MASTER OF PHILOSOPHY IN PHYSICS

SYLLABUS - 2007-09

ST. JOSEPH'S COLLEGE (AUTONOMOUS)

(Nationally Reaccredited with A+ Grade / College with Potential for Excellence)

TIRUCHIRAPPALLI - 620 002

TAMIL NADU, INDIA

ST. JOSEPH'S COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI - 620 002
DEGREE OF MASTER OF PHILOSOPHY (M. PHIL.)
FULL TIME - AUTONOMOUS REGULATIONS

GUIDELINES

1. ELIGIBILITY

- ✧ A Candidate who has qualified for the Master's Degree in any Faculty of this University or of any other University recognized by the University as equivalent there to (including old Regulations of any University) subject to such conditions as may be prescribed therefore shall be eligible to register for the Degree of Master of Philosophy (M.Phil.) and undergo the prescribed course of study in a Department concerned.
- ✧ A candidate who has qualified for Master's degree (through regular study / Distance Education mode / Open University System) with not less than 55% of marks in the concerned subject in any faculty of this university or any other university recognized by Bharathidasan University, shall be eligible to register for M.Phil. SC / ST candidates are exempted by 5% from the prescribed minimum marks.

2. DURATION

The duration of the M.Phil. course shall be of one year consisting of two semesters for the full-time programme.

3. COURSE OF STUDY

The course of study shall consist of

Part - I : 3 Written Papers
Part - II : 1 Written Paper and Dissertation.

The three papers under Part I shall be :

Paper I : Research Methodology
Paper II : Advanced / General Paper in the Subject
Paper III : Advanced Paper in the subject

Paper I to III shall be common to all candidates in a course. Paper I, II, III & IV shall consist of 5 units each covering the subject requirements of the course offered. The Board of Studies shall approve the Syllabi for Papers. The syllabus for paper IV shall be prescribed by each Research Advisor, which is also to be approved by the Board of Studies. The number of specialized papers by the research advisor can be more than one.

Question papers for Papers I to III shall be set externally and valued by two examiners, one internal and one external. The concerned HOD will be in the Board of Examiners to pass the results. Paper IV shall be set and valued by the Research Adviser. The Controller of Examinations shall conduct the examinations for all papers and dissertation.

4. SCHEME OF EXAMINATION

4.1 Part-I (First Semester)

Paper I : Research Methodology
Paper II : Advanced / General paper in the subject
Paper III : Advanced paper in the subject

Part-II (Second Semester)

Paper IV : Field of specialization
Paper V : Dissertation

4.2 Written Examination

The examinations for Papers-I, II and III shall be taken at the end of the first semester and Paper-IV at the end of the second semester. Each paper shall have 100 marks for the semester examination (written) and 100 marks for Continuous Internal Assessment.

The CIA components are:

Seminar-I	:	15 marks
Mid semester	:	35 marks
Seminar-II	:	15 marks
End semester	:	35 marks
Total	:	100 marks

Both the CIA marks and the external marks should be mentioned separately in the mark sheets. The duration for each semester examination shall be 3 hours. A candidate shall be declared to have passed Part-I & II examinations if he/she secures not less than 50 of the marks each in the CIA and the semester examination respectively. The aggregate of the marks secured in the semester examinations and CIA marks taken together must be 50% in each of the Papers I to IV and Dissertation.

4.3 Credits for Papers I to IV

Paper	Name	Contact Hours	Library Hours	Total Hours	Credits	CIA Marks
I	Research Methodology	6	6	12	10	100
II	Core Subject	6	6	12	10	100
III	Core Subject	6	6	12	10	100
IV	Optional Subject	2	4	6	5	100
	Total			42	35	400

Credits for Dissertation

Internal Examination (the split up for CIA)

Project	Credits	Marks	Total Marks
Seminar on review of related literature	3	30	200
Seminar on Data Analysis / Results	2	20	
Dissertation Evaluation	15	150	
Viva - voce	5	100	100
Total	**25**	**300**	**300**

External Examination

	Credits	Marks
Dissertation Evaluation	20	200
Viva-voce	5	100
Total	**25**	**300**

4.4 Dissertation

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

4.4.1a 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 just before the submission of the final draft of the dissertation

4.4.1b Submission

Candidates shall submit the Dissertations to the Controller of Examination not earlier than five months but within six months in the full time programme. The above said time limit shall start from 1st of the month which follows after the month in which Part-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 three months in the first instance and another three months in the second instance with penalty fees. If a candidate does not submit his Dissertation even after the two extensions, his registration shall be treated as cancelled and he 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.

