RAJAH SERFOJI GOVERNMENT COLLEGE(AUTONOMOUS)

(Reaccredited with 'A'Grade by NAAC)

(Affiliated to Bharathidasan University, Tiruchirappalli)

THANJAVUR – 613 005,

TAMIL NADU.

DEPARTMENT OF PHYSICS

CURRICULUM AND SYLLABUS

Academic year 2022-2023 onwards.

RAJAH SERFOJI GOVT. COLLEGE(AUTONOMOUS)
Re accredited with 'A' Grade by NAAC
(Affiliated to Bharathidasan University, Tiruchirappalli)
Thanjavur – 613 005, Tamil Nadu, India

DEPARTMENT OF PHYSICS

BOARD OF STUDIES

IN PHYSICS

Date: 18.08.2022

BOARD OF STUDIES MEETING – 18.08.2022

The Board of Studies (BOS) meeting in Physics was held on 18.08.2022 (Thursday) at 11.00 am in the Department of Physics under the chairmanship of Dr. A. Santhanam Head, Department of Physics. The following members were present in the meeting.

INTERNAL MEMBERS		SIGNATURE
1. Dr. G. Rani	-	18/8/22.
2. Dr. S. Sakthivel	-	
3. Dr. S. Rosepriya	-	18-8-22
4. Mrs. S. Senthilkumari	-	18/08/2022
5. Dr. B. Shanmugapriya	-	18/8/22
6. Dr. S. Nilavazhagan.	-	18/8/22
7. Dr. C. Kumar	-	18/8/22
8. Dr.S. Veera Rethina Murugan	-	18/8/22
9. Dr. T. Ganesh	-	18/8/22
10. Dr. N. Chidambaram.	-	18/8/22
11. Dr. D. Anbuselvan	-	18/8/22
12. Dr. P. Jagdish	-	
13. Dr. P. Paramasivam	-	18/8/22

EXTERNAL MEMBERS: - **SIGNATURE**

1. Dr.T. Sabari Girisun
   (University Nominee) -
2. Dr. R. S. Sundararajan
   (Subject Expert) -
3. Dr. S. Valanarasu
   (Subject Expert) -
4. Mr. T. Manoharan
   (Representative from Industry/
   Corporate relating to placement) -
5. Dr. T. Arivudai Nambi
   (PG Meritorious alumni) -

The syllabus for B.Sc., physics (Major and Allied), M.Sc., physics and M.Phil., physics under CBCS system was discussed, corrections/changes were made and finalized. The finalized syllabus was approved in the meeting held on 18.08.2022. This syllabus is for the candidates admitted from the academic year 2022-2023.

Dr. A. Santhanam

(Chairman, BOS-Physics)
HEAD,
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M.PHIL.

RAJAH SERFOJI GOVT COLLEGE (AUTOMONOUS), THANJAVUR-5

M.Phil. PHYSICS COURSE STRUCTURE

(For candidates admitted from the academic year 2022-2023)

PART	CODE	COURSE	TITLE	MARKS		TOTAL	EXAM HOURS	CREDIT
			I SEMESTER	IA	WE		3	
III	A1MPH1	CC1	Research Methodology	25	75	100	3	4
III	A1MPH2	CC2	Advanvced Physics	25	75	100	3	4
III	A1MPTL3	CC3	Teaching and Learning Skills	25	75	100	3	4
III		CC4	Guide Paper*	25	75	100	3	4
		TOTAL				400		16
			II SEMESTER					
				V.V	Dis	TOTAL		
III	A2MPHD	CC5	Dissertation and viva voce	50	150	200		8
	GRAND TOTAL					600		24

Guide Paper*	
A1MPH4A	Crystal Growth and Application to Nano Materials
A1MPH4B	Thin Flim Physics
A1MPH4C	Physics of Dielectric Materials
A1MPH4D	Chemical Physics
A1MPH4E	Nano-Materials
A1MPH4F	Nano Materials and Applications

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

Passing Minimum is prescried for Internal and External

a) The Passsing minimum for CIA shall be 50% out of 25 Marks(ie 12 Marks)

b)The Passing minimum for Autonomous Examinations shall be 50% out of 75 marks (ie 38 Marks)

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Course: CC1

Credits :4

Code: A1MPH1

RESEARCH METHODOLOGY

(For Students admitted from 2022-2023)

OBJECTIVE

- To have the knowledge on literature survey on research fields

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 guideand 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 thesis Illustrations 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.

