M.PHIL. SYLLABUS – 2015

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 following year.

2. **Course Work:**

Semester - I			Semester - II		
Course	**Title**	**Cr**	**Course**	**Title**	**Cr**
C1	Professional 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 Course	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.** The Scholar should acquire a minimum of 30 marks in Semester Examination. 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).

2. b) (i) In course C1 on **'Professional Skills for Teaching – Learning'** the first three units are common to all the Departments of the College. The Academic Council has granted permission to incorporate some modifications in the C1 Course by Physics, Computer Science and Mathematics Departments. 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 Core Course.

The C1 Course 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 are likely to acquire in the Education Industry. Thus only for the course (C1) the written component is 60% and Practical component is 40% both in CIA and SE.

b) (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.

c) Question papers for C1, C2 & C3 are set by External Examiners.

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

e) Departments will be permitted to offer either paper 2 or paper 3 as Open Online Course to the M.Phil. students. The evaluation method will be the same for both C2 and C3 Courses.

3. Credits:

	Courses	**Title**		**Contact Hrs.**	**Library Hrs.**	**Total Hrs.**	**Cr**	**CIA Mk.**	**SE Mk.**	**Total Mk.**
SEMESTER – I	C1	Professional 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 Course		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
Arts	**Course**	**Mid & End Semester Tests and Semester Examinations**		
	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 Examinations **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 the 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 marks for 90% as stated above to the COE in a sealed cover

5.3. All the M.Phil. Scholars (along with their Guides) have to submit at least one Research articles for publication, at the time of submitting the dissertation.

Departments (with the constituted Expert Committee) will scrutinize; select and recommend the best articles for a publication either in RETELL or in School-based Journals.

5.4. 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.

5.5. *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 Semester – II examinations in their first attempt shall be classified as follows:

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

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M.PHIL. PHYSICS COURSE PATTERN – 2015

Sem	Code	Title of the Paper
I	15 MPH101	Course – C1: Professional Skills for Teaching – Learning
	15 MPH102	Course – C2: Research Methodology (OOC)
	15 MPH103	Course – C3: Advanced Physics
	15 MPH104A	Course – C4: Dielectric Thin Film Physics
	15 MPH104B	Course – C4: Semiconductor Thin Film Physics
	15 MPH104C	Course – C4: Microcontroller And Interfacing Techniques
	15 MPH104D	Course – C4: Materials Science (Special Paper)
	15 MPH104E	Course – C4: Thin Film Sensors
	15 MPH104F	Course – C4: Laser Physics
	15 MPH104G	Course – C4: Phonon Physics
	15 MPH104H	Course – C4: Principles and Methods of Crystal Growth
	15 MPH104I	Course – C4: Lattice Dynamics
	15 MPH104J	Course – C4: Chemical Physics
	15 MPH104K	Course – C4: Microprocessor And Its Applications
	15 MPH104L	Course – C4: Liquid State Chemical Physics
	15 MPH104M	Course – C4: Instrumentation And Control
	15 MPH104N	Course – C4: Crystal Growth
	15 MPH104O	Course – C4: Nanoscience and Technology
	15 MPH104P	Course – C4: Thin Film Technology And Its Applications
	15 MPH104Q	Course – C4: Crystal Growth And Characterization Techniques
	15 MPH104R	Course – C4: Crystal Growth Processes And Its Characterization Techniques
	15 MPH104S	Course – C4: Principles of Nanotechnology
	15 MPH104T	Course – C4: Liquid State Chemical Physics
	15 MPH104U	Course – C4: Liquid State Chemical Physics with Spectroscopic Confirmation
II	15 MPH221	Course – C5:Dissertation

15 MPH 101 **Paper: I**

CI: PROFESSIONAL SKILLS FOR TEACHING – LEARNING

Objectives:

i) To empower scholars with soft skills.
ii) To introduce the teaching and dynamics of teaching – learning
iii) To facilitate e- learning/ e-teaching with the ICT tools
iv) To enable them to understand the nature of growth and development, learning, motivation and its various educational implications.

UNIT – I: Soft Skills

a. Introduction to Soft Skills, Soft Skills Vs Hard Skills, types of Soft Skills
b. Communication skills- Basics in communication, structure of written and oral sentences, Verbal, non-verbal, body language, JOHARI Window, Intrapersonal and Interpersonal Communications, Activities in Effective Communication
c. Behavioral Skills- Leadership skills, Time Management, Creativity and Lateral thinking
d. Interview Skills- Resume Writing, Different types of interviews, Etiquettes in interviews, Mock interviews
e. Team Building and Group Discussion- Progressive stages of Team Building, Parameters of GD (special reference to attending, listening, responding skills), Mock Group GDs

Unit – II: Techniques and Dynamics of Teaching- Learning

a. Emerging trends in Educational Psychology- Meaning, Scope and Methods
b. Learning- Different Theories of learning, Approaches to learning(Classical Conditioning-Ivan Pavlov; Operant conditioning-B.F.Skinner); kinds of learning, factors affecting learning
c. Motivation: Intrinsic and extrinsic motivation, Development of memory and intelligence

Unit – III: e-Learning and e-Teaching

Microsoft office-2007: MS WORD- MS Powerpoint, Concepts in e-Resources: World Wide Web Concepts - Making use of Web Resources- LaTex- Origin – SSP software.