4.4.1c Requirement

For the valuation of dissertation the mandatory requirement is a pass in papers I to IV. 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.

4.4.2 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 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 test and Dissertation valuation. A student can undertake project in the second semester whether or not he /she has passed the first semester.

5. QUESTION PAPER PATTERN

5.1 Internal (Mid & End)

5.1a For Science

There are two sections A and B:

Section A contains 8 short answer Questions	8 × 4	= 32
Section B contains 4 Essay Question	4 × 17	= 68
		100

5.1b For Arts

Only one section of Essay type questions 5 × 20 = 100

5.2 External Exam (Semester)

5.2a For Science

Section A - 10 short answer Questions	10 × 3	= 30
Section B - 5 Essay type Questions either or	5 ×14	= 70
		100

5.2b For Arts

Only one section of Essay type questions 5 out of 8 (5 × 20 = 100)

5.2c For the Paper-IV (Optional/Research Adviser's paper)

The Question paper pattern for Paper IV is common for both Science and Arts. The pattern is only one section with Essay type Questions 5 out of 8 (5 × 20 = 100)

There may be two separate mark sheets for the first and second semester respectively. The marks allotted by the guide and that by the External Examiner must be shown in separate columns of the 2nd Semester mark sheet.

6. CLASSIFICATION OF SUCCESSFUL CANDIDATES

6.1 The candidates who pass the Part - I and Part - II examinations in their first attempt shall be classified as follows:

No.	Total Marks secured in Part - I and Part - 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 (Mathematics, Statistics and Computer Science / Applications shall be treated as Science Subjects)	II Class

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

7. QUALIFICATIONS OF RESEARCH ADVISER FOR THE M.Phil. COURSE

7.1 A person eligible to be a Research Adviser shall be required to possess a Ph.D. Degree or two years of Post-Graduate teaching experience after qualifying for M.Phil. / M.Litt. degree. He / She should have obtained recognition from the University.

7.2 In view of the paucity of guides in the newly emerging subjects like Biotechnology, Microbiology, Remote Sensing the research guides in the related areas may be permitted to guide students provided these guides satisfy the qualification requirements.

7.3 Normally a person shall be allowed to guide not more than three candidates.

7.4 Change of guide may be permitted by the Principal based on the merit of the individual cases.

8. ATTENDANCE

- ✧ Daily attendance for 90 working days should be enforced for the students.
- ✧ Periodical report of a student to the guide concerned should be recorded in the register kept by the guide.

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M.PHIL. PHYSICS - COURSE PATTERN - 2007

Sem	Code	Course	Title of the paper
I	07 MPH 101	I	Research Methodology
	07 MPH 102	II	Mathematical and Computational Physics
	07 MPH 103	III	Advanced Physics
II	07 MPH 204	IV	Liquid State Chemical Physics
	07 MPH 205	IV	Dielectric Thin Film Physics
	07 MPH 206	IV	Semiconductor Thin Film Physics
	07 MPH 207	IV	Microcontroller and Interfacing Techniques
	07 MPH 208	IV	Thin Film Sensors
	07 MPH 209	IV	Laser Physics
	07 MPH 210	IV	Phonon Physics
	07 MPH 211	IV	Lattice Dynamics
	07 MPH 212	IV	Chemical Physics
	07 MPH 213	IV	Microprocessor and Its Applications
	07 MPH 214	IV	Instrumentation and Control
	07 MPH 215	IV	Crystal Growth
	07 MPH 216	IV	Thin Film Technology and its Applications
	07 MPH 217	IV	Crystal Growth Processes and its Characterization Techniques
	07 MPH 225	V	Dissertation

07 MPH 101

Course - I : RESEARCH METHODOLOGY

Unit 1: 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: MODERN TOOLS FOR RESEARCH

Internet and its applications - e-mail - www-web browsing - TELNET - FTP-MS-Office - SPSS - LaTeX .

