M.PHIL. SYLLABUS - 2013

PHYSICS

DEPARTMENT OF PHYSICS

St. JOSEPH'S COLLEGE (Autonomous)

Accredited at 'A' Grade (3rd Cycle) by NAAC
College with Potential for Excellence by UGC

TIRUCHIRAPPALLI – 620 002

GUIDELINES FOR FULL TIME M.Phil.

1. **Duration :** The programme runs for one year consisting of two semesters. The Semester-I is from August to February and the Semester- II runs from March to August, of the consecutive year.

2. **Course Work :**

Semester – I			Semester - II		
Course	**Title**	**Cr**	**Course**	**Title**	**Cr**
C1	General Skills for Teaching & Learning	3	C5	Dissertation (Topic selected should be relevant to the topic of the Guide Paper)	8
C2	Research Methodology	4			
C3	Core Subject	5			
C4	Guide Paper	5			
	Total	17		Total	8

2. a. Each Course should contain 5 units, covering the subject requirements of the courses offered.

Marks for CIA and SE are in the ratio 40 : 60.

The CIA components are **Mid Semester Test (25), End Semester Test (25), Seminar (15), Objective Type Assignment Test (15)**. The total mark 80 will be converted into 40 marks. **The tests and Semester Examination are centrally conducted by COE for 3 hours.**

CIA & SE	Tentatively on
Mid Semester Test	December 2nd Week
End Semester Test	February 2nd Week
Semester Examinations	February 4th Week

Scholar should acquire **a minimum of 20 marks from CIA to appear for SE.** He/She will be declared to have passed in the various courses in Semester I, provided he/she secures not less than 50 marks on an aggregate (CIA+SE).

2b(i). In course C1 on ' **General Skills for Teaching & Learning'** the first 3 units are common to all the departments of our college. The first three unit titles are **Soft Skills, E-teaching & E-learning, Elements of Technology of Teaching and Learning.** The remaining two units are department specific to make use of the above mentioned skills & techniques to teach the course subject at the Allied / UG level. This paper is (to be) designed to exploit the various teaching-learning- research skills to be imbibed / cultivated to make the research scholars to be fit for the profession they would likely to acquire in the Education Industry. Thus only for the course (C1) the written component is 60% and Practical component 40% both in CIA and SE.

2b(ii) **EVALUATION for C1:**

Theory Component: For both CIA & SE, there will be a 2 hour test only from the first THREE units. The CIA components are Mid Semester Test (35), End Semester Test (35) and Assignment (30). The total 100 will be converted into 25 marks.

Practical Component: The last TWO units are department specific. There is no Mid and End Semester Tests. But the CIA for the same are assessed continuously by the teacher(s) concerned totaling 15 marks. For SE, the Practical evaluation is done by an external examiner.

2. c. Question papers for C1, C2 & C3 are set by external examiner.

2. d. Question paper for C4 will be set and valued by the Research Advisor only.

3. CREDITS

	Courses	Title		Contact Hrs.	Library Hrs.	Total Hrs.	Cr	CIA Mk	SE Mk	Total Mk
SEMESTER-I	C1	General Skills for Teaching & Learning	T	3	2	5	2	25	35	60
			P	2	2	4	1	15	25	40
	C2	Research Methodology		5	4	9	4	40	60	100
	C3	Core Subject		5	5	10	5	40	60	100
	C4	Guide Paper		5	5	10	5	40	60	100
	Total			**20**	**18**	**38**	**17**	**160**	**240**	**400**

		INTERNAL			EXTERNAL		
			Cr	Mk		Cr	Mk
SEMESTER-II	C5 – DISSERTATION	Seminar & Review of Related Literature	2	15	Dissertation Evaluation	6	75
		Mid term review Presentation	2	15	*Viva-voce*	2	25
		Dissertation work	3	60			
		Viva-Voce	1	10			
		Total	**8**	**100**		**8**	**100**

4. Question Pattern

	Course	Mid & End Semester Tests and Semester Examinations		
Science	C1	Section A : Short Answers Section B : Either / Or – Essay Type	7/9 3	7 x 2 = 14 3 x 7 = 21
	C2	Section A : Short Answers Section B : Either / Or – Essay Type	10 5	10 x 2 = 20 5 x 8 = 40
	C3	Section A : Short Answers Section B : Either / Or – Essay Type	10 5	10 x 2 = 20 5 x 8 = 40
	C4	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
	Course	**Mid & End Semester Tests and Semester Examinations**		
Arts	C1	Section A : Short Answers Section B : Either / Or – Essay Type	7/9 3	7 x 2 = 14 3 x 7 = 21
	C2	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
	C3	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
	C4	Open Choice : Comprehensive Type	5/8	5 x 12 = 60

5. Dissertation

For carrying out the dissertation, it is mandatory to strictly adhering to the rules of the college as given below:

5.1 Requirement

Every student is expected to give two seminars one concerning Review of Related Literature within the four weeks from the beginning of the second semester and the other on Data Analysis/Result/Mid Term Review just before the submission of the final draft of the dissertation

5.2 Submission

Candidates shall submit the Dissertations to the Controller of Examination **not earlier than five months but within six months** from the date of the start of the Semester –II. The above said time limit shall start from 1st of the month which follows the month in which Semester - I examinations are conducted. If a candidate is not able to submit his/her Dissertation within the period stated above, he/she shall be given an extension time of **four** months in the first instance and another **four** months in the second instance with penalty fees. If a candidate does not submit his/her Dissertation even after the two extensions, his/her registration shall be treated as cancelled and he/she has to re-register for the course subject to the discretion of the Principal. However the candidate need not write once again the theory papers if he/she has already passed these papers.

At the time of Submission of Dissertation, the guide concerned should forward the mark for 90% as stated above to the COE in a sealed cover

5.3 Requirement

For the valuation of dissertation it is mandatory to have passed in all the four courses. One external examiner and the Research Adviser shall value the Dissertation. The external examiner should be selected only from outside the college and shall be within the colleges affiliated to Bharathidasan University. In case of non-availability, the panel can include examiners from the other university/colleges in Tamil Nadu. The external examiner shall be selected from a panel of 3 experts suggested by the Research Adviser. However, the Controller of Examination may ask for another panel if he deems it necessary. Both the internal and external examiner will evaluate the Dissertation and allot the marks separately. However the *viva-voce* will be done by both of them. The average marks will be considered.

5.4 *Viva-Voce*

The external examiner who valued the Dissertation and the Research Adviser shall conduct the *Viva-Voce* for the candidate for a maximum of 100 marks. A Candidate shall be declared to have passed in *viva-voce* if he/she secures not less than 50% of the marks prescribed for Dissertation and 50% of the marks in the aggregate of the marks secured in *viva-voce* and Dissertation valuation. *A student can undertake dissertation in the second semester whether or not he/she has passed the first semester*.

6. CLASSIFICATION OF SUCCESSFUL CANDIDATES

6.1 The candidates who pass the Semester– I and Sem ester – II examinations in their first attempt shall be classified as follows:

No.	Total Marks secured in Semester – I and Semester – II Examinations	Classification
1.	80% and above in the case of Science Subjects & 75% and above in the case of Arts and Social Science Subjects	I Class with Distinction
2.	60% to 79% in the case of Science Subjects & 60 % to 74% in the case of Arts and Social Science Subjects	I Class
3.	50% to 59% in all the subjects	II Class

Note : Mathematics, Statistics and Computer Science/ Application shall be treated as Science Subjects

6.2 Candidates who pass the courses in more than one attempt shall be declared to have completed the programme under II Class.

6.3 Candidates who have failed in the courses may take the supplementary exams conducted by the COE immediately. Even then if they could not complete the course(s), they will be given two more chances only to appear for those courses along with the next batch scholars. The maximum duration for the completion of the M.Phil. Programme is 2 Years.

7. ATTENDANCE

Daily attendance for 90 working days should be enforced for the students.

Periodical report of a student to he guide concerned should be recorded in he register kept by the guide.