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: traditional instructor-centered environment – The active engagement student-centered 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.

Books for Study and Reference:

Unit – 1:

JASS (2013).Winners in the Making. Introduction to Soft Skills. St.Joseph's College, Trichy.
Murphy, Raymond. (1998). *Essential English Grammar*. 2nd ed., Cambridge University Press.
Trishna (2004) Knowledge System *How to do well in GDs and Interviews.* Reprographic and Printing services, Secunderabad.

Unit – II:

Covey, Stephen. (2004). *7 Habits of Highly effective people,* Free Press.
Driscoll, M.P. (1994). Psychology of Learning for Instruction. Needham, MA: Allyn & Bacon.
Gardner, Howard (1983; 1993) Frames of Mind: The theory of multiple intelligences, New York: Basic Books

Unit – III:

Joyce Cox, CurtisFrye etc., (2007), "Step by 2007 Microsoft Office System", Prentice Hall of India Private Let, New Delhi.

Unit – IV:

Teaching Physics with the physics suite – Edward F. Redish.

15 MPH 102 **Paper: 2**

C2 - RESEARCH METHODOLOGY (OOC)

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 – Role of scholar and guide.

Unit – II: Techniques of Scientific Writing

Scientific Writing - definition – organizing a scientific paper – Title – listing of authors and address – abstract – introduction – materials and methods section – results section – discussion section – acknowledgement – references – 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 meaningful experimental results. Basic statistical concepts – best estimate of true value of data – measure of dispersion – confidence level – central limit– significance test – chi square test for goodness of fit – criteria for goodness of fit . Graphical Representation – equations – functional relationships – sequential differences – method of extended differences – method of least squares. Analysis and Interpretation using MS-XL and Origin

Unit – IV: Research Instruments

Working principles and characterization studies: UV-VISIBLE, IR, FTIR, XRD, SEM, TEM, SPM, Hardness tester, Hall effect, Four probe, Ultrasonic interferometer, Dielectric measurement (solid/liquid) & Thermal Analyzer (DSC & DTA).

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 Important Theorems – The Convolution theorem – The Gaussian Wave Packet in Quantum Mechanics – Three dimensional Fourier transform - The Use of Fourier Transforms in Solving Differential Equations.

Books for Study and Reference:

Unit

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

II How to write and publish a scientific paper – (4^{th} Edn.), Robert A. Day.

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

IV Lecture material – collection from Internet.

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).

Unit – I: Techniques for research:

1) Identification of a research problem:

a) https://www.nyn.edu/bkg/methods/010072.pdf.
b) https://www.arxiv.org/pdf/physics/0601009.pdf.
c) https://www.uk.sagapub_cross/sites/defaults/..

2) Mode of attack:

a) www.solving problems with scientific method.
b) https://www.studygs.net/shared/..

3) Literature survey:

a) https://library.bcu.ac.uk
b) https://writing.utoronto.ca/advice/scientific_types..
c) https://www.duluth.umu.edu/...
d) https://www.writingcenter.une.edu.
e) https://.wikihow.com

4) Awareness of Current Status of Art:

PPT PRESENTATION I

5) Abstract of Research Paper:

a) http://www.vky.edu/academy/files/how to write research abstract.
b) https://abelaide.edu.au/writing centre/learing_guides/..
c) Https://www2.kent.edu/write-science-abstract.pdf.

6) Possible way of getting abreast with current literature.

PPT PRESENTATION II

7) Role of a Guide and Scholar:

a) https://www2.le.ac.edu/departements-guides.
b) https://www.pagesound.edu/../students--research.
c) https://www.christuniversity.in.
d) https://www.research.usc.edu./policies/responsibilites.

Unit – II: Techniques of Scientific Writing

Web:

- http://www.scientific writing
- http://www.materials and methods section in research
- http://www.how to write results section related to research findings
- http://www.discussion section in research findings
- http://www.design of effective tables uses in research field
- http://www.effective illustrations in research
- http://www.how to write research thesis
- http://www.usage of English

PPT:

- organizing a scientific paper
- Title
- listing of authors and address
- abstract
- introduction
- acknowledgement
- references
- manuscript
- submission
- review process
- publishing process
- reprints
- review paper
- onference report
- oral and poster presentation

