Maissel and Glang McGraw Hill, (1970)
4. Thin film Phenomena, K.L.Chopra, Krieger Publishing Company, (1979).
5. Solar energy utilization-G.D.Rai Khanna Publishers, (1987)
6. Fundamentals of Microprocessor 8085: Architecture Programming, and Interfacing,Viswanathan, S. Printers & Publishers Pvt Ltd,(2009)
7. Fundamentals of Microprocessor and computers by Badri Ram, Dhanpat Rai and sons,New Delhi,(1995.)
8. Industrial Electronics and Control S.K.Battarcharya,S.Chatterjee, Tata McGraw Hill,(2001)
9. Laser: Theory and Application, Thyagarajan, K.; Ghatak, A. K. New York, Plenum Press,(1981.)

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks: 60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)

Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M. Phil-Physics
Credits :4

Code:S1MPH3

NANO SCIENCE

UNIT: 1 IMPERFECTION IN ATOMIC PACKING AND TOOLS

Atomic structures-Molecular and atomic size-Bohr radius -Nucleation-Influence of nucleation rate on the size of the crystals- macroscopic to microscopic crystals and nanocrystals - large surface to volume ratio, top-down and bottom-up approaches-self assembly process-grain boundary volume in nanocrystals-defects in nanocrystals-surface effects on the properties. Nano SEM - Scanning Conducting microscopy (SCM) - High-resolution Transmission Electron Microscopy (HRTEM) - single nanoparticle characterization – Scanning capacitance microscopy. Principle and working of Atomic Force Microscopy (AFM) and Scanning tunneling microscopy (STM) – Principle of Transmission Electron Microscopy (TEM) – applications to nanostructures – nanomechanical characterization – nanoindentation.

UNIT: 2 NANOMATERIALS AND SYNTHESIS ROUTES

Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO2, CeO2, ZnO) –Semiconductors (Si, Ge, CdS, ZnSe) - Ceramics and Composites - Dilute magneticSemiconductor -Metallic glasses- Shape Memory Alloys (SMA) - Bio Materials - Biologicalsystem - DNA and RNA - Lipids - Size dependent properties - Mechanical, Physical and Chemical properties.

New forms of Carbon- Types of nanotubes- formation of nanotubes- methods and reactants- arcing in the presence of Cobalt- Laser methods- Ball Milling-Chemical Vapour Deposition Methods- Catalytic route-Properties of Nano tubes- Plasma arcing electro deposition-Pyrolytic Synthesis.

UNIT: 3 NANO OPTICS AND NANO COMPUTING

Optics-Photonics of Nanotechnology –Properties of light and nanotechnology interaction of light with nano systems- Absorbance- Surface Plasma excitation.

Nano computers -Types - Quantum computers - DNA computers - construction-working - molecular computing - optical computing.

UNIT: 4 NANO ELECTRONICS

Nano electronics -Nanofabrication-molecular electronics- Nano electronic devices-Nano circuitry- Nano electronics with tunneling devices and superconducting devices - Molecular electronics- Applications of superconducting devices-- Plastic electronics.

UNIT: 5 SENSORS AND ENERGY APPLICATIONS

Chemical and Molecular Sensors- Bio sensor-DNA Sensors-optical bio sensorsDisplacement and motion sensors- Force nano sensors- pressure sensors- Thermal SensorsNeural microsensing. Nanotubes based sensors, Fluid flow, gas temperature, Gas sensing
(SnO2) - LPG (sensorSnO2-Powder.) - Fuel cells - Solar cells.

BOOKS FOR STUDY & REFERENCES:

1. Understanding nanotech, Scientific American, editors at Scientific Wmer Books(2002)
2. Nanoelectronics and nanosystem: From transistors to molecular devices K.Goser, P.Glosekottert,J.Dienstuhl sringer 2004
3. Magnetic Materials: Fundamentals and device applications Nicola Am Spaldin, Cambridge University Press(2003) ISBN 0521016584.
4. Nanocomposite Science and Technology, Pulicket.M.Ajayan, Linda.S.Schadler Paul V.Braum,Willey-VCH Verlag, Weiheim(2003).