8. Scholar must obtain 80% of attendance per semester in order to appear for the Semester Examinations/*Viva-Voce*

M.Phil. Physics Course Pattern – 2013

Sem	Code	Title of the paper
I	13 MPH 101	Course – C1 : General Skills for Teachin g and Learning
	13 MPH 102	Course – C2 : Research Methodology
	13 MPH 103	Course – C3 : Advanced Physics
	13 MPH 104A	Course – C4 : Dielectric Thin Film Phys ics
	13 MPH 104B	Course – C4 : Semiconductor Thin Film P hysics
	13 MPH 104C	Course – C4 : Microcontroller And Inter facing Techniques
	13 MPH 104D	Course – C4: Materials Science
	13 MPH 104E	Course – C4 : Thin Film Sensors
	13 MPH 104F	Course – C4 : Laser Physics
	13 MPH 104G	Course – C4 : Phonon Physics
	13 MPH 104H	Course – C4 : Principles and Methods of Crystal Growth
	13 MPH 104I	Course – C4 : Lattice Dynamics
	13 MPH 104J	Course – C4 : Chemical Physics
	13 MPH 104K	Course – C4 : Microprocessor And Its A pplications
	13 MPH 104L	Course – C4 : Liquid State Chemical Phy sics
	13 MPH 104M	Course – C4 : Instrumentation And Contr ol
	13 MPH 104N	Course – C4 : Crystal Growth
	13 MPH 104O	Course – C4 : Thin Film Technology and its Applications
	13 MPH 104P	Course – C4 : Crystal Growth And Char acterization Techniques
	13 MPH 104Q	Course – C4: Crystal Growth Processes a nd its Characterization Techniques
	13 MPH 104R	Course - C4 : Principles of Nanotechnology
	13MPH 104S	Course – C4: Liquid State Chemical Physi cs
	13 MPH 104T	Course – C4 : Liquid State Chemical Phy sics with Spectrsocopic Confirmation
II	13 MPH 205	Course – C5 : Dissertation

13 MPH 101 **PAPER – 1**

C1 - GENERAL SKILLS FOR TEACHING AND LEARNING

Objective

1. To enhance the employability of the students by empowering them with Soft Skills.
2. To provide students a theoretical background of educational psychology and its important concepts.
3. To help them understand the application of theories of educational psychology in education practice.
4. To enable them to understand the nature of growth and development, learning, motivation and its various educational implications.

Unit-I : SOFT SKILLS

a) Communication Skills : Oral – Written - Verbal – Non-Verbal – Aids and blocks – Active Listening & Passive Listening – Intrapersona l and Interpersonal communication – Effective Communication.
b) Behavioral Skills : Attitude – Time Management – Leadership – Team building.
c) Lateral Thinking: Conventional teacher and Lateral teacher – Creativity and innovation.
d) Facing Interviews: Different types of Interviews – Dress Code – Do's and Don'ts – Frequently asked questions – preparing a resume – M ock Interviews.
e) Group Dynamics – Knowledge – Leadership – Thinking – Listening – Mock GDs.

Unit-II : e-LEARNING & e-TEACHING

- An overview of Microsoft Office-2007: MS Word-2007 – MS Excel-2007 – MS Powerpoint-2007
- Concepts in e-Resources and e-Design: World Wide Web Concepts – Making use of Web Resources – Web site Creation Concepts – Creati ng Web pages by using Web page Editors – Creating Web Graphics - Creating Web Audi o Files.

UNIT-III : ELEMENTS OF TECHNOLOGY OF TEACHING AND LEARNING.

Psychology – Meaning Branches Scope and Methods – E merging areas of Educational Psychology – kinds and levels of Learning – Differe nt theories of learning – Factors affecting learning – Intrinsic and extrinsic motivation – mot ivation – Memory and forgetting – Approaches to learning (Pavlov, skinner) – Creative thinking – theories of intelligence.

UNIT IV : Methods of Teaching Physics:

Motivation: Growth and goal of physics – impact of research on teaching and learning – Cognitive model for instruction: Five foothold principles – Instructional methods derived from cognitive models – Models of the class room: t raditional instructor-centered environment – The active engagement student-centere d environment – Lecture based methods: Traditional lecture – Interactive lecture demonstration – Just-in-time teaching.

UNIT V : Learning, Teaching and Evaluation Practice

- Teacher assisted class room teaching- assignment – (5 classes) and Teacher evaluation and suggestions.
- Teacher assisted laboratory practice – assignment – (5 lab sessions) and teacher evaluations and suggestions.

BOOK FOR REFERENCE

REFERENCE

1. Prof. G. Ravindran, Dr. S.P.B. Elango and Dr. L. Arockiam: Success through Soft Skills.
2. Dr. K. Alex: Soft Skills.
3. Edward De Bono: Lateral Thinking.
4. Joyce Cox, Curtis Frye etc., Step by 2007 Microsoft Office System, Prentice Hall of India Private Ltd., New Delhi, 2007 : Chapters: 1-8 & 13-16
5. Margaret Levine Young, Internet: The Complete Reference, Tata McGraw Hall, Publishing company Ltd., New Delhi, 2007: Chapters: 16 & 25-30.
6. Educational Psychology in classroom – Lindaren H enrry-Asia Publishing Home. Psychology of Class room Learning – Holt Richard.
7. Teaching Physics with the physics suite – Edward F. Redish.

13 MPH 102 **Paper : 2**

C2 - RESEARCH METHODOLOGY

UNIT I : TECHNIQUES FOR RESEARCH

Identification of the problem–determining mode of attack–literature survey–references – awareness of current status of the art - abstraction of a research paper – possible ways of getting abreast of current literature – Rol e of scholar and guide.

UNIT II : TECHNIQUES OF SCIENTIFIC WRITING

Scientific Writing - definition – organizing a sci entific paper – Title – listing of authors and address – abstract – introduction – mat erials and methods section – results section – discussion section – acknowledgement – re ferences – design of effective tables – effective illustrations – manuscript – submission – review process – publishing process – reprints – review paper – conference report – oral and poster presentation – thesis — usage of English.

UNIT – III : DATA ANALYSIS AND INTERPRETATION

Basic concepts and definitions on data and error - various types of data and their error – propagation of errors – four steps to a meaningfu l experimental results. Basic statistical concepts – best estimate of true value of data – me asure of dispersion – confidence level –

central limit– significance test – chi square test for goodness of fit – criteria for goodness of fit . Graphical Representation – equations – functi onal relationships – sequential differences – method of extended differences – method of least sq uares. Analysis and Interpretation using MS-XL and Origin

UNIT IV : RESEARCH EQUIPMENTS

Working principles and applications of UV-VISIBLE, IR, FTIR, XRD, SEM, TEM, SPM, Hardness tester, Hall effect kit, Four probe unit, Ultrasonic interferometer, Dielectric measurement unit (solid/liquid) – Thin film vacuum coating unit.

UNIT V : APPLIED MATHEMATICAL FUNCTIONS AND TRANSFORMS

Hypergeometric equation- various cases - integral representations - applications of Fourier series to periodic functions and forced vibrations. Fourier Transform theory: Fourier Transform of a Time Dependent Function – Some Impor tant Theorems – The Convolution theorem – The Gaussian Wave Packet in Quantum Mecha nics – Three dimensional Fourier transform - The Use of Fourier Transforms in Solving Differential Equations.

Book for reference:

Unit

I Research in Education, Best, McGraw Hill, in 1986.

II How to write and publish a scientific paper – (4th edn), Robert A. Day.

III Instrumentation Measurement Analysis, BC Nakra, KK Chaudhry, Tata McGraw Hill 2004/2e (Relevant Sections from Chapter 2, 21, 22).

V Mathematical Physics, AK Ghatak, IC Goyal & SJ Chua Macmillan. Delhi, 2002, Ch. (secs.) 8(8.2-8.4), 9(9.3 & 9.4), 10(10.3,10.5,10.6,10.8-10.10, 10.14).

13 MPH 103 **Paper : 3**

C3 - ADVANCED PHYSICS

Unit –I : IMPERFECTIONS IN CRYSTALS

Introduction- classifications of imperfections – co ncentration of vancancies – Schottky defects – Frenkel defects – Extrinsic vacancies- Va cancies and diffusion through solids – Colour centers – excitons – dislocations – Dislocat ion energies – Dislocation and shear strength of single crystals – Plane defects – The S onder-Sibley notation rules for point defects in insulators

Unit-II : PHOTONICS

Postulates of ray optics and wave optics – Gaussian beam – transmission through optical components – Fourier optics – optical Fourier trans form – diffraction of light – Holography – guided wave optics : planar mirror wave guides, dielectric wave guides – Fiber optics : Step index and graded index fibers – principles of elect ro optics – electro optics in anisotropic and liquid crystals – fiber optics communications: com ponents, modulation, multiplexing and coupling – coherent optical communications.

UNIT III : APPLIED GROUP THEORY

Diagonalization of matrix – homomorphism and isomo rphism – matrix representations: reducible and irreducible – Format ion of character table and representation for C_{2v}, C_{3v} and C_{4v} group. Generators of continuous groups – rotation groups SO(2), SO(3) – rotation of function and orbital angular momentum: SU(2) – SO(3) homomorphism – SU(2) isospin and SU(3) eightfold way .