Unit – IIIL e-Learning and e-Teaching

1) MS-XL
   https://www.ischool.utexas.edu/~wyllys/IRLISMaterials/excelnotes.html
2) Origin
   http://www.physics.rutgers.edu/~eandrei/389/Origin6_Tutorial.pdf
3) Chi-square test
   http://courses.wcupa.edu/rbove/Berenson/10th%20ed%20CD-ROM%20topics/section12_5.pdf
4) Basic concepts of statistics
   http://bobhall.tamu.edu/FiniteMath/Module8/Introduction.html
   http://documents.software.dell.com/Statistics/Textbook/Elementary-Statistics-Concepts
5) Measure of dispersion-confidence level-central limit
   http://www.mathsrevision.net/advanced-level-maths revision/statistics/measures-dispersion
6) Four steps to a meaningful experimental results
   http://www.nku.edu/~filaseta/FourSteps.pdf
7) Propagation of errors
   https://www.lhup.edu/~dsimanek/scenario/errorman/propagat.htm
8) Types of Data
   https://www.mathsisfun.com/data/index.html

Unit – IV: Research Instruments

UV-visible spectrophotometer:
http://www.slideshare.net/mariomS7/uvvis-spectroscopy
IR
https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/infrared.htm
http://teaching.shu.ac.uk/hwb/chemistry/tutorials/molspec/irspec1.htm

FTIR spectrophotometers:
http://chemwiki.ucdavis.edu/Physical_Chemistry/Spectroscopy/Vibrational_Spectroscopy/Infrared_Spectroscopy/How_an_FTIR_Spectrometer_Operates
http://science.unitn.it/~semicon/members/pavesi/FTIR.pdf
XRD
http://web.pdx.edu/~pmoeck/phy381/Topic5a-XRD.pdf
SEM, TEM ,SPM
http://www.medic.ula.ve/histologia/anexos/microscopweb/MONOWEB/anexos/scanningmicrosc.pdf
http://www.wsi.tum.de/Portals/0/Media/Lectures/20082/cb899e9b-2deb-4cb9-bfd5-344821c84fe9/electron_microscopy_forster.pdf
http://www1.na.infn.it/TIMSI/materialicorsi/iavarone/chapter1.pdf

HARDNESS Tester
http://eng.sut.ac.th/metal/images/stories/pdf/09_Hardness_test.pdf

Hall effect apparatus
http://courses.washington.edu/phys431/hall_effect/hall_effect.pdf
Four Probe method:
http://www.sardarsinghsir.com/MSc/MSc%20-pdf%20files/Four-Probe-Method.pdf
Ultrasonic interferometer
http://vlab.amrita.edu/?sub=1&brch=201&sim=803&cnt=1
http://www.mittalenterprises.com/app/webroot/files/image/Template_/image/mittal/Ultrasonic%20Interferometer%20Liquids.pdf
Dielectric measurement
http://cp.literature.agilent.com/litweb/pdf/5989-2589EN.pdf

Thermal analyser – DSC&DTA
http://www.fhi-berlin.mpg.de/acnew/department/pages/teaching/pages/teaching__wintersemester__2012_2013/andrey_tarasov__thermal_analysis__121026.pdf

Unit – V: Applied Mathematical Functions and Transforms

Unit – V's Website Link and Presentation:

Hypergeometric equation - various cases - integral representations - applications of Fourier series to periodic functions and forced vibrations.

Presentation 1
http://pages.uoregon.edu/njp/beukers.pdf
http://www.hindawi.com/journals/jam/2014/128787/
http://people.math.umass.edu/~cattani/hypergeom_lectures.pdf
https://en.wikipedia.org/wiki/Frobenius_solution_to_the_hypergeometric_equation
http://mathworld.wolfram.com/HypergeometricFunction.html
http://www1.maths.leeds.ac.uk/~kisilv/courses/sp-funct.html
http://www.fuw.edu.pl/~derezins/hyper-published.pdf
http://homepage.tudelft.nl/11r49/documents/wi4006/hyper.pdf
https://www.rose-hulman.edu/~cornwell/courses/em406/em406_lectures/lecture%2013%20%20fourier%20series.pdf

http://aerostudents.com/files/vibrations/generalForcedVibrations.pdf
http://pioneer.netserv.chula.ac.th/~pphongsa/teaching/vibration/Ch3.pdf
http://www.personal.soton.ac.uk/jav/soton/HELM/workbooks/workbook_23/23_7_app_fourier_series.pdf
http://www.mb.uni-siegen.de/imr3/lehre/dynamics/skript/machdyn-chapt_4_2.pdf
http://www.med.harvard.edu/jpnm/physics/didactics/improc/intro/fourier2.html
http://kom.aau.dk/~sko/sp/.soloh/mm14oh.pdf