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks: 60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)
Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M. Phil-Physics Code:S1MPH4A

Credits : 4

ADVANCES IN CRYSTAL GROWTH AND APPLICATIONS TO NANOMATERIALS

UNIT :1 CLASSICAL THEORY OF NUCLEATION

Gibbs Thomson equation – theory of nucleation – energy of formation of a nucleus – different possible shapes of nucleus - homogenous nucleation of binary system – heterogeneous nucleation - free energy of formation of critical heterogeneous – cap shaped – disc shaped nucleus – secondary nucleation.

UNIT :2 THEORY OF CRYSTAL GROWTH

Surface energy theory – diffusion theory – absorption layer theory – Volmer theory – Bravais theory – Kossel theory – Straski's treatement – two dimensional nucleation theory.

UNIT :3 GROWTH OF CRYSTAL FROM MELT

Growth of III-V materials – growth of oxide materials – growth crystal from flux – slow cooling method- temperature difference method – high pressure method – solvent evaporation method – electro crystallization – crystal growth by thermal, hydrothermal method.

UNIT : 4 CRYSTAL CHARACTERIZATION

Single crystal diffraction techniques – power diffraction – indexing – least square refinement – X-ray fluorescence – X-ray topography – SEM and TEM studies – electron probe microanalysis – secondary ion mass spectroscopy (SIMS) – electron spectroscopy for chemical analysis (ESCA) – electrical conductivity – measurement of electrical conductance – measurement of dielectric constant – micro hardness – etching studies.

UNIT : 5 PROPERTIES OF NANOMATERIALS

Nanomaterials – method used to produce nanomaterials – Sol-Gel synthesis – applications of nanomaterials – Automobiles with greater fuel efficiency – Aero space components with enhanced performed characteristics – better and future weapons platforms – longer lasting satellites – longer lasting medical implants – ductile, machinable ceramics – large electrochromic display devices.

BOOKS FOR STUDY:

1. Modeling crystal growth rates from solution by Makoto Oharo and Robert C.Reid PHI Pvt. Ltd., New Delhi, 1973
2. Crystal Growth Process by J. C. Brice . John Wily and sons., NY 1986.

BOOKS FOR REFERENCE:

1.Synthesis, crystal growth and characterization – Krishnan Lal, North Holland Amerstdam (1982).
2. A Guide to materials characterization and chemical analysis – John P. Sibilia, Wiley VCH(1996)
3. Introduction to Nano Technology – Charles P. Pool Jr. and Frank J. Owens , John Wiley Sons., New Delhi 2006.

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks: 60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)

Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M. Phil.,Physics **Code:S1MPH4B**

Credits :4

THIN FILM PHYSICS

UNIT: 1 NUCLEATION THEORY AND DEPOSITION METHODS

Theories of nucleation- Four stages of film growth incorporation of defects during growth-Chemical methods: Liquid phase epitaxy– electrodeposition-Ion plating- Chemical reduction plating-Vapour phase growth - Anodisation-Vacuum evaporation- Evaporation theory-Sputtering methods- Reactive sputtering-RF sputtering- Preparation technique of semiconducting- Chalcogenide binary compounds - Molecular beam epitaxy (MBE).

UNIT 2: PRESSURE AND THICKNESS MEASUREMENTS

High vacuum Technology: Vacuum pump- Oil sealed Rotary pumps-Diffusion pump- pressure measurement- Thermal conductivity –Gauge –Pressure gauges for high to ultra high vacuum.

Thickness measurements: Electrical methods –microbalance monitors-optical interference methods multiple beam interferometry- Fizeau and FECO methods- Quartz crystal thickness monitor.

UNIT 3: INSULATING AND DIELECTRIC FILMS

Metal insulator contact –Ohmic-neutral, blocking contacts –two electrode systemconduction mechanism in insulator film- Photoconduction –Experimental techniques. Dielectric properties –dielectric constant –dielectric loss capacitance – breakdown voltage – polarization – effect of temperature and frequency on dielectric properties.