OUTCOME

By the end of the course the students will be able to

- Have knowledge on various research fields to proceed in a systematic and in scientific methodologies.

BOOKS FOR STUDY

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).

BOOKS FOR REFERENCE

1. 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).
2. E. Balagurusamy. Programming in ANSI C. 6th Edition. Tata McGraw Hill Education Private Limited, New Delhi, India. (2012).
3. K. Ravichandran, K. Swaminathan, and B. Sakthivel. Introduction to Thin Films.

Question Paper Pattern

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

Part-A 10x2=20 Marks Answer ALL Questions (Two questions from each unit)

Part-B 5x5=25 Marks Answer ALL Questions (Either or Type-Two questions from each unit)

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

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Course: CC2 **Credits :4**

CODE: A1MPH2

ADVANCED PHYSICS

(For students admitted from 2022-2023)

OBJECTIVE

- To know about defects and solids, high vacuum technology, ultrasonic and non conventional energy sources

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 electroluminescence Glow curve-absorbtion and emission spectra.

UNIT 2: PREPARATION TECHNIQUES

CHEMICAL METHODS: Electroplating-ion plating-Chemical reduction plating-vapourphase 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.

UNIT5: 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.

OUTCOME

By the end of the course the students will be able to

- Infer fundamentals of imperfections of solids, production of ultrasonics and various non conventional energy sources.

BOOKS FOR 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)

BOOKS FOR REFERENCES

1. Fundamentals of Microprocessor 8085: Architecture Programming, and Interfacing, Viswanathan, S. Printers & Publishers Pvt Ltd,(2009)
2. Fundamentals of Microprocessor and computers by Badri Ram, Dhanpat Rai and sons, New Delhi,(1995.)
3. Industrial Electronics and Control S.K.Battarcharya,S.Chatterjee, Tata McGraw Hill,(2001)
4. Laser: Theory and Application, Thyagarajan, K.; Ghatak, A. K. New York, Plenum Press, (1981.)

Question Paper Pattern

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

Part-A 10x2=20 Marks Answer ALL Questions (Two questions from each unit)

Part-B 5x5=25 Marks Answer ALL Questions (Either or Type-Two questions from each unit)

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

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Semester – I
Course :CC3

Credit: 4
Code : A1MPTL3

TEACHING AND LEARNING SKILLS

(Common Paper for All M.Phil. Courses)
(For Students admitted from 2022 -2023)

UNIT I

Computer Application Skills. Computer system: Characteristics, Parts and their functions. Different generations of Computer. Information and Communication Technology (ICT): Definition, Meaning, Features, Trends–Integration of ICT in teaching and learning –ICT applications: Using word processors, spread sheets, Power point slides in the classroom–ICT for Research: On-line journals, e-books, Courseware, Tutorials, Technical reports, Theses and Dissertations.

UNIT II

Communication Skills. Communication: Definitions. Elements of Communication: Sender, Message, Channel, Receiver, Feedback and Noise–Types of Communication: Spoken and written; Non-verbal communication–Intrapersonal, Interpersonal, Group and Mass communication–Barriers to communication: Mechanical, Physical, Linguistic & Cultural –Skills of communication: Listening, Speaking, Reading and writing –Methods of developing fluency in oral and written communication – style, Diction and Vocabulary –Classroom communication and dynamics.

UNIT III

Communication Technology: Bases, Trends and Developments –Skills of using Communication Technology. Computer Mediated Teaching: Multimedia, E-content –Satellite based communication: EDUSAT and ETV channels, Communication through web: Audio and Video applications on the Internet, interpersonal communication through the web.

UNIT IV

Pedagogy. Instructional Technology: Definition, Objectives and Types–Difference between Teaching and Instruction–Lecture Technique: Steps, Planning of a Lecture, Delivery of a lecture–Narration in tune with the nature of different disciplines –Lecture with power point presentation – Versatility of lecture technique –Demonstration, Characteristics, Principles, Planning Implementation and Evaluation –Teaching –Learning Techniques: Team Teaching, Group discussion, Seminar, Workshop, Symposium and Panel Discussion –Models of teaching: CAI, CMI and WBI.