Unit III: 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 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: NON-LINEAR DYNAMICS

Linear and nonlinear forces - Linear superposition principle - Definition of nonlinearity - Effects of nonlinearity - Linear and nonlinear oscillators - free oscillations - Damped oscillations - Damped and forced oscillation - Bifurcations : The saddle node, the pitch fork, Trans critical and Hopf - the logistic map - period doubling phenomenon - KdV equation.

BOOKS FOR STUDY AND REFERENCE

Unit

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

II **Internet - An introduction**, CI Systems School of Computing, Tata McGraw Hill, Delhi, 1999

III **How to write and publish a scientific Paper** - (4th edn), Robert A. Day

IV **Lecture material**, Collection from Internet

V **Non-linear dynamics: Integrability, Chaos and Pattern -** M. Lakshmanan and S. Rajasekar, Springer Int. Edn., New York, 2003.

07 MPH 102

Course - II : MATHEMATICAL AND COMPUTATIONAL PHYSICS

Unit I : 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.

Unit II : 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 III: NUMERICAL METHODS

Roots of a polynomial and transcendental equations - Newton-Raphson method. Curve fitting: linear, polynomial and exponential - Solving a set of simultaneous linear equations: Gauss-Seidal, Gauss-Jordan methods. Solving Differential equations: Euler's method, Runge-Kutta method. Numerical integration: Trapezoidal, Simpson's, Gaussian Quadrature method.

Unit IV: PROGRAMMING IN C

Programming methodologies - Scientific programming languages - Programing in C- Variables-expressions and statement- operators-library functions- data input and output - structure of C programming- control statements- functions-pointers-global variables-arrays-Character-strings.

Unit V : COMPUTATIONAL PHYSICS

Developing Algorithm and C-Programming for: Motion of a projectile including air drag (Feynman -Newton method), Motion of a charged particle in E and B fields (Euler method and Predictor - corrector method), Non-linearity study of rectifier output, Energy analysis in RL Circuit (Euler method), Solution of time independent Schroedinger equation (RK methods).

BOOKS FOR STUDY AND REFERENCE

Unit

I **Mathematical Physics**, AK Ghatak, IC Goyal & SJ Chua Macmillan. Delhi, 2002.

II **Mathematical methods for Physicists** - Arfken and Weber,Academic Press, USA, 2001

III **Numerical Methods**, MK Jain , SRK Iyengar and RK Jain New Age Ltd 2005

IV **Programming in C**, Byron Gottfried, 2/e,Tata McGraw-Hill education, New Delhi , 2005

V **Computer Programming: An Introduction** - RC Verma *et al*.,New Age Int. Pub, New Delhi, 1999.

Computation methods in Physics and Engineering - Samuel SM Wong, Allied Publishers Pvt. Ltd ,Delhi, 2002

07MPH103

Course III - ADVANCED PHYSICS

Unit 1: IMPERFECTIONS IN ATOMIC PACKINGS

Types of imperfections- Point defects – Line defects: Theories, derivations for their concentrations, effect - defect and energy state – Burger vector and circuits – Dislocation motions in perfect and imperfect case – slip planes and slip direction – surface imperfections Diffusion mechanism – Random walk treatment- Kirkendall effect – Diffusions in Alkali halides and ionic crystals. Colour center and generations.

Unit II: QUANTUM FIELD THEORY

Indistinguishability – Second Quantisation: Bose- Einstein Statistics, Fermi-Dirac Statistics, Equation of motion- distribution function. Ideal gases: The Grand canonical ensemble, Ideal Fermi gas, Ideal Bose gas – Weak field approximation: Dilute Bose Einstein Condensation – Hartree-Fock equation.

Unit III : 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 – optical coupling - Fiber optics : Step index and graded index fibers – principles of electro optics – electro optics in anisotropic and liquid crystals – non linear optics; optical media, second order nonlinear optics – Acousto optics : optic devices - fiber optic communications: components, modulation, multiplexing and coupling – coherent optical communications .

Unit IV : ELECTRONIC CONTROL CIRCUITS

Introduction to automatic control system - Open loop control systems - Closed loop control systems - Basic elements of a servo mechanism - Advantages of electronic control of Devices - DC motor speed control – Temperature control – Illumination control – Automatic water level indicator using SCR – Battery operated inverter circuit using power transistor – semiconductor transducers.