UNIT 4: ELECTRICAL, OPTICAL AND MAGNETIC PROPERTIES

Sources of resistivity in metallic conductors – sheet resistance – TCR influence of thickness on the resistivity –Hall effect- influence of heat treatment – optical characterization by spectrophotometer (refractive index, Absorption Edge – Transmission and absorbance) – Energy band gap – Magneto resistance – Ferromagnetic Domain studies –Meissner effect –super conducting stage.

UNIT: 5 THIN FILM APPLICATIONS

Thin film passive components –Thin film battery –Thin film for Gas sensors and photovoltaic applications –Thin film flexible LED –CNT and its applications - Field Emission Display - Decorative and Barrier Coatings.

REFERENCES:

1. Hand Book of Thin Film Technology –L.T. Maissel and Glang McGraw Hill,NY (1983).
2. Thin film Fundamentals –A.Goswami New Age International ,New Delhi(2003).
3. Thin film Phenomena –K.L.Chopra McGraw Hill NY (1969).

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks: 60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)

Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M. Phil-Physics
Credits :4

Code:S1MPH4C

LIQUID STATE AND THIN FILM PHYSICS

UNIT :1 ULTRASONICS

Introduction – Generation of ultrasonic waves – piezo electric generator – magnetostriction – generator – applications of ultrasonic waves – ultrasonic communication – testing materials – separation of mixtures – thermal effect – physical and chemical effect- biological effect.

UNIT :2 ULTROSONIC STUDY OF LIQUID MIXTURES AND SOLUTIONS

Molecular interactions – Types – Ultrasonic study – Preparation of multi component mixtures – Measurement Techniques – Coefficient of absorption – Density , viscosity measurements – Theories of ultrasonic velocity in mixtures and solutions.

UNIT :3 INTERNAL PRESSURE AND FREE VOLUME

Theories of liquid state –inadequacy- Internal pressure – derivation – free energy – significance – thermodynamic equation of state – internal pressure , free volume- sound velocity – experimental determination.

UNIT : 4 PREPARATION TECHNIQUES

Chemical methods: Electroplating - ion platting – chemical reduction plating – vapour phase growth. Anodisation – vacuum evaporation – evaporation theory – sputtering methods – reactive sputtering – RF sputtering – preparation technique of semi conducting chalcogenide binary compounds.

High vacuum technology: Vacuum pump – oil sealed rotary pumps – diffusion pump – pressure measurement – thermal conductivity – Gauge – pressure gauges for high and ultra high vacuum.

UNIT : 5 THICKNESS MEASUREMENTS

Thickness measurements: Electrical methods – microbalance monitors – optical interference methods – multiple beam interferometer – Fizeau and FECO methods –Quartz crystal thickness monitor. Theories of nucleation – four stage film growthincorporation of defects during growth.

REFERENCES:

1. Robert. T. Beyerand Stephen, GB., Physical Ultrasonics, Vol.32, Academic Press, New York.
2. Panaj and Sharma, Ultrasonics (G.B) (1991).
3. Barker J.A, Lattice Theories of Liquid state, Oxford, Pergaman (1963).
4. Eyring H., Jhon, M.S. Significant Liquid structure, New York, Wiley (1969).
5. L.T. Maissel and Glang, Hand book of Thin film Technology, McGraw Hill,New York, (1983).
6. A. Goswamy, Thin Film Fundamentals, New Age, New Delhi, (2003)
7. Thin Film Phenomena, K.L. Chopra, McGraw Hill NY(1969)

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks: 60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)

Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M. Phil – Physics
Credits :4

Code: S1MPH4D

PHYSICS OF DIELECTRIC MATERIALS

Unit 1: THEORIES OF STATIC PERMITTIVITY

The molecular origins of permittivity and loss – Polarization types Debye's theory of static permittivity – Onsager's theory of the internal field and permittivity – Kirkwood's theory and Frohlich's theory for non-polarizable dipoles – relation between Kirkwood's and Frohlich's theory.