Presntation 2

http://mathworld.wolfram.com/ConvolutionTheorem.html
http://www3.ul.ie/~mlc/support/Loughborough%20website/chap20/20_6.pdf
http://www-structmed.cimr.cam.ac.uk/Course/Convolution/convolution.html
https://en.wikipedia.org/wiki/Wave_packet
http://www.physicspages.com/2012/07/28/free-particle-gaussian-wave-packet/
http://quantummechanics.ucsd.edu/ph130a/130_notes/node83.html
http://physics.stackexchange.com/questions/36430/reason-for-the-gaussian-wave-packet-spreading
http://www.ias.ac.in/pramana/v74/p867/fulltext.pdf
https://see.stanford.edu/materials/lsoftaee261/chap8.pdf
http://accessengineeringlibrary.com/browse/quantitative-phase-imaging-of-cells-and-tissues/apxB
http://physics.unm.edu/Courses/Finley/p406/FourierTransforms06.pdf
http://arxiv.org/abs/1302.1830
http://math.stackexchange.com/questions/142235/three-dimensional-fourier-transform-of-radial-function-without-bessel-and-neuman
http://www.thefouriertransform.com/applications/differentialequations.php
http://www.sosmath.com/fourier/fourier6/fourier6.html
http://cms.unipune.ac.in/~bspujari/courses/Transforms/IntegralTransform/node18.html
www.math.ubc.ca/~feldman/m267/pdeft.pdf
https://physics.ucf.edu/~schellin/teaching/phz3113/lec9-3.pdf

15 MPH 103 **Paper: 3**

C3 - ADVANCED PHYSICS

Unit – I : Imperfections in Crystals

Introduction- classifications of imperfections – concentration of vancancies – Schottky defects – Frenkel defects – Extrinsic vacancies- Vacancies and diffusion through solids – Colour centers – excitons – dislocations – Dislocation energies – Dislocation and shear strength of single crystals – Plane defects – The Sonder-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 transform – diffraction of light – Holography – guided wave optics : planar mirror wave guides, dielectric wave guides – Fiber optics : Step index and graded index fibers – principles of electro optics – electro optics in anisotropic and liquid crystals – fiber optics communications: components, modulation, multiplexing and coupling – coherent optical communications.

Unit – III: Applied Group Theory

Diagonalization of matrix – homomorphism and isomorphism – matrix representations: reducible and irreducible – Formation 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 transducers – elastic – resistive – Inductive – Capacitive – Thermo-electric – Piezo electric – electro-mechanical – electro-chemical – ultrasonics.

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 parameters – Implementation of controller using microcontroller and digital computer.

Unit – V: Astrophysics

Spectral classification of stars – Boltzmann's formula-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.

Books for Study and 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, Wiley Series in Pure and Applied Optics, 2003.

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

IV Industrial Electronics and Control – SK Bhattacharya, 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 Basu – Prentice-hall of India-New Delhi, 1997.

15MPH104A **Dr. R. Victor Williams**

C4 – DIELECTRIC THIN FILM PHYSICS

Unit – I: Preparation of Thin Films:

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

Unit – II: Thickness Measurement and Nucleation Growth in Thin Films:

Thickness measurements: electrical methods – microbalance monitors – optical interference methods – multiple beam interferometry – Fizeau and Feco methods – Quartz crystal thickness monitor – Theories of nucleation – Four stages of film growth –Incorporation of defects during growth.

Unit – III: 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 – IV: Optical Properties of Thin Films:

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

Unit – V: 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 International Pub., 2003.
4. Polymer Science and Technology, Joel R. Fried, Prentice Hall PTR, 1995.
5. Polymer Science –V.R. Gowriker et al New age international (P) Ltd., 2003.

15 MPH 104 B **Prof. S. Antony Raj**

C4 - SEMICONDUCTOR THIN FILM PHYSICS

Unit – I: Preparation Of Thin Films:

Chemical methods: Electroplating – Ion plating – Chemical reduction plating –vapour phase growth. Anodisation – Vacuum evaporation: Evaporation theory – sputtering methods: - Reactive sputtering – RF sputtering – preparation technique of Semiconducting chalcogenide binary 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 – II: Thickness Measurement and Nucleation and Growth in Thin Films:

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

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

Unit – III: Transport and Mechanical Properties:

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

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

Unit – IV: Electrical Properties:

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

Unit – V: Optical Properties:

Thin films optics _ Theory – optical constants of thin 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. Das. Plenum Press, New York, 1983.
7. Thin film fundamentals –A. Goswami, New Age Internations Pub., 2003.

15 MPH 104 C **Dr. I. Arul Rayappan**

C4 - MICROCONTROLLER AND INTERFACING TECHNIQUES

Unit – I: Microcontroller Architecture

Introduction – 8051 Register organization - Flags and Program status word- Program counter – Stack and stack pointer-Special function registers- 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 – serial 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 of Parallel port SPP, EPP, ECP, RS232 Serial port, and USB port – interfacing and programming with ports.

Unit – V: Transducers

Electrical transducer – Selecting transducer – Resistive transducers – Strain gauges – Thermistor – Inductive transducer - LVDT – capacitive transducer – Photoelectric transducer - Opto couplers – The photo transducer – Semi conductor 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.

15 MPH 104 D **Dr. I. Arul Rayappan**

C4: MATERIALS SCIENCE

Unit – I: Optical Properties and Luminescence:

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

Unit – II: Synthesis of Glass and Re Doped Glasses

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

Unit – III: 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 Emission – 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 – IV: Spectral Intensities of F-F Transitions.

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

Unit – V: Advanced Experimental Techniques:

Introduction – Glass sample Preparation and Characterization – Xrd , Ftir, Raman, Epr, UV-Vis – NIR absorption , Photoluminescence, Decay Measurements, DTA,TGA,and DSC.