UNIT V

Teaching Skills. Teaching skill: Definition, Meaning and Nature –Types of Teaching skills: Skill of Set Induction, Skill of Stimulus Variation, Skill of Explaining, Skill of Probing Questions, Skill of Black Board writing and Skill of Closure –Integration of Teaching Skills–Evaluation of Teaching Skills.

BOOKS FOR REFERENCE

1. Bela Rani Sharma (2007), Curriculum Reforms and Teaching Methods, Sarup and sons, New Delhi .
2. Don Skinner (2005), Teacher Training, Edinburgh University Press Ltd., Edinburgh.
3. Information and Communication Technology in Education: A Curriculum for Schools and programme of Teacher development, Jonathan Anderson and Tom Van Weart, UNESCO, 2002
4. Kumar K.I (2008) Educational Technology, New Age International Publishers, New Delhi
5. Mangal, S.K. (2002) Essential of Teaching –Learning and Information Technology, Tandon Publications, Ludhiana.
6.Michael D. and William (2000), Integrating Technology into Teaching and Learning: Concepts and Applications, Prentice Hall, New York.
7. Pandey S.K. (2005) Teaching Communication, Commonwealth Publishers, New Delhi.
8. Ram Babu A. and Dandapani S (2006) Microteaching (Vol.1&2) Neelakamal Publications, Hyderabad
9. Singh V.K. and Sudarshan K.N. (1996) Computer Education, Discovery Publishing Company, New York.

Question Paper Pattern

Maximum Marks: 75 Marks **Exam Duration: 3 Hour**

Part – A – 10X2=20 Marks (Two Question from Each Unit)
Part – B – 5X5=25 Marks (Either or type – Two Questions from Each Unit)
Part – C – 3 X10=30 Marks (Three out of five and One Question from Each Unit)

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Course: CC4 **Credits: 4**

Code: A1MPH4A

CRYSTAL GROWTH AND APPLICATIONS TO NANOMATERIALS

(For Students admitted from 2022-2023)

OBJECTIVE

- To have the knowledge on literature survey on research fields

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 – largeelectrochromic display devices.

OUTCOME

By the end of the course the students will be able

- Acquire knowledge on crystal growth and applications to nanomaterials.

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

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

Part-A 10x2=20 Marks Answer ALL Questions (Two questions from each unit)

Part-B 5x5=25 Marks Answer ALL Questions (Either or Type-Two questions from each unit)

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

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Course: CC4 **Credits: 4**

Code: A1MPH4B

THIN FILM PHYSICS

(For Students admitted from 2022-2023)

OBJECTIVE

- To have the knowledge on 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.

OUTCOME

By the end of the course the students will be able to

- Acquire knowledge on Thin Flim Physics and applications.

BOOKS FOR STUDY

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).

BOOKS FOR REFERENCE

1.Thin film Phenomena –K.L.Chopra McGraw Hill NY (1969).

Question Paper Pattern

Maximum Marks: 75 Marks **Exam Duration: 3 Hrs**
Part-A 10x2=20 Marks Answer ALL Questions (Two questions from each unit)
Part-B 5x5=25 Marks Answer ALL Questions (Either or Type-Two questions from each unit)
Part-C 3x10=30 Marks Answer Any Three Questions (Three out of Five-one question from each unit)

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Course: CC4 **Credits :4**

Code: A1MPH4C

PHYSICS OF DIELECTRIC MATERIALS

(For Students admitted from 2022-2023)

OBJECTIVE

- To have the knowledge on 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.

UNIT4: 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: POLYMER

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.

OUTCOME

By the end of the course the students will be able to

- Acquire knowledge on Physics of dielectric materials.

BOOKS FOR STUDY

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).

BOOKS FOR REFERENCE

1) Polymer Science V.R. Gowariker, N.V. Viswanathan and Jayadev Sreedhar – New Age International (P) Ltd (1986).
2) Dielectric materials and applications – Von – Hippel A.R., John wiley and Sons Inc., New York (1974).
3) Dielectric Relaxation – Daniel V. E., Academic Press., London (1967).
9) Molecular interactions Vol(2) – Rataj C Zak and Orville –Thomas – Wiley Interscience(1982).
4) A special issue on conducting polymers – Indian journal of Chemistry Sec A – (1994).
5) Handbook of conducting polymers – Terje A. Skotheim – Marcel Dekkar Inc (1986).
6) Text book of Polymer Science-F.W. Bill Mayer-Wiley International Publications-(1984).