UNIT – IV: INSTRUMENTATION AND CONTROL SYSTEM

Introduction to Instruments – sensors and transduce rs – elastic – resistive – Inductive – Capacitive – Thermo-electric – Piezo electric – ele ctro-mechanical – electro-chemical – ultrasonic. Control: Introduction to control systems – Mathematical model of physical systems in transfer function and state space forms – response of dynamic systems – stability analysis – PID controller – tuning of controller pa rameters – Implementation of controller using microcontroller and digital computer.

UNIT - V: ASTROPHYSICS

Spectral classification of stars – Boltzmann's form ula-Saha's equation of thermal ionization – Harvard system of spectral classification-theory of sun spots-solar flares-stellar temperatures-classification of variable stars-erupting and exploding stars- distribution of novae in our galaxy-cosmology-red shift and the expansion of the universe.

BOOK FOR REFERENCE:

Unit

I Solid State Physics: Structure and Properties of Materials – MA Wahab Narosa Pub, Delhi 1999

I Solid state physics-Theory, applications and problems – S.L. Kakani, C.Hemrajani Sultan Chand & sons, 2005.

II Fundamentals of Photonics – Bahaa E.A. Saleh, W iley Series in Pure and Applied Optics, 2003.

III Mathematical Methods for Physicists – Arfken a nd Weber, Academic Press, USA, 2001.

IV Industrial Electronics and Control – SK Bhattach arya, S., Chatterjee, Tata McGraw Hill, New Delhi, 1995.

IV Instrumentation and control systems; by N. Bolton.

IV Handbook of Instrumentation and Control by V.S. Department of Energy.

V An Introduction to Astrophysics – Baidyanath Bas u – Prentice-hall of India-New Delhi, 1997.

13 MPH 104A **Prof. V W**

C4 - DIELECTRIC THIN FILM PHYSICS

UNIT 1: PREPARATION OF THIN FILMS:

Chemical methods: Electroplating - Ion plating - Chemical reduction plating – Vapour phase growth – Anodisation Physical methods: Vacuum evapo ration-The Sputtering – Reactive sputtering - RF sputtering - Dip coating Technique - spin coating technique**.**

UNIT 2: THICKNESS MEASUREMENT AND NUCLEATION GROWTH IN THIN FILMS:

Thickness measurements: electrical methods – microb alance 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: INSULATOR and DIELECTRIC FILMS:

Metal insulator contact-ohmic, neutral, blocking contacts-two electrode system-conduction mechanism in insulator films-photoconduction-experimental techniques. Dielectric properties-dielectric constant-dielectric loss-capacitance –breakdown voltage-polarization-effect of temperature and frequency on dielectric properties.

UNIT 4: OPTICAL PROPERTIES OF THIN FILMS:

Thin films optics – Theory – Optical constants of thin films – Experimental techniques – Size effects – multilayer optical syst ems – Interference filters-transmittance, reflectance absorption studies-band model for amorphous material-band gap calculation.

UNIT 5: **POLYMER THIN FILMS:**

Basic concepts-structure-solid state properties of polymers-polymer blends –interpenetrating network-process of polymer solution-solubility of amorphous and crystalline polymers-dielectric analysis –experimental methods-thermally stimulated current analysis.

BOOKS FOR STUDY AND REFERENCE

1. Hand Book of Thin Film Technology, L.I. Maissel and R. Glang, McGraw Hill Book co, New York, 1970.
2. Thin Film Phenomena: K.L. Chopra McGraw Hill Book co, New York, 1969.
3. Thin film fundamentals –A. Goswami, New age inte rnations pub., 2003.
4. Polymer Science and technology, Joel R. Fried, Prentice Hall PTR, 1995.
5. Polymer Science –V.R. Gowriker et al New age int ernational (P) Ltd., 2003.

13 MPH 104B **Prof. A R**

C4 - SEMICONDUCTOR THIN FILM PHYSICS

UNIT 1: PREPARATION OF THIN FILMS:

Chemical methods: Electroplating – Ion plating – Ch emical reduction plating –vapour phase growth. Anodisation – Vacuum evaporation: Evaporati on theory – sputtering methods: - Reactive sputtering – RF sputtering – preparation t echnique of Semiconducting chalcogenide binary and ternary compounds.

HIGH VACUUM TECHNOLOGY: Vacuum pump: oil- Sealed Rotary Pumps – Diffusion Pump. Pressure measurement: Thermal conductivity Gauges – Pressure Gauges for High to Ultra High Vacuum.

UNIT 2: THICKNESS MEASUREMENT AND NUCLEATION AND GROWTH IN THIN FILMS:

Thickness measurements: Electrical methods – microb alance monitors – optical interference methods multiple beam interferometry – Fizeau and F ECO methods – Quartz crystal thickness monitor.

Theories of nucleation – Four stages of film growth Incorporation of defects during growth.

UNIT 3: TRANSPORT AND MECHANICAL PROPERTIES:

Semiconducting films: Theory – preparation and prop erties – photoconducting – Field effect thin film transistors.

Properties of Semiconducting chalcogenide thin films (PbSe, CdSe, ZnSe, ZnTe and CdTe) Internal stress - Experimental techniques – Intrins ic stress – Anisotropic stress – Stress strain relation – Tensile strength.

UNIT 4: ELECTRICAL PROPERTIES:

Sources of resistivity in metallic conductors - Volt amp characteristics – resistivity – temperature coefficient - Lux – Ampere characterist ics of semi conducting thin films.

UNINT 5: OPTICAL PROPERTIES:

Thin films optics _ Theory – optical constants of t hin films – Experimental techniques – Size effects – Absorbance and Reflectance studies – Band gap studies of chalcogenide semiconducting films.

BOOKS FOR STUDY AND REFERENCE

1. Hand Book of Thin Film Technology: L.I. Maissel and R. Gland McGraw Hill, New York.
2. Vacuum Deposition of Thin Films: L. Hollond John Wiley & Sons Inc, New York, 1958.
3. Thin Film Phenomena: K.L. Chopra, McGraw Hill, New York, 1960.
4. Physics of Thin Films, Vol.I-12, Ed., George Hass and others.
5. Scientific foundations of Vacuum Technique, 2nd edn. S. Dushman, John Wiley & Sons Inc, New York, 1962.
6. Thin Film Solar Cells – K.L. Chopra and S. R. Da s. Plenum Press, New York, 1983.
7. Thin film fundamentals –A. Goswami, New Age Inte rnations Pub., 2003.

13 MPH 104C **Prof. ALR**

C4 - MICROCONTROLLER AND INTERFACING TECHNIQUES

Unit I. Microcontroller Architecture

Introduction – 8051 Register organization - Flags a nd Program status word- Program counter – Stack and stack pointer-Special function register s- Internal RAM – Internal ROM – Port organization –Address and data bus-External memory– Counters and timers – Serial ports- Interrupts- Oscillator and clock

Unit II. Assembly language programming and Instruction set of 8051

8051 Assembly programming – Program counter and ROM space – data type and directives – Flag bits and PSW Register Bank and Stack

Jump and Call instructions – I/O port programming- Addressing modes – Arithmetic, Logical, Bit instructions – Timer and counter – ser ial port – Interrupt Programming.

Unit III. Peripherals and Interfacing

Peripherals: Seven segment and Liquid Crystal Displays, Analog to Digital and Digital to Analog converters, Stepper motor, Keyboard, I^2C EEPROM, I^2C Real Time Clock and line drivers.- Peripherals interfacing with 8051.

Unit IV. Personal computer ports organization and Interfacing

Introduction to personal computer – Organization o f Parallel port SPP, EPP, ECP, RS232 Serial port, and USB port – interfacing and p rogramming with ports.

Unit V. Transducers

Electrical transducer – Selecting transducer – Res istive transducers – Strain gauges – Thermistor – Inductive transducer - LVDT – capaciti ve transducer – Photoelectric transducer - Opto couplers – The photo transducer – Semi condu ctor transducer.

Books for Study and Reference

1. Muhammad Ali Mazidi and Janice Gillispie Mazidi, The 8051 microcontroller and embedded Systems, Pearson education Pvt. Ltd., 2004.
2. Stephen J. Bigelow PC, Trouble Shooting and Repair, Dreamtech Press, New Delhi, 2003.
3. Kalsi H.S, Electronic Instrumentation, Tata McGraw Hill Publishing.

13MPH104D Prof.ALR C4 : M.Phil . – MATERIALS SCIENCE

UNIT 1: OPTICAL PROPERTIES AND LUMINESCENCE:

Absorbance, Reflectivity and Transmittance, Electronic aspects of Phosphors – Energy in a Phosphor – Properties associated with Phosphor – Fa ctors associated with energy conversion by Phosphors – Prediction of Electronic Transition Intensities – Mechanisms of Energy Transfer in Solids – Summary of Phonon Process as r elated to solids.