Unit 2: DIPOLE MOMENT STUDIES

Dipole moment – Experimental determination – Debye's method and Onsager's method – application to molecular structure – dipole moment of molecular complexes – Few and Smyth method- Huyskens method.

Unit 3: DIELECTRICS

Dielectrics and insulators – various polarization mechanisms – polarization and relaxation in solid and liquid dielectrics – Ceramics and Plastic dielectrics – power and distribution equipments – electronic equipments – Capacitors – Dielectric rectifiers and piezo electric transducers – Memory devices.

Unit 4: MICROWAVE FREQUENCY TECHNIQUES

X-band microwave bench – Principle – Von Hippel Method Experimental arrangement – Determination of dielectric parameters-Dielectric and conductivity measurements at microwave frequencies – Microwave devices fabrication - Dielctric relaxation – Higasi's and Cole-Cole plot methods – Rate theory of dielectric relaxation and viscosity –Time domain Reflectometry – Principle, Experimental arrangementProcedure- Dynamic permittivity – Davidson – Cole model, Havariliak – Nagami model – Applications.

Unit 5: POLYMERS

Monomers – Polymers classification – Chain and step polymerization – Thermo plastic and thermosetting polymers – Mol.wt and degree of polymerization – Glassy solids and glass transition temperature with copolymers — Polymer dielectrics in power equipments – Conducting polymers –charge transfer complexes – Effect of doping on polymers and its techniques – Optical properties of polymers –Effect of polymerStructure on optical properties-clarity, transparency, haze, transmittance, reflectance and gloss-refractive indices of polymers by group contributions – polymer solar panels

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REFERENCES:

1) Dielectric properties and molecular behaviour – Nora E Hill – Van Nostrand Co.London(1969).
2) Dielectric behaviour and molecular structure – C.P Smyth –McGraw Hill publication(1955).
3) Electric dipole moments – J.W.Smyth – Butterworth publications(1955).
4) Microwave Techniques and Laboratory manual – M.L Sisodia and G.S. Raguvanshi – Wiley Eastern Limited – (1987).
5) Hydrogen bonding - S.N. Vinogradov – Nostrand Reinhold (1971).
6) Polymer Science V.R. Gowariker, N.V. Viswanathan and Jayadev Sreedhar – New Age International (P) Ltd (1986).
7) Dielectric materials and applications – Von – Hippel A.R., John wiley and Sons Inc.,New York (1974).
8) Dielectric Relaxation – Daniel V. E., Academic Press., London (1967).
9) Molecular interactions Vol(2) – Rataj C Zak and Orville –Thomas – Wiley Interscience(1982).
10) A special issue on conducting polymers – Indian journal of Chemistry Sec A – (1994).
11) Handbook of conducting polymers – Terje A. Skotheim – Marcel Dekkar Inc (1986).
12) Text book of Polymer Science-F.W. Bill Mayer-Wiley International Publications-(1984).

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks: 60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)

Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M. Phil – Physics
Credits :4

Code:S1MPH4E

CHEMICAL PHYSICS

Unit 1: THEORIES OF STATIC PERMITTIVITY

Molecular orgins of permittivity and laws – polarization types – Debye's theory of static permittivity – Onsager's theory of the internal field and permitivitty – Kirkwood's theory and Frolich theory for non-polarizable dipoles – Relation between and Kirkwood's and Frohlich theory.

Unit 2: DIPOLE MOMENT STUDIES

Dipole moment – Experimental determination – Debye's method and Onsager's method – application to - molecular structure – dipole moment of molecular complexes – Few and Symth method Huyskens method.

Unit 3: FREQUENCY DOMAIN AND TIME DOMAIN TECHNIQUES

X-band microwave bench – principle – experimental arrangement – dielectric relaxation – Higasi and Cole-Cole plot method – Rate theory of dielectric relxations and viscosity – Time Domain Reflectometry - principle – Experimental arrangement – procedure – dynamic permittivity – Davidson –Cole method - Havariliak – Negami model – applications.