Question Paper Pattern

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

Part-A 10x2=20 Marks Answer ALL Questions (Two questions from each unit)

Part-B 5x5=25 Marks Answer ALL Questions (Either or Type-Two questions from each unit)

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

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Course: CC4 Credits: 4

Code: A1MPH4D

CHEMICAL PHYSICS

(For Students admitted from 2022-2023)

OBJECTIVE

- To have the knowledge on 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 theoryand 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 – Fewand 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 – dipolemoment derivatives – enhancement of intensity in H-bonding system.

OUTCOME

By the end of the course the students will be able to

- Acquire knowledge on Chemical Physics

BOOKS FOR STUDY

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-(1980).
5) Hydrogen bond – G.C.Pimental and A.L.Mcclellan-Annual review of Physical Chemistry-(1971).

BOOKS FOR REFERENCE

1) Hydrogen bonding - S.N. Vinogradov and R.H.Linnell- Van Nostrand Reinhold Co. London.(1971)
2) Microwave techniques and laboratory manual – M.L Sisodhia and G.S. Raguvanshi – WileyEastern Limited – (1987).
3) Molecular interactions Vol.(2) –H. Ratajczak and J.Orville –Thomas – Wiley InterscienceNY-(1982).
4) Dielectric materials and applications – VonHippel A.R., John Wiley and Sons. NY (1954).
5) Dielectric Relaxation – DanielVera., Academic Press.,1st Edition London (1967).

Question Paper Pattern

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

Part-A 10x2=20 Marks Answer ALL Questions (Two questions from each unit)
Part-B 5x5=25 Marks Answer ALL Questions (Either or Type-Two questions from each unit)
Part-C 3x10=30 Marks Answer Any Three Questions (Three out of Five-one question from each unit)

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Course: CC4 **Credits :4**
Code: A1MPH4E

NANOMATERIALS

(For Students admitted from 2022-2023)

OBJECTIVE

- To have the knowledge on Nano materials

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.

OUTCOME

By the end of the course the students will be able to

- Acquire knowledge on Nano materials

BOOKS FOR STUDY

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.

BOOKS FOR REFERENCE

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.

Question Paper Pattern

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

Part-A 10x2=20 Marks Answer ALL Questions (Two questions from each unit)

Part-B 5x5=25 Marks Answer ALL Questions (Either or Type-Two questions from each unit)

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

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

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CONTROLLER OF EXAMINATIONS
RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMOUS)
THANJAVUR-613 005

Course: CC4 **Credits: 4**

Code: A1MPH4F

NANO MATERIALS AND APPLICATIONS

(For Students admitted from 2022-2023)

OBJECTIVE

- To have the knowledge on 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.

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.

OUTCOME

By the end of the course the students will be able to

- Acquire knowledge on nano materials and applications.

BOOKS FOR STUDY

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

BOOKS FOR REFERENCE

1. Willard, "Instrumental Methods of Analysis", Van Nostrand, 2000
2. J. Goldstein, D. E. Newbury, D.C. Joy, and C.E. Lyman et.al, Scanning Electron Microscopy and X-ray Microanalysis, Springer Publications, 2003.
3. Francois Leonard, The Physics of Carbon Nanotube Devices, William Andrew Inc.,2009.

Question Paper Pattern

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

Part-A 10x2=20 Marks Answer ALL Questions (Two questions from each unit)

Part-B 5x5=25 Marks Answer ALL Questions (Either or Type-Two questions from each unit)

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

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CONTROLLER OF EXAMINATIONS
RAJAH SERFOJI GOVERNMENT COLLEGE (AUTONOMO
THAN 005.

Code : A2MPHD

Course: CC5
Credits: 8

OBJECTIVE

- To develop the innovative thinking in project to make application oriented working models for theoretical concepts.

DISSERTATION AND VIVA VOCE

OUTCOME

- This will bring out innovative ideas from the students

EVALUATION

Viva Voce Examination: 50 Marks

Dissertation: 150 Marks

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