M. Phil-Physics **Code: RMPH1**

COURSE-I
RESEARCH METHODOLOGY

UNIT :1 RESEARCH TECHNIQUES

Problem identification – Determining the mode of approach-literature survey-various sources-currrent status of the problem –impact and usefulness of the research topic-role of guide and scholar.

UNIT :2 PREPARATION AND PRESENTATION OF SCIENTIFIC REPORTS

Writing a proper and preparing a poster-art of writing synopsis,dissertation and thesis-use of internet, e-mail and www browsing-use of software packages MS office, SPSS, MATLAB for Tables, Illustrations and analysis of results.

UNIT :3 NUMERICAL ANALYSICS

Curve fitting –Least squre method –solution of equation :Graphical Method , simple interactive method –Newton-Raphson method-Numerical Integration:Simpsons rule-Guassian's integration- Differential equation:Taylor's series solution- Predictor corrector method-Runge-Kutta method.

UNIT :4 BASICS OF C AND APPLICATIONS

Variables and Arithmetic constants- Symbolic constants- arrays- functions- external variables- variables- variable names – data types and sizes – constants, declarations, arithmetic operators, relational operators – logical operators – type conversions – increment and decrement operators – statements and blocks – if else, while and for , do while, break, continue and go to.

UNIT :5 RESEARCH EQUIPMENTS

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

REFERENCES:

1. J. Anderson, B.H. Durston and M.Poole, Thesis and Assignment Writing, Wiley Eastern (1977)

2. M.K. Venkatraman, Numerical methods in science and Engineering The National Publishing Company Madras, 1999

3. V. Rajaraman, Computer oriented Numerical methods, Prentice Hall (1985)

4. S.S. Sastthry, Numerical Methods

5. B.D. Guptha, Mathematical Physics

6. C. Balagurusamy, FundaC Programming

7. Rajammal P. Devadass, Avinashilingam University, Coimbatore for Unit I

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD

M. Phil-Physics **Code: RMPH2**

Max.Marks:60

COURSE-II
ADVANCED PHYSICS

UNIT :1 IMPERFECTION IN ATOMIC PACKING

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

UNIT :2 PREPARAITON TECHNIQUES

CHEMICAL METHODS: Electroplating-ion plating-Chemical reduction plating-vapour phase growth. Anodisation-Vacuum evaporation-Evaporation theory-Sputtering methods-Reactive 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 ultrasonic waves-behavier-reflection and transmission at normal incidence-stationary waves and resonance.

Detection of Ultrosonic waves-Measurment technique of ultrasound-pulse echo overlap method –cross coorelation method-phase slope method.

UNIT :4 ELECTRONICS AND CONTROL CIRCUITS

Electronics control circuits-Introdution to automatic control system open loop control system-closed loop control systemk-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-flate plate collectors- general characteristics-solar concentrators- parabolic and spherical systems-solar cells-characterics –peak power point photovoltaic cell-types of solar cell Applications -indirect sources of solar energy conversion- wind energy-Horizontal axis type wind mill.

REFERENCE:

1. Solid state physics by C.Kitel and Decker
2. Ultrasonics-Benson Carlin McGraw Hill Company
3. L.T.Maissel and Glang,Hand Book o Thinfilm technology(McGraw Hill, Newyork,1983)
4. Thinfilm Phenomena, K.L.Chopra, McGraw Hill, Newyork)
5. Solar energy utilization-G.D.Rai Khanna Publishers
6. Fundamentals of Microprocessors-8085 by V.Vijayendran,S.V.Printersand Publishers Pvt Ltd 2006
7. Fundamentals of Microprocessor and computers by Badri Ram, Dhanpat Raiand sons, New Delhi,1995.
8. Industrial Electronics and Control S.K.Battarcharya,S.Chatterjee,Tata McGraw Hill, New Delhi, 1995.
9. Laser Theory and Application, Thiyagaraja and A.K.Ghatak.

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD

M. Phil-Physics **Code:RMPH3**

COURSE-III
NANO PHYSICS

UNIT :1 IMPERFECTION IN ATOMIC PACKING

Background to Nanotechnology –scientific revolution- types of nanotechnology and nanomachines- automatic structure- molecules and phases- energy minomers and misconception of Nanotechnology.

Metallic glasses- Nanomaterials- Shape Memory Alloys(SMA)- Bio Materials, SEM, TEM, STEM, MEMs and NEMS Materials.

UNIT :2 NANO TUBES

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

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

UNIT :4 NANO ELECTRONICS

Nanoelectronics with tunneling devices and superconducting devices and superconducting devices- Molecular electronics- Applications of superconducting devices- Nanotubes based sensors, Fluid flow, gas temperature, Gas sensing(SnO2)- LPG (sensorSnO2-Powder.)