Books for Study and Reference:

1. Studies in inorganic chemistry – Luminescence and the 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)

15 MPH 104 E **Prof. P. Rajendran**

C4: THIN FILM SENSORS

Unit - I: Vacuum & Measurement and Thin Film Nucleation & Growth:
Kinetic Theory of Gases, Vacuum Pumps: Rotary Pump – Diffusion Pump – Turbo Molecular– Vacuum Units – Vacuum Measurement: Pirani Gauge – Penning Gauge.

Capillarity Theory - Atomistic Nucleation Processes – Cluster Coalescence & Deposition – Experimental Studies of Nucleation & Growth – Grain Structure of Film & Coatings – Amorphous Thin Films – Film Thickness Measurement Techniques – Structural Characterization – Chemical Characterization.

Unit – II: Preparation of Thin Films:
Physical Vapour Deposition: The Physics and Chemistry of Evaporation – Film Thickness Uniformity and Purity - Evaporation Hardware and Techniques – Thermal Evaporation – Electron Beam Evaporation – Pulsed Laser Deposition – DC/RF Magnetron Sputtering – Reactive Magnetron Sputtering – Molecular Beam Epitaxy (MBE).

Chemical Methods: Electroplating – Chemical Bath Deposition – Spray Pyrolysis – Chemical Vapour Deposition (CVD) – Reaction Types – Thermodynamics of CVD – Gas Transport - Growth Kinetics – Low Pressure CVD - Atmospheric Pressure CVD – Laser Enhanced CVD – Plasma Enhanced CVD - Metal Organic CVD – Microwave Plasma CVD – Hot Filament Technique.

Unit – III: Inter Diffusion , Electrical and Dielectric Properties of Thin Films:
Fundamentals of Diffusion – Fick's Law I & II - Inter Diffusion in Metal Alloy Film – Electro Migration in Thin Films – Metal Semiconductor Reactions – Silicides and Diffusion Barriers – Diffusion During Film Growth.

Electrical Properties of Thin Film – Conduction in Metal Films – Electrical Transport in Insulating Film – Semiconductor Contacts in MOS Structures – Superconductivity in Thin Films.

Polar and Non-polar Molecules - Dipole Moment – Polarization - Local Electric Field at an Atom – Dielectric Measurement-Classical Theory of Electronic Polarizability – Dipolar Polarizability.

Unit – IV: Thin Film Sensor Principle and Materials
Sensing Principles - different types of sensors, Sensors made up of organic and polymeric materials -Sensors and their applications. Gas Sensors Based on Conducting Polymers. Need of conducting polymers -Synthesis of conducting polymers and preparation of conducting polymer films- Methods of synthesis of CPs- Properties of conducting polymers- Structure-property relationship-Types of conducting polymers- Polyaniline (PANi), Polypyrrol (PPy), Polythiophene (PTh).

Unit – V: Gas Sensors
Sensing mechanism- Characteristics of gas sensors-Detection principles and requirements - electrochemical sensors- Mechanism behind change in resistance-oxidizing gases and reducing gases. Metal oxide semiconductor gas sensors, conducting polymer gas sensors, Hetrostructure gas sensors.

Books for Study and Reference:
1. Milton Ohring, "Materials Science of Thin Films", Academic Press, 2002.
2. Leon I. Meissel and ReinhardGlang, "Handbook of Thin Film Technology", McGraw-Hill, 1970.
3. Andrew Guthrie, "Vacuum Technology", John Wiley, 1963.
4. Polymers: G. Whitmore, IVY Publishing House, New Delhi (547.84).
5. Sensors: Principles and Applications: Peter Hauptmann, Prentice Hall
6. Hand book of Conducting Polymers: Terje A. Skoyheim (Vol.l), Dekker (668.42)

15 MPH 104 F **Prof. N. Ravi**

C4 - LASER PHYSICS

Unit – I: Theory of Lasers:

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

Unit – II: Type of Lasers:

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

Unit – III: Optical Resonators:

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

Unit – IV: Holography and Scientific Applications:

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

Unit – V: Lasers in Engineering:

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

Books for Study and Reference:

1. Lasers and nonlinear Optics – B.B. Laud, New Age International Pvt. Ltd., 2004.
2. Lasers Theory and Applications – Ghatak & Thyagarajan, Macmillan India Ltd., 1997.
3. Lasers – K.R. Nambiar, New Age International Publishers, 2004.

15 MPH 104 G **Dr. S. Alfred Cecil Raj**

C4 - PHONON PHYSICS

Unit – I: Classical and 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 relations – The long wave length limit – the Vibrational Spectrum. The adiabatic approximation – The phonon concept – creation and annihilation Operators – Matrix elements – Quantization of field.

Unit – II: 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 rigid ion model – the polarizable ion mode - the shell model

Unit – III: The Inelastic Scattering of Neutros and X–Rays:

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

Unit – IV: 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 – V: 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-Cambridge, 1972.
6. Current trends in Lattice dynamics – KR Rao (Educational) 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.