UNIT 2 : SYNTHESIS OF GLASS AND RE DOPED GLASSES

Introduction – Synthesis of glass and rare earth do ped glasses – Various methods, Optical properties – Thermal and Mechanical Properties , Fa ctors affecting laser Efficiencies, Color coordinates, the Luminescent center in Inorganic Materials – White LEDs – their Structures, internal Quantum Efficiency.

UNUIT 3 : RADIATIVE AND NON RADIATIVE RETURN AND ENERGY TRANSFER:

Introduction – general discussion of Emission from a Luminescent center, Rare earth ions – Line Emission and Band Emission – Stimulated Emissi on – Non – Radiative Transition in an isolated Luminescent center – Efficiency – Maximum Efficiency for high energy excitation, Photo ionization and Electron – Transfer Quenching, Energy transfer Between unlike Luminescent center- Energy transfer between identical luminescent center.

UNIT 4 : SPECTRAL INTENSITIES OF f-f TRANSITIONS

Introduction – Transition mechanism for Lanthanide ions – Definition of terms employed in intensity theory – magnetic dipoles transitions – J udd –Oflet theory for induced electric dipole transition – Hypersensitivity – Compositiona l dependence of the intensity parameters.

Unit 5 : ADVANCED EXPERIMENTAL TECHNIQUES:

Introduction – Glass sample Preparation and Charact erization – Xrd , Ftir, Raman, Epr, UV-Vis – NIR absorption , Photoluminescence, Decay Mea surements, DTA,TGA,and DSC.

Books for Study :

1. Studies in inorganic chemistry – Luminescence and t he solid state, R.C Ropp, Elsevier Publishers, (1990) . Chapter 7&8
2. Luminescent materials, G.Blasse and B.C Grabmaier Springer – Verleg(1994).Chapter 3,4,&5
3. Hand book on the physics and chemistry of rare earths, edited by K.A Gshneidner, Jr.and L.Eyring, Elsevier science publishers, (1987).chapters 167 & 58.
4. Properties , processing and application for glass and rare earths doped Glasses for optical Fibers, Edited by DANHEW K , Optoelectronic Research center, University of Southampton, Published by : INSPEC, the institution of electrical engineers, London United Kingdom, (1998)

13 MPH 104E **Prof. RA**

C4 - THIN FILM SENSORS

UNIT 1: PREPARATION OF THIN FILMS:

Chemical methods: Electroplating – Ion plating – Ch emical reduction plating –Vapour phase growth. Anodisation – Vacuum evaporation – Sputteri ng methods: - Reactive sputtering – RF sputtering – Dip coating technique.

HIGH VACUUM TECHNOLOGY: Rotary Pump – Diffusion Pum p. Pressure measurement – Pressure Gauges for High to Ultra High Vacuum.

UNIT 2: THICKNESS MEASUREMENT AND NUCLEATION AND GROWTH IN THIN FILMS:

Thickness measurements: Microbalance – Electrical m ethods - Optical interference methods - multiple beam interferometry – Fizeau and FECO met hods – Quartz crystal thickness monitor - Theories of nucleation – Four stages of film growth - Incorporation of defects during growth.

UNIT 3: UV-VISIBLE AND NEAR IR SEMICONDUCTOR SENSORS:

Silicon photo detector diodes – Properties - Chara cteristics of other silicon photo detectors - Indium – Gallium Arsenide detector diod es for fiber applications.

UNIT 4: IR AND FIR SENSORS:

Classification of IR detectors – Characteristics an d Measurements of IR detectors – IR detectors Materials – Far _IR detectors – Applicati ons.

UNIT 5: OPTICAL PROPERTIES:

Thin films optics _ Theory – optical constants of t hin films – Experimental techniques – Size effects – Absorbance and Reflectance studies – Band gap studies of semiconductor sensor materials.

BOOKS FOR STUDY AND REFERENCE

1. Hand Book of Thin Film Technology: L.I. Maissel and R. Gland McGraw Hill, New York, 1970.
2. Vacuum Deposition of Thin Films: L. Hollond John Wiley & Sons Inc, New York, 1958.
3. Thin Film Phenomena: K.L. Chopra McGraw Hill, New York, 1960.
4. Physics of Thin Films. Vol. I-12, Ed. George Hass and others.
5. Scientific foundations of Vacuum Technique, 2nd edn., S. Dushman, John Wiley & Sons Inc, New York, 1962.
6. Thin Film Solar Cells - K.L. Chopra and S.R. Das. Plenum Press, New York, 1983.
7. Thin film fundamentals – A. Goswami, New Age Intern ations Pub., 2003.
8. A sensors Comprehensive survey V6. Edited by W Gopal, J. Hesse, JN. Zend.

13 MPH 104F **Prof. NR**

C4 - LASER PHYSICS

UNIT 1 : THEORY OF LASERS:

Coherence – spatial and temporal – spontaneous and stimulated emission – amplification in a medium – population Inversion – rate equation – osc illation threshold – output power – optical resonator theory – pumping parameters.

UNIT 2 : TYPE OF LASERS:

Principle – design, construction and working of las er systems: Ruby laser – He-Ne laser – Co_2 laser – Nd:YAG laser – Dye laser – Semi conductor l asers.

UNIT 3 : OPTICAL RESONATORS:

Longitudinal mode locking – Q - Switching and cavit y damping – stable and unstable resonators – confocal and planar resonators – TEM $_{00,01,11}$ modes - Generation of ultrashort pulses.

UNIT 4: HOLOGRAPHY AND SCIENTIFIC APPLICATIONS:

Holography and holographic interferometer – polluti on monitoring – isotope separation - laser speckle and applications – laser communicatio n systems – optical sources for Fiber optic communication - medical applications of lasers.

UNIT 5: LASERS IN ENGINEERING:

Laser Materials Processing – Surface modification of materials – laser material interaction – laser beam shape – laser surface proc essing – hole drilling – laser cutting.

BOOKS FOR STUDY AND REFERENCE

1. Lasers and nonlinear Optics – B.B. Laud, New Age In ternational Pvt. Ltd., 2004.
2. Lasers Theory and Applications – Ghatak & Thyagaraj an, Macmillan India Ltd., 1997.
3. Lasers – K.R. Nambiar, New Age International Publis hers, 2004.

13 MPH 104G **Dr. Ce**

C4 - PHONON PHYSICS

UNIT 1: CLASSICAL & QUANTUM THEORIES OF LATTICE DYNAMICS:

Bloch's theorem – Point Symmetry and the Brillouin Zone. Equation of motion and lattice waves – Normal modes – Calculation of dispersion re lations – The long wave length limit – the Vibrational Spectrum. The adiabatic approximation – The phonon concept – creation and annihilation Operators – Matrix elements – Quan tization of field.

UNIT 2: THERMAL AND DIELECTRIC PROPERTIES OF CRYSTALS:

Thermodynamic functions - Lattice Specific heat – Atomic amplitudes and melting – Phonon – Phonon interactions – Thermal conductivity – thermal expansion. The dielectric constant – Long wavelength optical modes – the rigi d ion model – the polarizable ion mode - the shell model

UNIT 3: THE INELASTIC SCATTERING OF NEUTROS AND X – RAYS:

Basic principles – General formulation of neutron s cattering – Coherent and incoherent scattering – Coherent inelastic neutron scattering – thermal diffuse scattering of x-rays – The Debye - Waller factor.

UNIT 4: EFFECT OF DEFECTS ON THE VIBRATIONS OF CRYSTAL LATTICES- I

Time independent defect problems – Time dependent position and momentum correlation functions scattering of lattice wave by point defects – Defects with internal degrees of freedom – The use of symmetry and group theory in the lattice dynamical defect problems – Defect modes calculation.

UNIT 5: EFFECT OF DEFECTS ON THE VIBRATIONS OF CRYSTAL LATTICES- II.

One dimensional model – FG model – calculation of displacements for interstitial and its neighbours. Self consistent Phonons disordered solids – Phonons in disorded system Green's function in the defect crystals – Mixed crystals

BOOKS FOR STUDY AND REFERENCE

1. Lattice Vibrations by B. Donovan and J.F. Angress, 1970.
2. Progress in Physics – Lattice Dynamics – A reprint series. A.A. Maradudin et al., Institute of Physics and Physical Society London, 1969.
3. Solid State Physics Advance in Research and Applications Volume 10-Frederick Seitz and David Turnbull, Academic press, New York, 1960.
4. An introduction to Lattice Dynamics by A.K. Ghatak, L.S. Kothari, Addison pub, 1971.
5. Vibrational Spectroscopy of solids – Sherwood PM-Ca mbridge, 1972.
6. Current trends in Lattice dynamics – KR Rao (Educat ional) APT, Bombay, 1978.
7. Phonons in condensed matter Physics – R.K. Singh & S.P. Sanyal, Welly Eastern Ltd, 1990.
8. Advances in Phonon Physics – Philip (Ed) – Edu. Pub . & Distributors, Kochi, 2000.