UNIT :5 NANO SENSORS

Chemical and Molecular Sensors- Displacement and motion sensors- Force nano sensors- pressure sensors- Thermal Sensors- Neural microsensing.

REFERENCE:

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: Fundementals 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)

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD

M. Phil-Physics **Code: RMPH4A**

ADVANCES IN CRYSTAL GROWTH AND APPLICATIONS TO NANOMATERIALS

UNIT :1 CLASSICAL THEORY OF NUCLEATION

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

UNIT :2 THEORY OF CRYSTAL GROWTH

Surface energy theory – diffucsion theory – absortion layer theory – Volmer theory – Bavais theory – Kossel theory – Straski's treatement – two dimenstional 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 crystallinzation – crystal growth by thermal hydrothermal method.

UNIT : 4 CRYSTAL CHARACTERIZATION

Single crystal diffraction techniques – power diffraction – indexing – least square refinement – X-ry flouerscence – 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 – microhardness – etching studies.

UNIT : 5 PROPERTIES OF NANOMATERIALS

Nanomaterials – method used to produce nanomaterials – Sol-Gel synthesis – applications of nanomaterials – Next generation computer chips – Kineic energy (KE) penerators with enhanced lethality – better insulation materials – phosphors of high definition TV low – cost flat – panel display – Tougher and harder cutting tools – Elimination of plooutants - High energy density batteries – High power magnets – High sensitivity sensors – Automobiles with greater fuesl efficiency – Aero space componenets with enhanced performed characterstics – better and future weapons platforms – longer lasting satellites – longer lasting medical implants – ductile, machinable ceramics – large electtrochromic display devices.

REFERECNES:

1. Modellling crystal growth rates from solution by Makoto Oharo and Robert C.Reid 1973, PHI Pvt. Ltd., New Delhi

2. Crystal Grwoth Process by J. C. Brice . John Wily and sons., NY 1986.

3. Synthesis crystal growth and characterization – Krishnan Lal North Holland ,Amerstdam 1982.

4. A Guide to materials characterization and chemical analysis – Siblia J.P. VCH.

5. Introductio to Nano Technology – Charles P. Pool Jr. and Frank J. Owens , John

6. Wiley Sons., New Delhi 2006.

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD

M. Phil-Physics **Code: RMPH4B**

THIN FILM PHYSICS

UNIT :1 PREARATION TECHNIQUES

Chemical methods: Electroplating –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.

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 2: THICKNESS MEASUREMENTS

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

Theories of nucleation- Four stages of film growth incorporation of defects during growth.

UNIT 3: INSULATING AND DIELECTRIC FILMS

Metal insulator contact – Ohmic-neutral, blocking contacts – two electrode system- conduction 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 resitivity 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 reistance – Ferromagnetic Domain studies – Messiner effect – super conducting stage.

UNIT :5 THIN FILM APPLICATIONS

Thin film passive components – Thin film battery – Thin film for Gas sensors and thin for photovoltaic applications – Thin film flexible LED – CNT and its applications.

REFERENCE

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 .

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD

M. Phil-Physics **Code: RMPH4C**

LIQUID STATE AND THIN FILM PHYSICS

UNIT :1 LIQUID STATE THEORIES

Introduction – Theories of liquid state – Lattice theories – loosly bound crystalline model – cell model – condensed gas model – gas model – inadequancy of theories.

UNIT :2 ULTRASONICS

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

UNIT :3 INTERNAL PRESSURE AND FREE VOLUME

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 evopuration – evaporation theory – sputtering methods – reactive sputtering – RF sputtering – preparation technique of semi conducting chalcogenide binary compounds.

High vaccum 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 interferometry – Fizeau and FECO methods – Quartz crystal thickness monitor.

Theories of nucleation – four stage of film growth incorporation of defects during growth.

REFERENCE

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 Theries of Liquid state, Oxford, Pergman (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 (MeGraw Hill, New York, 1983.

6. A. Gowsamy, Thin Film Fundamentals (New Age, New Delhi, 2003)

7. Thin Film Phenoomena, K.L. Chopra, McGraw Hill New York.

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD

M. Phil – Physics **Code: RMPH4D**

X-RAY CRYTALLOGRAPHY

UNIT : 1

Crystal morphology, miller Indices, Zones, Concept of Lattice, Periodicity, Seven Crystal Systems, 14 – Bravais Lattices, Unit cell Volume.

Symmetry-Symmetry elements – Non existence of five fold symmetry in crstal lattice- Proper and improper rotations – Point groups- Space groups – Systematic abseces – Space group determination.

Concept of reciprocal lattice – Ewald's and limiting spheres.