Unit 4: FUNDAMENTALS OF H - BONDING STUDIES

Nature of H-bonding – Model of Hydrogen bonding (Electrostatic model, (Quantum mechanical models) – potential energy curves and symmetrical hydrogen bonds – proton transfer and ion pair formation – thermodynamics of H-bonding – equilibrium constants.

Unit 5: IR SPECTRA AND H – BONDING

Applications of IR spectra in the study of H-bonding - determination of equilibrium constants – Nash method – Whetsal and Kagarise method - thermodynamic properties – dipole moment derivatives – enhancement of intensity in H-bonding system.

BOOKS FOR REFERENCES:

1) Dielectric properties and molecular behaviour – Nora E Hill – Van Nostrand Reinhold London.Ny-(1969).
2) Dielectric behaviour and molecular structure – C.P Smyth –McGraw Hill publication-(1955).
3) Electric dipole moments – J.W.Smyth – Butterworth publications London –(1955).
4) The IR spectra of complex molecules – L.J. Bellamy-Publisher-2nd edition, London,Chagman and Hall-(198(
5) Hydrogen bond – G.C.Pimental and A.L.Mcclellan-Annual review of Physical Chemistry-(1971).
6) Hydrogen bonding - S.N. Vinogradov and R.H.Linnell- Van Nostrand Reinhold Co. London.(1971)
7) Microwave techniques and laboratory manual – M.L Sisodhia and G.S. Raguvanshi – Wiley Eastern Limited – (1987).
8) Molecular interactions Vol.(2) –H. Ratajczak and J.Orville –Thomas – Wiley InterscienceNY-(1982).
9) Dielectric materials and applications – VonHippel A.R., John Wiley and Sons. NY (1954).
10) Dielectric Relaxation – DanielVera., Academic Press.,1st Edition London (1967).

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks: 60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)
Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M.Phil -Guide Paper Code: S1MPH4F

Credits :4

CRYSTAL GROWTH AND CHARACTERIZATION STUDIES

UNIT I : FUNDAMENTALS OF CRYSTAL GROWTH

Importance of Crystal growth – Classification of Crystal Growth methods. Theories of nucleation – Classical theory – Gibb's Thomson equation for vapor, solution and melt – Energy of formation of nucleus- Absorption at the growth surface – Nucleation – Homogeneous and Hetrogeneous nucleation – Growth surface.

UNIT II : GROWTH FROM LOW TEMPERATURE SOLUTIONS

Solution - selection of solvents – solubility and super solubility – Saturation and super saturation – Meir's solubility diagram- Metastable zone width – Measurement and its enhancement – Growth by (i) restricted evaporation of solvent, (ii) Slow cooling of solution and (iii) Temperature gradient methods – Growth in Gel medium, Electro crystallization- Bio Crystal.

UNIT III : GROWTH FROM FLUX AND HYDROTHERMAL GROWTH

Flux Growth – principle – choice of flux – Growth kineties – phase equilibrium and phase diagram – Growth techniques – solvent evaporation techniques – slow cooling technique – transport in a Temperature gradient technique – Accelerated crucible rotation technique – Top seeded solution Growth – Hydrothermal Growth.

UNIT IV : GROWTH FROM MELT AND VAPOUR

Basis of melt growth – Heat and transfer – Growth techniques – conservative processes - Bridgman – Stockbarger method – pulling from the melt – Czochralski method – cooled seed – Kyropoulos method – Non – conservative processes – zone refining – vertical, horizontal floatzone methods – skull melting Process – Verneil method – flame fusion, plasma and its relative image methods. Basic principle – Physical Vapour Deposition – Evaporation and sublimation Processes – sputtering – Chemical Vapour deposition – Advantages and disadvantages – chemical vapour transport – Fundamental – Growth by chemical vapour transport fundamentals.

UNIT 5: CHARACTERIZATION STUDIES

Basic characterization's of Crystals – AFM – SEM – TEM – XRD (Single and powdered crystal method) – XRF – Dielectric studies – TGA / DTA – Quantitative and qualitative studies of crystals.