15 MPH 104 H **Dr. S. Alfred Cecil Raj**

C4 - PRINCIPLES AND METHODS OF CRYSTAL GROWTH

Unit – I: Fundamentals Of Crystal Growth

Importance of crystal growth – classification of crystal 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 nucleation: 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 Processes: Burton, Cabera and Frank Bulk diffusion model, Surface diffusion growth theory.

Unit – III: Experimental Crystal Growth Part-I: Melt and Vapour Growth Techniques

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

Basic Principles – Physical Vapour Deposition: – Crystallization in a closed system – Gas flow crystallization Chemical Vapour Deposition: Transport Agents, Sealed capsule method, open flow systems – Temperature variation method: 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-saturation – 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 – Thermal properties of crystals – Thermogrametric analysis (TGA), Differential Thermogram (DTA) and Differential Scanning Calorimetry (DSC) – Vicker Microhardness .

Book for Study and Reference:

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.

15 MPH 104 I **Dr. N. Lawrence**

C4 - LATTICE DYNAMICS

Unit – I: Classical and 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 relations – The long wave length limit – the Vibrational Spectrum. The adiabatic approximation – The phonon concept – creation and annihilation Operators – Matrix elements – Quantization of field.

Unit – II: 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 rigid ion model – the polarizable ion mode. The shell model.

Unit – III: The Inelastic Scattering of Neutros and X–Rays:

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

Unit – IV: Defects in Solids

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

Unit – V: Lattice Dynamical Theory of the Diffusion Process

Fluctuation of the reaction co-ordinate – plane wave approximation – elastic theory for the metals – diffusion in nonmetallic crystals – activation volume for motion – isotopic effect – diffusion at low temperatures – diffusion of very light 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-Cambridge, 1972.
6. Current trends in Lattice dynamics – KR Rao (Educational) 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.

15 MPH 104 J **Dr. I. Johnson**

C4 - CHEMICAL PHYSICS

Unit – I: 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 out look – The behavior of solutions of electrolytes and non-electrolytes – a new thermodynamic outlook.

Unit – II: Distribution Function Theories:

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

Unit – III: Liquid Theories Based on Hard Sphere Model:

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

Unit – IV: Perturbation Theories:

The Van der Waals model – a detailed study – the expansion – Treatment of soft cores – The LENNARD-JONES fluid long range perturbations – Liquid mixtures.

Unit – V: Ultrasonics of Biological Substances and Biochemic-Als:

Introduction – solutions – Amino acids – Polypeptides – 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 Biology – 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 Eastern Ltd, 1978.
5. Liquid State Physics – M. M. Woolfson and J. M. Ziman, 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.

15 MPH 104 K **Prof. A. Patrick Prabhu**

C4 - MICROPROCESSOR AND ITS APPLICATIONS

Unit – I: 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 – Assembly 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 Memory 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 instruction and its timing diagram – Design of and Input Port (Direct I/O) – Out instruction and 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 Peripheral Interface 8155 – Programmable peripheral device 8255 – Programmable Keyboard / Display 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 converter – 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 VIJAYENDRAN, S V Printers and Publishers, Pvt. Ltd., 2006.
2. Fundamentals of Microprocessor and Microcomputers by BADRI RAM, Dhanpat Rai and Sons, New Delhi, 1995.

15 MPH 104 L **Prof. A. Patrick Prabhu**

C4 - LIQUID STATE CHEMICAL PHYSICS

Unit – I: Theory and Models of Liquid State:

Similarities between liquids and solids – similarities between liquids and gases – peculiarities of liquid state – Van der Waals equation – molecular properties from bulk data – method of pair distribution function – method of collective variables.

Unit – II: Equilibrium Statistical Mechanics of Fluids:

Statistical mechanical averages – distribution functions – thermodynamic equations – virial expansion of the equation of state – approximate theories of the radial distribution function – perturbation theory.

Unit – III: Structure of Liquids:

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

Unit – IV: 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 theories to liquids – interpretation of the results obtained.

Unit – V: Experimental Techniques For Liquid Mixtures:

Mole fraction – volume fraction – molarity and molality – 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. Kalidoss, M., Ph.D. dissertation, Bharathidasan University, 1998.

15 MPH 104 M **Prof. B. Kanickairaj**

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, instruction 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

15 MPH 104 N **Prof. B. Kanickairaj**

C4 - CRYSTAL GROWTH

Unit – I: Nucleation and Kinetics of Crystal Growth:

Theories of nucleation – classical theory of nucleation – heterogeneous nucleation – singular and rough faces – modes on surface roughness – Kossel, Stranski, Volmer (KSV) theory – Burton, Cabrera, Frank (BCF) theory – periodic bond chain theory – Muller – Krumbhaar model.

Unit – II: Crystal Growth from the Melt:

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

Unit – III: Solution Growth:

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

Unit – IV: Modern Crystal Growth Techniques:

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

Unit – V: Physical Properties of Crystals:

Effect of symmetry on physical properties – Elastic properties – Thermal properties – Electrical properties – Magnetic properties – Dielectric properties – Optical properties – Transport properties – Characterization of crystals.