13 MPH 104H **Dr. Ce**

C4 - PRINCIPLES AND METHODS OF CRYSTAL GROWTH

UNIT I : FUNDAMENTALS OF CRYSTAL GROWTH

Importance of crystal growth – classification of c rystal growth methods – basic steps: Generation, transport and adsorption of growth reactants – Nucleation: Kinds of nucleation – Classical theory of nucleation: Gibbs Thomson equations for vapour and solution – kinetic theory of nucleation – Becker and Doring concept on nucleation rate – energy of formation of a spherical nucleus – statistical theory on nucleat ion: Equilibrium concentration of critical nuclei, free energy formation.

UNIT II : THEORIES OF CRYSTAL GROWTH

An introductory note to surface energy theory, diffusion theory and adsorption layer theory – concepts of Volmer theory, Bravais theory, Kossel theory and Stranski's treatment – Two Dimensional nucleation theory: Free energy formation, Possible shapes and Rate of nucleation – Mononuclear, Polynuclear and Birth and Spread models – Modified Birth and Spread model – Crystal growth by mass transfer Proc esses: Burton, Cabera and Frank Bulk diffusion model, Surface diffusion growth theory.

UNIT III: EXPERIMENTAL CRYSTAL GROWTH PART-I : MELT & VAPOUR GROWTH TECHNIQUES

Basics of melt growth – heat and mass transfer – Co nservative growth processes: Bridgman – Stockbarger method – Czochralski pulling method – Kyropolous method. Non-conservative processes: Zone refining – Vertical an d Horizontal float zone methods – Skull melting method – Vernueil flame fusion method.

Basic Principles – Physical Vapour Deposition: – C rystallization in a closed system – Gas flow crystallization Chemical Vapour Deposition: Transport Agents, Sealed capsule method, open flow systems – Temperature variation m ethod: Stationary profile, linearly time varying profile and oscillatory profile.

UNIT IV: EXPERIMENTAL CRYSTAL GROWTH PART-II: SOLUTION GROWTH TECHNIQUES

Growth from low temperature solution : Selection of solvents and solubility – Meir's solubility diagram – Saturation and super-saturatio n – meta-stable zone width – growth by restricted evaporation of solvent, slow cooling of solution and temperature gradient methods – crystal growth in gel medium : Chemical reaction and solubility reduction methods –
Growth from high temperature solutions : Flux growth principles of flux method – Choice of flux – Growth by slow evaporation and slow cooling methods – Hydrothermal growth method.

UNIT V: CHARACTERISATION TECHNIQUES

Characterisation using X-ray powder method – single crystal methods – Spectroscopic methods : FTIR, Raman, SEM, Energy Depressive, S-ray (EDX), UV, Visible – Band Gap Energy calculation – Etching – Chemical Etching – T hermal properties of crystals – Thermogrametric analysis (TGA), Differential Thermogram (DTA) and Differential Scanning Calorimetry (DSC) – Vicker Microhardness .

BOOK FOR STUDY AND REFERENECE:

1. Crystal Growth Process, JC Brice, 1986, John Wiley and Sons, New York.
2. Crystallisation, JW Mullin, 2004, Elsevier Butterworth – Heinemann, London.
3. Crystal Growth: Principles and Progress, AW Vere, 1987, Plenum Press, New York.
4. Crystals: Growth, Morphology and Perfection, Ichiro Sunagawa, 2005, Cambridge University Press, Cambridge.
5. Crystal Growth, BR Pamplin, 1975, Pergamon Press, Oxford.
6. Crystal Growth Process and Methods, SP Santhanraghavan and P Ramasamy, 2000, KRU Pub, Kumbakonam.
7. Instrumental Methods of Analysis, HH Williard , LL Merritt, J Dean and FA Settle, 1986, CBS Pub, Delhi.

13 MPH 104I **Dr. NL**

C4 - LATTICE DYNAMICS

UNIT 1: CLASSICAL & QUANTUM THEORIES OF LATTICE DYNAMICS:

Bloch's theorem – Point Symmetry and the Brillouin Zone. Equation of motion and lattice waves – Normal modes – Calculation of dispersion re lations – The long wave length limit – the Vibrational Spectrum. The adiabatic approximation – The phonon concept – creation and annihilation Operators – Matrix elements – Quan tization of field.

UNIT 2: THERMAL AND DIELECTRIC PROPERTIES OF CRYSTALS:

Thermodynamic functions - Lattice Specific heat – Atomic amplitudes and melting – Phonon – Phonon interactions – Thermal conductivity – thermal expansion. The dielectric constant – Long wavelength optical modes – the rigi d ion model – the polarizable ion mode. The shell model.

UNIT 3: THE INELASTIC SCATTERING OF NEUTROS AND X – RAYS:

Basic principles – General formulation of neutron s cattering – Coherent and incoherent scattering – Coherent inelastic neutron scattering – thermal diffuse scattering of x-rays – The Debye - Waller factor.

UNIT 4: DEFECTS IN SOLIDS

Point defects – colour centres – dislocations – Gre en's functions technique and scattering matrix formalism for defect studies.

UNIT 5: LATTICE DYNAMICAL THEORY OF THE DIFFUSION PROCESS

Fluctuation of the reaction co-ordinate – plane wav e approximation – elastic theory for the metals – diffusion in nonmetallic crystals – activa tion volume for motion – isotopic effect – diffusion at low temperatures – diffusion of very l ight interstitials.

BOOKS FOR STUDY AND REFERENCE:

1. Lattice Vibrations by B. Donovan and J.F. Angress, 1970.
2. Progress in Physics – Lattice Dynamics – A reprint series. A.A. Maradudin et al., Institute of Physics and Physical society London, 1969.
3. Solid State Physics Advance in Research and Applications Volume 10-Frederick Seitz and David Turnbull, Academic press, New York and London, 1960.
4. An introduction to Lattice Dynamics by A. K. Ghatak, L. S Kothari, Addison pub, 1971.
5. Vibrational Spectroscopy of solids – Sherwood PM-Ca mbridge, 1972.
6. Current trends in Lattice dynamics – KR Rao (Educat ional) APT, Bombay, 1978.
7. Phonons in condensed matter Physics–RK Singh & S.P. Sanyal, Weilly Eastern Ltd., 1990.
8. Advances in Phonon Physics-Philip (Ed)-Edu. Pub. & Distributors, Kochi 2000.

13 MPH 104J **Dr. JN**

C4 - CHEMICAL PHYSICS

UNIT 1: LIQUID STATE:

The liquid state – Phase diagram of a typical mono atomic substance – Intermolecular forces – a detailed study – Experimental methods – the liq uid state - a new out look – The behavior of solutions of electrolytes and non-electrolytes – a new thermodynamic outlook.

UNIT 2: DISTRIBUTION FUNCTION THEORIES:

The static structure factor – The Ornstein –Zernik e direct correlation function – Diagrammatic expansions of the pair functions – Fun ctional expansions and integral equations – The PY solution for hard spheres – The mean – spherical approximation – Numerical results – Extensions of integral equation s – Integral equations for non-uniform fluids.

UNIT 3: LIQUID THEORIES BASED ON HARD SPHERE MODEL:

Thermodynamics properties of hard sphere fluids – r adial distribution function for hard sphere – explicit equations for hard sphere propert ies – a simple perturbation theory for mixtures.

UNIT 4: PERTURBATION THEORIES:

The Van der Waals model – a detailed study – the ex pansion – Treatment of soft cores – The LENNARD-JONES fluid long range perturbations – Liqu id mixtures.

UNIT 5: ULTRASONICS OF BIOLOGICAL SUBSTANCES AND BIOCHEMICALS:

Introduction – solutions – Amino acids – Polypepti des – Proteins – carbohydrates – Bases, Nucleotides and nucleosides, Nucleic acids and Lipids.

BOOKS FOR STUDY AND REFERENCE

1. Theory of Simple Liquids by Hansen and McDonald (for UNITS I, II, III and IV) 2nd edition, Academic Press, 1976.
2. Ultrasound – its applications in Medicine and Biolo gy – Part I by Francis J. Fry. Elsevier Scientific Publishing Co., New York (for Unit V only), 1978.
3. Applied Statistical Mechanics – Thomas M. Reed and Keith E. Qubbins, McGraw Hill & Co. 1973.
4. Statistical thermodynamics – M. C. Gupta (Wiley Eas tern Ltd, 1978.
5. Liquid State Physics – M. M. Woolfson and J. M. Zim an, Academic Press, 1982.
6. Dr. C.V. Suryanarayana, Journal of Acoustical Society of India (JASI), Vol. V(4), 1977 and Vol. XI (I), 1983 issues.
7. Ultrasonic Instrumentation, Pathak, IGCAR, JASI, 1970.
8. Medical Ultrasonics, R.S. Kahandpur, JASI, Vol. XVII (1&2), 1989.