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REFERENCES:

1. Brice. J.C. Crystal Growth Processes – Halstesd press. John Wiley & sons, New York *1986)
2. Elwell. D and Scheel. H.J. Crystal growth from High Temperature solutions, Academic press, London (1975)
3. Ichiro Sunagawa, Crystal Growth, Morphology and performance, Cambridge University press, (2005),
4. Mallin J.N. 'Crystallization', Butternmths, London (2004),
5. Hand book of crystal growth, volume 1,2,&3. Edited by D.T.J. Hurle North Holland – London (1993)
6. Buckley, H.E. 'Crystal Growth', Chepman and Hall, London (1952)
7. Heinz K. Henisch, Crystal Growth in Gels Dover publications(1996)

Question Paper Pattern

Exam Duration: 3 Hrs **Maximum Marks: 60**

Part – A (5x6=30 Marks)- Answer ALL Questions (Either or type – Two questions from each unit)

Part – B (3x10=30 Marks)- Answer Any Three Questions (Three out of Five – One question from each unit)

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M. Phil - Physics
Credits :4

Code: S1MPH4G

NANOMATERIALS

UNIT 1: NANOMATERIALS SYNTHESIS – AN OVERVIEW

Classification based on dimensionality – Quantum Dots, Wells and Wires – Metal based nano materials (nanogold, nanosilver, metal oxides and sulphides) – Top-Down and Bottom-Up approaches – Wet chemical – Sol-gel synthesis – Hydrothermal and solvothermal Synthesis - Metal Nanocrystals by Reduction – Photochemical Synthesis – Sonochemical Routes – Ball Milling – Combustion – Nanocomposites - Nanopolymers – Nanoglasses – Nanoceramics - Biological nanomaterials.

UNIT 2: CHARACTERIZATION TECHNIQUES

X-ray diffraction – Energy Dispersive Analysis of X-rays – X-ray fluorescence – UV-vis absorption and diffuse reflectance spectroscopy – Fluorescence spectroscopy – Fourier Transform-Infrared Spectroscopy – Thermogravimetric Analysis – Differential Thermal Analysis – Differential Scanning Calorimetry - Field Emission Scanning Electron Microscopy – High Resolution Transmission Electron Microscope - Scanning Tunneling Microscope – Surface Enhanced Raman Spectroscopy – X-ray Photoelectron Spectroscopy – Auger Electron Spectroscopy – Rutherford Backscattering Spectroscopy – Vibrating Sample Magnetometer.

UNIT 3: CARBONACEOUS MATERIALS

Fullerenes – Synthesis (CVD and Arc Discharge) – fullerene functionalization - Single-walled carbon nanotubes and multiwalled carbon nanotubes – Synthesis - Graphene Oxide structure and properties – Hummers method – reduced Graphene Oxide – Graphene and graphene oxide functionalization.

UNIT 4: NANOTECHNOLGY IN AGRICULTURE AND FOOD TECHNOLOGY

Nanotechnology in Agriculture – Precision farming – Insecticides using nanotechnology –Potential of nano-fertilizers – Nanotechnology in Food industry – Packaging, Food processing –Food safety and biosecurity – Contaminant detection – Smart packaging.

UNIT 5: APPLICATIONS OF NANOMATERIALS

Solar energy conversion and catalysis – Electrode material for super capacitor – Energy storage (Graphite) – Hydrogen Storage (CNT, Aerogels) – Fuel cells – Chemical and biosensors – Anti-bacterial agents – Nanoparticles for Delivery of Drugs – Nanoparticles in Cancer Therapy – Detection of viruses by Nanowires.

BOOKS FOR STUDY AND REFERENCE:

1. Rao C. N., A. Muller, A. K. Cheetham, Nanomaterials Chemistry, Wiley-VCH , 2007.
2. Introduction to Nanotechnology, Charles P Poole Jr, Frank J Ownes, John Wiley Sons, Inc., 2003.
3. Instrumental Methods of Analysis, Willard. Merritt, Dean and Settle, CBS Publications, 6th Edition, 2000.
4. Jennifer Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center, 2006.
5. Lynn J. Frewer, Willehm Norde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, 2011.
6. Niemeyer C. M., and Mirkin, C. A., Nanobiotechnology: Concepts, applications, and perspectives. Weinheim: Wiley-VCH, 2004.
7. Schmid, G., Nanoparticles: From theory to application. Weinheim:Wiley-VCH, 2004.