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.

15 MPH 104 O **Prof. B. Kanckiaraj**

C4: NANOSCIENCE AND TECHNOLOGY

Unit – I: Fundamentals of Nanoscience

Scientific Revolutions – Types of Nanotechnology and Nanomachines – the Periodic table – Atomic Structure - Molecules and phases - Energy - Molecular and atomic size – Surfaces and dimensional space – top down and bottom up - Forces between atoms and molecules - Particles and grain boundaries – strong Intermolecular forces – Electrostatic and Vander Waals forces between surfaces – similarities and differences between intermolecular and inter particle forces – covalent and coulomb interactions – interaction polar molecules – Thermodynamics of self assembly.

Unit – II: Fundamentals Of Nanotechnology

Quantum dots - Nano wires – Nano tubes - 2D and 3D films - Nano and mesopores, micelles, bilayer, vesicles –bionano machines – biological membranes - Influence of Nano structuring on mechanical, optical, electronic, magnetic and chemical properties-gram size effects on strength of metals- optical properties of quantum dots and quantum wires-electronic transport in quantum wires and carbon nano tubes - magnetic behavior of single domain particles and nanostructures – surface chemistry of Tailored monolayer – self assembling.

Unit – III: Synthesis of Nanomaterials

Bulk Synthesis: Synthesis of bulk Nano structured materials – solgel processing – Mechanical alloying and mechanical milling - Inert gas condensation technique.

Chemical Approaches: Self-assembly, self-assembled monolayer (SAMs) – Longmuir Blodgett (LB) films, clusters, colloids,

Biomimetic Approaches: polymer matrix isolation and surface templated nucleation and/or crystallization

Electrochemical Approaches: Anodic oxidation of alumina films, porous silicon and pulsed electrochemical deposition.

Physical Approaches: Vapor deposition and different types of epitaxial growth techniques-pulsed laser deposition - Magnetron sputtering - Micro lithography
Microwave, Laser and Ultrasound assisted methods.

Unit – IV: Characterization Of Nanomaterials

Optical Microscopy – Scanning Electron Microscopy – Transmission Electron Microscopy - Atomic Force Microscopy – Scanning Tunneling Microscopy – Optical Absorption and Emission Spectroscopy – Thermogravimetric Analysis – Differential Scanning Calorimetry – Thermomechanical Analysis- X-Ray Diffraction - Modulus and load carrying capability of nano region - Compression - micro hardness – Fatigue – Abrasion and wear resistance – Super elasticity – Nanoindentation - Nanotribology – Nanotribometre – Surface Force Apparatus – Quartz Crystal Microbalance – Friction Force Microscope.

Unit – V: Nanoscale Materials And Devices

Bulk Nanostructured Materials - Gas Sensor Materials – Biosensors - Semiconductor Nanodevices

Books for Study and Reference:

1. Mick Wilson, KamaliKannangara, Geoff smith, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas press, 2005.
2. Charles P.PooleJr and. Frank J.Owens, “Introduction to Nanotechnology”, Wiley Interscience, 2003.
3. Mark A.Ratner, Daniel Ratner,”Nanotechnology: A gentle introduction to the next Big idea”, Pearson Education, 2003.
4. Hari Singh Nalwa, “Nanostructured materials and Nanotechnology”, Academic press, 2001.
5. Charles P.PooleJr and. Frank J.Owens, “Introduction to Nanotechnology”, Wiley Interscience, 2003.
6. G. Cao, “Nanostructures and Nanomaterials: Synthesis, Properties and Applications”, Imperial College Press, 2004.
7. C.M. Niemeyer and C.A. Mirkin, “Nanobiotechnology, Concepts, Applications and perspectives”, WILEY-VCH, 2004.
8. G.M.Chow and K.E.Gonsalves, “Nanotechnology - Molecularly Designed Materials”, American chemical society Symposium series 622, 1996.
9. SV. Gaponenko, Optical Properties of semiconductor nanocrystals, Cambridge University Press, 1998.
10. W.Goddard, Handbook of NanoScience, engineering and technology, CRC Press, 2007.
11. G.Cao, “Nanostructures and Nanomaterials: Synthesis, Properties and Applications”, Imperial College Press, 2004.
12. T.Pradeep, “Nano: The essentials, understanding Nanoscience and Nanotechnology”, Tata McGraw Hill, 2007.
13. Willard, “Instrumental Methods of Analysis”, Van Nostrand, 2000.

15 MPH 104 P **Prof. J. Charles**

C4 - THIN FILM TECHNOLOGY AND ITS APPLICATIONS

Unit – I: Thin Film Deposition Techniques

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

Unit – II: Film Growth And Structure

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

Unit – III: Thin Film Analysis

Structural Characterisation- X-ray Diffraction – SEM – 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 – IV: 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 Spectrophotometer (Refractive Index – Absorption Edge – Transmission and Absorbance) - Energy Band Gap – Magneto Resistance – Ferro Magnetic Domain Studies – Meisner Effect – Super Conducting Stage.