C4 - MICROPROCESSOR AND ITS APPLICATIONS

UNIT 1 ARCHITECTURE AND INSTRUCTION SET OF 8085

Introduction to Intel Processors – Pin functions of 8085 – Architecture of 8085– Addressing Modes – Programmer's model of 8085 – Data transfer Instructions – Arithmetic instructions – Logical instructions – Special instructions – Ass embly language to Hex code – Branch instructions – Stack and stack related instructions – I/O and machine control instructions

UNIT II ASSEMBLY LANGUAGE PROGRAMS AND TIMING DIAGRAMS

Addition – Subtraction – Multiplication – Division – Square and Square root – Sorting and Searching – Code conversion – Debugging a program – Multibyte operations – Rotate operations – Timing diagrams for Memory read and M emory write cycles – Wait, Halt and Hold states

UNIT III INTERFACING INPUT / OUTPUT AND MEMORY DEVICES

Memory interface basics – Demultiplexing Address / data bus – Generating control signals – ROM / EPROM interface – RAM interface – IN instruct ion and its timing diagram – Design of and Input Port (Direct I/O) – Out instruction an d its timing diagram – Design of and output port (Direct I/O) – Memory Mapped I/O

UNIT IV 8085 INTERRUPTS AND VARIOUS PERIPHERAL DEVICES

INTR and INTA – RST 5.5, RST 6.6, RST 7.5 and TRAP – Triggering Levels – interrupt priority – Handshake signals – Programmable Periphe ral Interface 8155 – Programmable peripheral device 8255 – Programmable Keyboard / Di splay interface 8279 – serial communication interface

UNIT V MICROPROCESSOR APPLICATIONS

LED Interface (Flashing LEDs, Hex counter, BCD counter and Traffic controller) – Seven Segment Display interface – Hex Keyboard interface – Operational Amplifier fundamentals – Digital to Analog Converter – Analog to Digital con verter – Temperature controller – Data Transfer Methods (Direct, Polled, Interrupt controlled) – Direct Memory Access (DMA)

BOOKS FOR STUDY AND REFERENCE:

1. Fundamentals of Microprocessor – 8085 by V VIJAYEND RAN, S V Printers and Publishers, Pvt. Ltd., 2006.
2. Fundamentals of Microprocessor and Microcomputers by BADRI RAM, Dhanpat Rai and Sons, New Delhi, 1995.

13 MPH 104L **Dr. APP**

C4 - LIQUID STATE CHEMICAL PHYSICS

UNIT 1 : THEORY AND MODELS OF LIQUID STATE:

Similarities between liquids and solids – similarit ies between liquids and gases – peculiarities of liquid state – Van der Waals equation – molecula r properties from bulk data – method of pair distribution function – method of collective v ariables.

UNIT 2 : EQUILIBRIUM STATISTICAL MECHANICS OF FLUIDS:

Statistical mechanical averages – distribution func tions – thermodynamic equations – virial expansion of the equation of state – approximate th eories of the radial distribution function – perturbation theory.

UNIT 3 : STRUCTURE OF LIQUIDS:

Pair Distribution Function and Structure of Liquids – Experimental determination of the structure – theoretical determination of static str ucture – the hard sphere liquid – structure of noble gases.

UNIT 4 : RECENT THEORIES OF LIQUID STATE:

Scaled Particle Theory- Khasare's Equation of State – Free Length Theory – Revised Free Length Theory –Hole Theory – application of these t heories to liquids – interpretation of the results obtained.

UNIT 5 : EXPERIMENTAL TECHNIQUES FOR LIQUID MIXTURES:

Mole fraction – volume fraction – molarity and mola lity – Measurement of velocity of sound – continuous ultrasonic wave method and pulse echo overlap method – experimental determination of density, viscosity, refractive index. Calculation of various thermodynamic parameters and their excess values – interpretation of such data.

BOOKS FOR STUDY AND REFERENCE

1. Henry Eyring and Mu Shik Jhon, *Significant Liquid Structures*, John Wiley, New York, 1969.
2. Watts, R.O. and McGee, I.J., *Liquid State Chemical Physics*, Wiley-Interscience, New York, 1976.
3. Chen, S.H., *Structure of Liquids*, Chapter 2, Baxter, R.J., *Distribution Functions*, Chapters 4, in *Physical Chemistry: An advanced Treatise*, Eds. Eyring, H, Henderson, D. and Jost, W., Volume 8A, Ed. Henderson, D., Academic Press, New York, 1971.
4. Theory of simple liquids, Hansen and McDonald, 2nd Edition, Academic Press, 1976
5. Hirschfelder, J.O., Curtis, C.F. and Bird, R.B., *Molecular Theory of Gases and Liquids*, Wiley, New York 1954.
6. Egelstaff, P.A., *An Introduction to Liquid State*, Chapters 2 & 8, Academic Press, London, 1971.
7. Baldev Raj, Rajendran, V. and Palanichamy, P., *Science and Technology of Ultrasonics*, Chapters 4 & 6, Narosa, New Delhi, 2004.
8. Kalidoss, M., Ph.D. dissertation, Bharathidasan University, 1998.

13 MPH 104M **Prof. BK**

C4 - INSTRUMENTATION AND CONTROL

UNIT I : Transducers, Mechanical Measurements, and Industrial Instrumentation

Transducers: elastic, resistive, inductive, capacitive, thermo-electric, piezoelectric, photoelectric, electro-mechanical, electro-chemical, and ultrasonic -- Measurement of displacement, velocity (linear and rotational), acceleration, shock, vibration, force, torque, power, strain, stress, pressure, flow, temperature, humidity, viscosity, and density -- Basics of Circuits and Measurement Systems -- Static and dynamic characteristics of Measurement Systems -- Error and uncertainty analysis -- Statistical analysis of data and curve fitting.

UNIT II : Signals and Systems

Vectors and matrices -- Fourier series -- Fourier transforms -- Ordinary differential equations. Impulse and frequency responses of first and second order systems. -- Laplace transform and transfer function, convolution and correlation. Discrete time systems -- Z-transforms and transfer functions -- IIR and FIR filters.

UNIT III : Electrical and Electronic Measurements

Measurement of R, L and C -- bridges and potentiometers. Measurement of voltage, current, power, power factor, and energy -- Instrument transformers -- Q meter, waveform analyzers. Digital volt-meters and multi-meters. Time, phase and frequency measurements – Oscilloscope -- Noise and interference in instrumentation.

UNIT IV : Control Systems and Process Control

Principles of feedback -- transfer function, signal flow graphs. Stability criteria, Bode plots, root-loci, Routh and Nyquist criteria. Compensation techniques -- State space analysis. -- On-off, cascade, P, PI, PID and feed-forward controls. Controller tuning and general frequency response.

UNIT V : Biomedical and Microcontroller based Instrumentation

Biomedical instruments: EEG, ECG and EMG. Clinical measurements. Ultrasonography – features of PIC microcontroller – architecture, ins truction set, I/O, ADC, I2C, USART of 16F877a -- microcontroller based instruments -- Principles of Computer Assisted instruments.

BOOKS FOR STUDY AND REFERENCE:

1. PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control by Kevin James
2. Process Control Instrumentation Technology by Curtis D. Johnson
3. Analytical Instrumentation by Bela G. Liptak
4. Handbook of Microcomputer-Based Instrumentation Controls by John D. Lenk
5. Industrial Instrumentation: Principles and Design by Tattamangalam R. Padmanabhan
6. Instrumentation and Process Control by Nicholas P. Chopey
7. Measurement systems by D O Deobelin
8. Instrumentation by Nakra and Chaudary
9. www.microchip.com for PIC microcontroller
10. WEB SITES

13 MPH 104N **Prof. BK**

C4 - CRYSTAL GROWTH

UNIT 1: NUCLEATION AND KINETICS OF CRYSTAL GROWTH:

Theories of nucleation – classical theory of nucle ation – heterogeneous nucleation – singular and rough faces – modes on surface roughne ss – Kossel, Stranski, Volmer (KSV) theory – Burton, Cabrera, Frank (BCF) theory – peri odic bond chain theory – Muller – Krumbhaar model.