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M. Phil - Physics Code: S1MPH4H

Credits :4

NANO MATERIALS AND APPLICATIONS

Unit 1 : Background to Nanotechnology

Types of nano-structures and nano-crystals - Classification: of bulk Nanostructured materials, 0D, 1D, 2D structures – Size Effects – Fraction of Surface Atoms – Specific Surface Energy and Surface Stress – Effect on the Lattice Parameter – Phonon Density of States - Particles, Quantum dots, Nano-wires, Ultra-thin films, Multi-layered materials.

Top-down and bottom-up approaches - self assembly process - grain boundary volume in nanocrystals - defects in nanocrystals - surface effects on the properties - Metals (Au, Ag) - Metal oxides (TiO_2, CeO_2, ZnO, SnO_2, WO_3, MoO_3) - Ceramics and Composites.

Unit 2: Synthesis Techniques

Solution growth techniques of 1D-2D nano structures - Synthesis of metallic, semiconducting and oxide nanoparticles – homo and hetero-nucleation growth methods - Template-based synthesis (electrochemical, electrophoretic, Melt and solution, CVD, ALD) - Gas Phase Synthesis of Nanopowders: Vapor (or solution) – liquid – solid (VLS or SLS) growth – Self assembly technique - Sol-gel method - Spray pyrolysis.

Unit-3: Characterization of Nanomaterials

Fundamentals of the techniques – Experimental approaches - Sample preparation and data interpretation – applications/limitations of Microscopic equipments: SEM, EDAX, STM, TEM and AFM. UV-VIS Spectroscope – XRD - RAMAN Spectroscope - XPS – SIMS - NMR - DLS (Dynamic Light Scattering or photon correlation spectroscope) - DPI (Dual Polarisation Interferometry), FTIR - Photoluminescence.

Unit-4: Nano Graphene & Carbon-dots

Nano-Graphene Structure, Properties and fabrication (Physical &Cheical methods) - Carbon dots: Structures - Properties (Optical, Photocatalytic, Chemical Inertness & Water Solubility. Synthesis of carbon dots by: Chemical, Electrochemical, Combustion, Thermal, Hydrothermal and Acidic Oxidation of Carbon Precursors, Pulsed Laser Irradiation, Laser Ablation of Graphite, Arc Discharge, Plasma Treatment, Opening of Fullerene Cage, Ultrasonic-/Microwave-Assisted and Biogenic methods.

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Unit 5: Applications of Nanomaterials

Molecular electronics and nanoelectronics – Quantum electronic devices - CNT based transistor and Field Emission Display - Biological applications - Biochemical sensor - Membrane based water purification.

Hydrogen Fuel Cell: types of fuel cell and their merits & demerits, Hydrogen Storage: as liquid and gaseous form - Super Capacitors –Lithium batteries and application of Carbon and Nano-carbon in Lithium batteries.

Books for study and reference:

1. C.N.R.Rao, A.Muller, A.K.Cheetham (Eds), The chemistry of nanomaterials: Synthesis, properties and applications, Wiley VCH Verlag Gmbh&Co, Weinheim, 2004.
2. Kenneth J. Klabunde (Eds), Nanoscale Materials Science, John Wiley & Sons, InC, 2001.
3. G.Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004.
4. Zhong Lin Wang, Handbook of Nanophase and Nanomaterials (Vol 1 and II) Springer
5. Roland Wiesendanger, Scanning Probe Microscopy and Spectroscopy: Methods and Applications, Cambridge Univ press
6. Willard, "Instrumental Methods of Analysis", Van Nostrand, 2000
7. J. Goldstein, D. E. Newbury, D.C. Joy, and C.E. Lyman et.al, Scanning Electron Microscopy and X-ray Microanalysis, Springer Publications, 2003.
8. Francois Leonard, The Physics of Carbon Nanotube Devices, William Andrew Inc., (2009).

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