Unit – V: 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 Internations 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. Plenum Press, New York 1983
6. Vacuum Deposition of Thin Films: L. Hollond, John Wiley & Sons Inc, New York, 1958.

15 MPH 104 Q **Prof. S. Dominique**

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 - Cylindrical nucleus - Heterogeneous nucleation Cap shaped nucleus – Disc shaped nucleus, Significance of single crystals - Reasons for growing single crystals - Criteria for optimizing growth parameters.

Unit – II: Crystal Growth Techniques

Crystal growth from melt: Czocharlski technique – Bridgmann - 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 Study and Reference:

1. Crystal Growth processes and methods – Dr. P. SanthanaRaghavan 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, (2002) 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 (Third Edition 1993) - Prentice Hall of India.

15 MPH 104 R **Prof. PC**

C4 - CRYSTAL GROWTH PROCESSES AND ITS CHARACTERIZATION TECHNIQUES

Unit – I: Thermodynamics of Crystal Growth

Saturation and super saturation – solubility curve – expression for super saturation – Solubility diagram – nucleation – Theories of nucleation – Gibbs Thomson equation for vapour – Modified Thomson's equation for melt – Gibbs 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 electrolytic 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 – Verneuil process – Heat exchange method.

Unit – IV: Other Crystal Growth Techniques

Physical vapour deposition – chemical vapour deposition – Chemical vapour transport – Definition – fundamentals – choice of transport reactions – specifications – Transported materials and agents – STP, LTVTP, OTP – Hydrothermal growth: Design aspect of autoclave – electro crystallization – Gel Method: principle- types of gels- structure of gels- growth in gels – experimental procedure – biological crystallization.

Unit – V: Analysis And Characterization Of Crystals

Optical transmission studies (UV) Micro hardness studies -Structural analysis – XRD – Fourier Transform –IR – Spectral analysis – Scanning 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

15 MPH 104 S **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 – surfaces 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 and Kinetics of Nano Particles

Basic concepts of nanostructured materials – nucleation: surface nucleation growth – grain size distribution – nano particle transport in low density media – vapour nano phase thermodynamics – coagulation of nano particles, determination 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 deposition – 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 inorganics and nano composites – the Pecheni method – silica gel –zirconia and Yttrium gel – alumino silicate gel – polymer nano composites.

Unit – IV: Structural Studies

XRD, Electron microscopes – scanning electron microscopes – transmission electron microscopes − Scanning probe microscopy – atomic force microscopy – scanning tunneling microscope – Scanning Non-linear Dielectric microscopy - 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 Data Storage − Magnetic Semiconductors − Spintronics devices − Nanosensors − optical industry − metrology − defense and environment.

Books For Study And Reference:

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).

15 MPH 104 T **Dr. M.M. Armstrong Arasu**

C4 – LIQUID STATE CHEMICAL PHYSICS

Unit – I: Theory and Models of Liquid State:

Similarities between liquids and solids – similarities between liquids and gases – peculiarities of liquid state – van der Waals equation - molecular properties from bulk data- method of pair distribution function – method of collective variables.

Unit – II: Equilibrium Statistical Mechanics of Fluids:

Statistical mechanics averages – distribution functions – thermodynamic equation – virial exapansion of the equation of state – approximate theories of the radial distribution function – perturbation theory.

Unit – III: 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 – IV: 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 theories to liquids – interpretation of results obtained.

Unit – V: Experimental Techniques for Liquid Mixtures:

Mole Fraction – volume fraction – molarity and molality – measurement of velocity of sound – continuous ultrasonic wave method and pulse 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
6. Armstrong Arasu M.M - Ph.D. dissertation – Bharathidasan university, 2010

15 MPH 104 U **Dr. A.J. Clement Lourduraj**

C4: LIQUID STATE CHEMICAL PHYSICS WITH SPECTRSOCOPIC CONFIRMATION

Unit – I: 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 – II: Distribution Function Theories:

The state structure factor – The Ornstein – Zernike direct correlation function – Diagrammatic expansions of the pair functions – Functional expansions and integral equations – The PY solution for hard spheres – The mean – spherical approximation – Numerical results – Extensions of integral equations – Integral equations for non-uniform fluids.

Unit – III: Liquid Theories Based on Hard Sphere Model:

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

Unit – IV: Experimental Techniques for Liquid Mixtures:

Mole fraction – volume fraction – percentage by weight - 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 – interpretation of such data.

Unit – V: Spectroscopic Confirmation:

FTIR spectroscopy – sample preparation – analysis of the spectra – comparison with a reference – advantages of FTIR – applications of FTIR – 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 Eastern Ltd. 1978.
4. Liquid State Physics – M. M. Woolfson and J. M. Ziman, Academic press 1982.
5. Liquid state chemical physics – Watts, R.O and McGee I.J – Willey interscience, New York, 1976.
6. An Introduction to Liquid state – Egelstaff P.A, chapters 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 – Bharathidasan university, 2010

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