UNIT 2: CRYSTAL GROWTH FROM THE MELT:

Growth from the melt – Bridgeman and related techn iques – crystal pulling – convection in melts – simulation of bulk crystal – melt growth of oxide crystals – Czochralski technique – Zone melting technique – Skull melting process – verneuil process – heat exchanger method.

UNIT 3: SOLUTION GROWTH:

Low temperature solution growth – crystal growth s ystem – non-linear phenomena in KDP family crystals – solubility of KDP and ADP – Seed preparation – high temperature solution growth – growth of potassium titanyl phosp hate – practical aspects.

UNIT 4: MODERN CRYSTAL GROWTH TECHNIQUES:

Vapour growth (physical and chemical) – Hydrotherm al growth – Electro crystallization – Gel growth – Liquid crystals – Te chnology of Epitaxy – Practical aspects.

UNIT 5: PHYSICAL PROPERTIES OF CRYSTALS:

Effect of symmetry on physical properties – Elasti c properties – Thermal properties – Electrical properties – Magnetic properties – Diele ctric properties – Optical properties – Transport properties.

BOOKS FOR STUDY AND REFERENCE

1. Crystal growth process and methods Dr. P. Santhanaraghavan and Dr. P. Ramasamy: KRU Pub, Kumbakonam, 2000.
2. Crystal Growth Processes, J.C. Brice, John Wiley and Sons, New York, 1986.
3. Crystal Growth, H.E. Buckley, John Wiley and Sons, New York, 1986.
4. Physics of Crystals, Macmillan S. Bhagavantam and S. Radhakrishna, New Delhi, 1965.
5. The Art and Science of Growing Crystals, J. Gilman: John Wiley and sons, New York, 1965.
6. Fundamentals of Crystal Physics, I. Sirotin and P. Shaskolskaya: Mir Publications, New Delhi, 1982.

13 MPH 104O **Mr. JC**

C4 - THIN FILM TECHNOLOGY AND ITS APPLICATIONS

UNIT 1: THIN FILM DEPOSITION TECHNIQUES

Deposition Technology – Physical Vacuum Deposition - Resistance Heating, Electron Beam Technique, Laser Gun Evaporation – Sputtering Metho ds - Reactive Sputtering, RF Sputtering, Chemical Vapour Deposition - Spray Pyrolysis - Chemical Deposition – Electro Deposition, Electroless Plating, Anodic Oxidation, Chemical Reaction – Sol Gel.

UNIT 2: FILM GROWTH AND STRUCTURE

Thermodynamics of nucleation – Theories: Capillarit y model and Statistical model – film growth and its process - Deposition Parameters and Grain Size – Stages of Films and Theories – Defects in Growth Mechanism.

UNIT 3 : THIN FILM ANALYSIS

Structural Characterisation- X-ray Diffraction – SE M – TEM - UV Visible Spectrum - FTIR and NMR Studies for Organic samples - X-ray Photo Electron Spectroscopy (XPES) - Energy Dispersive of Atomic X-ray Spectrum (EDAX) – HEED – LEED - Film Thickness Measurement - Mass and Optical methods.

UNIT 4: ELECTRICAL , OPTICAL AND MAGNETIC PROPERTIES:

Sources of Resistivity in metallic conductors - Sheet Resistance – Temperature Coefficient of Resistance, Influence of Thickness on the Resistivity – Hall Effect – Influence of Heat Treatment – Optical Characterisation by Spectrophot ometer (Refractive Index – Absorption Edge – Transmission and Absorbance) - Energy Band G ap – Magneto Resistance – Ferro Magnetic Domain Studies – Meisner Effect – Super Co nducting Stage.

UNIT 5: THIN FILM APPLICATION

Thin Film Passive Components – Thin Film Battery – Thin Film for Gas Sensors and Thin Film for Photo Voltaic Applications.

BOOKS FOR STUDY AND REFERENCE

1. Hand Book of Thin Film Technology: L.I. Maissel and R. Gland, McGraw Hill, New York 1970.
2. Thin film fundamentals –A. Goswami, New Age Interna tions Pub., 2003.
3. Thin Film Phenomena: K.L. Chopra, McGraw Hill, New York, 1960.
4. Scientific foundations of Vacuum Technique, 2nd edn., S. Dushman, John Wiley & Sons Inc, New York, 1962.
5. Thin Film Solar Cells – K.L. Chopra and S.R. Das. P lenum Press, New York 1983
6. Vacuum Deposition of Thin Films: L. Hollond, John Wiley & Sons Inc, New York, 1958.

13 MPH104P **Prof. SD**

C4 - CRYSTAL GROWTH AND CHARACTERIZATION TECHNIQUES UNIT I: NUCLEATION

Theories of nucleation - classical theory of nucleation - Gibbs Thomson equation for vapour - Modified Thomson equation for melt - Gibbs-Thomson equation for solution - Energy of formation of a nucleus – Spherical nucleus - Cylind rical nucleus - Heterogeneous nucleation Cap shaped nucleus – Disc shaped nucleus, Significa nce of single crystals - Reasons for growing single crystals - Criteria for optimizing growth parameters.

UNIT II: CRYSTAL GROWTH TECHNIQUES

Crystal growth from melt: Czocharlski technique – B ridgmann - stockbarger technique - Zone melting technique - Verneuil Technique. Crystal growth from Solution: Low temperature solution growth - Slow cooling technique - Slow evaporation technique - High temperature solution growth (Flux growth) - Hydrothermal growth - Gel growth.

UNIT III: STRUCTURAL ANALYSIS:

Interaction of X- rays with matter, X- ray diffraction methods: Laue method - Bragg's method - Rotating crystal method - Powder method, Single crystal XRD analysis: Instrumentation - Crystal data - Structure determination.

UNIT IV: OPTICAL ANALYSIS:

FT-IR analysis: Theory of IR spectroscopy - Instrumentation - Methods of vibrations of atoms in polyatomic molecules - frequency assignments. UV- Vis.-NIR Analysis: Theory of UV spectroscopy - Instrumentation- Optical absorption - Optical transmittance. Non Linear Optics: Harmonic generation - General description of NLO materials - Kurtz's powder technique - SHG measurements.

UNIT V: MECHANICAL, ELECTRICAL AND THERMAL ANALYSIS:

Methods of Hardness test - Vicker's test - Correlation of micro hardness with other properties, Dielectric constant - dielectric loss - Conductivity and photoconductivity, Thermo gravimetric analysis (TGA) - Differential Thermal analysis(DTA) - Differential scanning calorimetry (DSC)

Books for reference:

1. Crystal Growth processes and methods – Dr. P. Santh anaRaghavan and Dr. P. Ramasamy (2000), KRU Publications, Kumbakonam.
2. The growth of Crystals from liquid -J.C. Brice, North Holland Publishing Company, Amsterdam.
3. Fundamentals of Crystallography – C. Giacovazzo, (2 002) Oxford Science Publications.
4. Instrumental methods of analysis-H.H. Willard, L.L. Merrit, J.A. Dean and F.A. Settle –(2005) CBS publishers, New Delhi.
5. Lasers and non linear optics (Second Edition, 2004) B.B Land New Age India (P) Ltd.
6. Material Science and Engineering – V. Raghavan (Thi rd Edition 1993) - Prentice Hall of India.

13 MPH 104Q **Prof. PC**

C4 - CRYSTAL GROWTH PROCESSES AND ITS CHARACTERIZATION TECHNIQUES

UNIT 1: THERMODYNAMICS OF CRYSTAL GROWTH

Saturation and super saturation – solubility curve – expression for super saturation – Solubility diagram – nucleation – Theories of nucle ation – Gibbs Thomson equation for vapour – Modified Thomson's equation for melt – Gib bs Thomson equation for solution – Kinetics of crystal growth – Single and rough faces – Models of surface roughness – KSU theory and BCF theory.

UNIT II: GROWTH FROM SOLUTIONS

Low temperature solution growth: Slow cooling process – solvent evaporation process - Temperature difference process – Use of electrolyti c process High temperature solution growth: Solvent & solutions – Slow cooling methods – temperature difference methods – high pressure method – solvent evaporation method – electrolytic process – liquid phase epitaxy.

UNIT III: GROWTH FROM MELT

Bridgeman and related techniques – crystal pulling – convection in melts – modeling and simulation of bulk crystal growth considering melt growth – czocharalski technique – Zone melting technique – skull melting process – Verneui l process – Heat exchange method.

UNIT IV: OTHER CRYSTAL GROWTH TECHNIQUES

Physical vapour deposition – chemical vapour depos ition – Chemical vapour transport – Definition – fundamentals – choice of transport rea ctions – specifications – Transported materials and agents – STP, LTVTP, OTP – Hydrotherm al growth: Design aspect of autoclave – electro crystallization – Gel Method: p rinciple- types of gels- structure of gels- growth in gels – experimental procedure – biologica l crystallization.