UNIT :2

Scattering of X-Rays – Atomic scattering factor- Molecular scattering factor- Structure factor- Scattering by crystals- Bragg's law.

Practicing film techniques – Weissenberg and Precession methods- Diffractometer measurements – 4 – Cirrcle Diffractometer – Data collection – Data reduction, Absorption correction – CCD.

UNIT :3

Solution of phase problem – Fourier Synthesis – Patterson synthesis – Direct methods – Various steps involved in structure determination using direct methods.

UNIT :4

Refinement of structures – Difference Fourier methods – Least square technique- F and F_0^2 Refinement – Weighting schemes – R- indices.

UNIT :5

Structure interpretation – Computation of bond lengths, bond angles, torsion angles- Conformational features – Packing – H-bonds – Other short contacts – Crystallographic programs and packages – DIRDIF – SHELXS-SIR-SHELXL-PARST-PLUTON-PLATON-ORTEP.

REFERENCE

1. Dunitz J.D. (1979). X-Ray Analysis and the structure of Organic molecules, Cornell University Press, Ithaca, New York.
2. Giacovazzo C., Monco, H.l., Viterbo, DScordari F., Gilli G., Zanotti, G and Catti, M (1992). In fundamentals of crystallography. Edited by C. Giacovazzo, IUCr, OUP, Oxford.

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD

M. Phil – Physics **Code: RMPH4E**

PHYSICS OF DIELECTRIC MATERIALS

OBJECTIVE:

This paper provides detailed information about various dielectric studies on molecular interaction in materials at high frequency electromagnetic fields.

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 Symth 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 Dielctric relaxation – Higasi's and Cole-Cole plot methods – Rate theory of dielectric relaxation and viscosity –Time domain Reflectometry – Principle, Experimental arrangement-Procedure- 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 – Dielectric and conductivity measurements of microwave frequencies – Microwave devices fabrication – Polymer dielectrics in power equipments – Conducting polymers – Effect of doping on polymers and its techniques – Optical properties of polymers – Polymer solar pannels.

REFERENCES:

1) Dielectric properties and molecular behaviuour – Nora E Hill – Van Nosterend Co.London (unit1)

2) Dielectric behavior and molecular structure – C.P Symth –McCraw Hill publication.

3) Electric dipole moments – J.W.Symth – Butterworth publicastions

4) Mivrowave Techniques and Laboratory manual – M.L Sisodhia and G.S. Ragunvanshi – Wiley Eastern Limited – 1987.

5) Hydrogen bonding - S.N. Vinogradov – Nostrand Reinhold

6) Polymer Science V.R. Gowriker, N.V. Viswanathan and Jayadev Sreedhar – New Age International (P) Ltd.

7) Dielectric materials and applications – Von – Hippel A.R., John wiley and Sons Inc., Newyork (1974).

8) Dielectric Relaxation – Daniel V. E., Academic Press., London 1967.

9) Molecular interactions Vol(2) – Rataj C Zak and Orville –Thomas – Wiley Interscience

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.

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD

M. Phil – Physics **Code: RMPH4F**

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 – Relaction 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 – Higasis 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,Qunatum mechanical models) – potential energy curvers 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 derivaties – enhancement of intensity in H-bonding system.

BOOKS FOR REFERENCE:

1) Dielectric properties and molecular behaviuour – Nora E Hill – Van Nosterend Co.London (unit1)

2) Dielectric behavior and molecular structure – C.P Symth –McCraw Hill publication.

3) Electric dipole moments – J.W.Symth – Butterworth publicastions

4) IR spectra of complex molecules – L.J. Bellamy

5) Hydrogen bond – G.C.Pimental – Freeman Sanfrancsico

6) Hydrogen bonding - S.N. Vinogradov – Nostrand Reinhold

7) Mivrowave Techniques and Laboratory manual – M.L Sisodhia and G.S. Ragunvanshi – Wiley Eastern Limited – 1987.

8) Molecular interactions Vol(2) – Rataj C Zak and Orville –Thomas – Wiley Interscience

9) The teory og rate processes – Glasstone S., Laider K.J., and Eyring H., - McCrawHill 1941.

10) Application Note – Fellner – Fldog ,HP Co. Polo, Auto California 1972.

11) Dielectric materials and applications – Von-Hippel A.R., John Wiley and Sons. NY 1974.

12) Dielectric Relaxation – Daniel V. E., Academic Press., London 1967.

M.Phil Question Paper Pattern
Maximum: External – 60 Marks, Internal – 40 Marks

Section – A: Either or type Questions (5x6=30 Marks) (1 pair from each unit)
Section – B: 3 Out of 5 (3x10=30 Marks) (1 Question from each Unit)

Signature of the HOD