UNIT V: ANALYSIS AND CHARACTERIZATION OF CRYSTALS

Optical transmission studies (UV) Micro hardness studies -Structural analysis – XRD – Fourier Transform –IR – Spectral analysis – Scannin g Electron Microscope studies (SEM) – different etching techniques.

BOOKS FOR STUDY AND REFERENCE:

1. Brice J.C, 1986, Crystal Growth Processes, John Wiley & sons, New York.
2. Santhanaraghavan S.P, Ramasamy. P, 2000, Crystal growth-Processes and methods, KRU publications, Kumbakonam.
3. Buckley H.E, 1986, Crystal growth, John Wiley & sons, New York.
4. Gilman J, 1965, The art of science of growing crystals, John Wiley & Sons, New York.
5. William Kemp, 2004, Third edition, Organic Spectroscopy, Palgrave, New York

13 MPH 104R **Dr. LR**

C4 – PRINCIPLES OF NANO TECHNOLOGY

Unit I FUNDAMENTALS OF NANOSCALE SCIENCE

Background to nanotechnology - scientific revolutions – atomic structure – molecules & phases – energy – molecular and atomic size – surfa ces and dimensional space – top down and bottom up. Definition of a nano system - dimensionality and size dependent phenomena; Quantumdots, Nanowires and Nanotubes, 2D films; Nano & mesopores – size dependent variation in Magnetic, electronic transport, reactivity.

Unit II NUCLEATION ANDKINETICS OF NANO PARTICLES

Basic concepts of nanostructured materials – nuclea tion: surface nucleation growth – grain size distribution – nano particle transport in low density media – vapour nano phase thermodynamics – coagulation of nano particles, det ermination of grain size – aggregate formation – mass fractal morphologies.

Unit III SYNTHESIS OF NANO MATERIALS

Film deposition methods: Fundamentals of film deposition – Spray Pyrolysis, molecular beam epitaxy – pulsed laser deposition – sputter de position – chemical vapour deposition – layer by layer growth and ultra thin films. Sol-gel methods: Fundamentals of sol-gel process – sol-gel, synthesis methods for oxides –other inor ganics and nano composites – the Pecheni method – silica gel –zirconia and Yttrium gel – alu mino silicate gel – polymer nano composites.

Unit IV STRUCTURAL STUDIES

XRD, Electron microscopes – scanning electron micro scopes – transmission electron microscopes − Scanning probe microscopy – atomic fo rce microscopy – scanning tunneling microscope – Scanning Non-linear Dielectric microsc opy - nano manipulator– nano tweezers – XPS – ICP.

Unit V APPLICATIONS OF NANOMATERIALS

Nanotechnology in industries − quantum computation − super computing system − drug delivery system − drug encapsulation − Magnetic Dat a Storage − Magnetic Semiconductors − Spintronics devices − Nanosensors − optical industr y − metrology − defense and environment.

References:

1. Nanotechnology: basic science and emerging technologies – Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Overseas Press (2005).
2. Introduction to Nanotechnology by Charles P. Poole, Frank J. Owens, Wiley-Interscience (2003).
3. Nanotechnology: A Gentle Introduction to the Next Big Idea, Mark A. Ratner, Daniel Ratner, Mark Ratne, Prentice Hall PTR; 1st Edition (2002).
4. Nanocomposite science and technology, Pulickel M. Ajayan, Linda S. Schadler, Paul V. Braun, Wiley-VCH Verlag, Weiheim (2003).
5. Amorphous and Nanocrystalline Materials: Preparation, Properties, and Applications, A. Inoue, K. Hashimoto (Eds.,) (2000).
6. Nano Medicines Edited by Dr. Parag Diwan and Ashish Bharadwaj, Pentagon Press (2006).

13 MPH 104S **Dr. MMA**

C4 – LIQUID STATE CHEMICAL PHYSICS

UNIT 1: THEORY AND MODELS OF LIQUID STATE:

Similarities between liquids and solids – similari ties between liquids and gases – peculiarities of liquid state – van der Waals equat ion - molecular properties from bulk data- method of pair distribution function – method of co llective variables.

UNIT 2 : EQUILIBRIUM STATISTICAL MECHANICS OF FLUIDS:

Statistical mechanics averages – distribution func tions – thermodynamic equation – virial exapansion of the equation of state – approx imate theories of the radial distribution function – perturbation theory.

UNIT 3 : STRUCTURE OF LIQUIDS:

Pair distribution function and structure of liquids – experimental determination of the structure - theoretical determination of statistical structure- the hard sphere liquid- structure of noble gases.

UNIT 4: RECENT THEORIES OF LIQUID STATE:

Scaled particle theory – Khasare's equation of stat e – Free length theory – Revised Free length theory – Hole theory – application of these theories to liquids – interpretation of results obtained.

UNIT 5 : EXPERIMENTAL TECHNIQUES FOR LIQUID MIXTURES:

Mole Fraction – volume fraction – molarity and mol ality – measurement of velocity of sound – continuous ultrasonic wave method and pu lse echo overlap method – experimental determination of density, velocity, refractive index calculation for various thermodynamic parameter and their excess values – interpretation of such data.

BOOKS FOR STUDY AND REFERENCE

1. Hendry Eyring and Mu Shik Jhon , Significant liquid structure, John wily, New York, 1969.
2. Watts, R.O and McGee, I.J. , Liquid state chemical Physics, Wiley – Interscience,New York.1976.
3. Chen,S.H., structure of liquids , Chapter 2, Baxter, R.j , Distribution Functions, Chapter 4 in Physical Chemistry: An advanced treatiese , Eds.Eyrings, H, Henderson, D.and Jost , W., Volume 8A, Ed Henderson , D., Academic Press, New York,1971.
4. Theory of simple liquids, Hansen and MCDOnald, 2 nd Edition, Academic Press,1976
5. Hirschfelder, J.O Curtis, C.F and Bird, R.B., Molecular Theory of Gases and Liquids , Wiley, New York. 19

13 MPH 104T **Dr. CL**

C4: LIQUID STATE CHEMICAL PHYSICS WITH SPECTRSOCOPIC CONFIRAMATION

Unit 1: LIQUID STATE:

The liquid state – Phase diagram of a typical mono atomic substance – Intermolecular forces – a detailed study – Experimental methods – the liquid state – a new outlook – the behavior of solutions of electrolytes and non-electrolytes – a new thermodynamic outlook.

Unit 2: DISTRIBUTION FUNCTION THEORIES:

The state structure factor – The Ornstein – Zernik e direct correlation function – Diagrammatic expansions of the pair functions – Fun ctional expansions and integral equations – The PY solution for hard sphers – The m ean – spherical approximation – Numerical results – Extensions of integral equation s – Integral equations for non-uniform fluids.

Unit 3: LIQUID THEORIES BASED ON HARD SPHERE MODEL:

Thermodynamics properties of hard sphere fluids – radial distribution function for hard sphere – explicit equations for hard sphere pr operties – a simple perturbation theory for mixtures.

Unit 4: EXPERIMENTAL TECHNIQUES FOR LIQUID MIXTURES:

Mole fraction – volume fraction – percentage by we ight - molarity and molality – experimental determination of density, viscosity and speed of sound – Van der Walls forces - dipole-dipole, dipole-induced dipole interaction – calculation of various thermodynamic parameters and their deviation values – interpretat ion of such data.

Unit 5: SPECTROSCOPIC CONFIRMATION:

FTIR spectroscopy – sample preparation – analyse of the spectra – comparison with a reference – advantages of FTIR – applications of FT IR – interpretation of such data

BOOKS FOR STUDY AND REFERENCE

1. Theory of Simple Liquids - Hansen and McDonald 2nd edition, Academic press 1976. (for units I, II and III)
2. Applied statistical mechanics – Thomas M. Reed and Keith E. Qubbins, McGraw Hill & Co. 1973.
3. Statistical thermodynamics – M. C. Gupta, Willey Ea stern Ltd. 1978.
4. Liquid State Physics – M. M. Woolfson and J. M. Zim an, Academic press 1982.
5. Liquid state chemical physics – Watts, R.O and McGe e I.J – Willey interscience, New York, 1976.
6. An Introduction to Liquid state – Egelstaff P.A, ch apters 2 & 8, Academic press, London, 1971.
7. Ultrasonic Instrumentation – Patnak, IGCAR, JASI, 1970
8. Organic Spectroscopy – William Kemp, 3rd edition, Palgrave, New York,2004.
9. Clement Lourduraj A. J - Ph.D. dissertation – Bhara thidasan university, 2010