Unit V : ASTROPHYSICS

Astronomical instruments - optical telescopes- radio telescopes - Hubble space telescope-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

II **Quantum Mechanics: Fundamentals** – Kurt Gottfried & Ting mow Yan Springer Int. Edn., New York 2003

III **Fundamentals of Photonics** – Bahaa E.A. Saleh, Wiley Series in Pure and Applied Optics, 2003.

IV **Industrial Electronics and Control** - SK Bhattacharya, S. Chatterjee, Tata McGraw Hill,. New Delhi, 1995

V **An introduction to AstroPhysics**- Baidyanath Basu - Prentice-hall of India- New Delhi, 1997

07MPH204

Course IV: LIQUID STATE CHEMICAL PHYSICS

Dr. M.K

Unit 1: 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 2: 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 3: 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 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 theories to liquids - interpretation of the results obtained.

Unit 5: 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.
8. Kalidoss, M., Ph.D. dissertation, Bharathidasan University, 1998.

07MPH205

Course IV: DIELECTRIC THIN FILM PHYSICS

Prof. V W

Unit 1: PREPARATION OF THIN FILMS

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

Unit 2: THICKNESS MEASUREMENT & NUCLLEARTION 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 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 THINFILMS

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 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 internations 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.

07MPH206

Course IV: SEMICONDUCTOR THIN FILM PHYSICS

Prof. A R

Unit 1: 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 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 - microbalance monitors - optical interference methods multiple beam interferometry - Fizeau and FECO methods - Quartz crystal thickness monitor.
Theories of nucleation - Four stages of film growth Incorporation of defects during growth.

Unit 3: TRANSPORT AND MECHANICAL PROPERTIES

Semiconducting films: Theory - preparation and properties - photoconducing - 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 4: ELECTRICAL PROPERTIES

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

Unit 5: 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, NewYork
2. Vacuum Deposition of Thin Films: L. Hollond John Wiley & Sons Inc, New York 1958.
3. Thin Film Phenomena: K.L.Chopra McGraw Hill NewYork 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

07MPH207

Course IV: MICROCONTROLLER AND INTERFACING TECHNIQUES

Prof. ALR

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 Pte. 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

07MPH208

Course IV: THIN FILM SENSORS

Prof. Ra

Unit 1: PREPARATION OF THIN FILMS

Chemical methods: Electroplating - Ion plating - Chemical reduction plating -Vapour phase growth. Anodisation - Vacuum evaporation - Sputtering methods: - Reactive sputtering - RF sputtering - Dip coating technique .

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

Unit 2: THICKNESS MEASUREMENT & NUCLEATION AND GROWTH IN THIN FILMS

Thickness measurements: Microbalance - Electrical methods - 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: UV-VISIBLE AND NEAR IR SEMICONDUCTOR SENSORS

Silicon photo detector diodes - Properties - Characteristics of other silicon photo detectors - Indium - Gallium Arsenide detector diodes for fiber applications.

Unit 4: IR AND FIR SENSORS

Classification of IR detectors - Characteristics and Measurements of IR detectors - IR detectors Materials - Far _IR detectors - Applications.

Unit 5: OPTICAL PROPERTIES

Thin films optics _ Theory - optical constants of thin 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, NewYork 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 NewYork 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
8. A sensors Comprehensive survey V6. Edited by W Gopal, J. Hesse, JN. Zend.

07MPH209

Course IV: LASER PHYSICS

Prof. NR

Unit 1: 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 2: 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 3: 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 4: HOLOGRAPHY AND SCIENTIFIC APPLICATIONS

Holography and holographic interferometer - pollution monitoring - isotope seperation - laser speckle and applications - laser communication 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 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

07MPH210

Course IV: PHONON PHYSICS

Dr. Ce

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 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 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 rigid 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 scattering - 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

Cooks 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 etal, 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, Newyork,1960.
4. An introduction to Lattice Dynamics by A. K. Ghatak, L. S Kothari,Addison pub1971
5. Vibrational Spectroscopy of solids - Sherwood PM-Cambridge, 1972
6. Current trends in Lattice dynamics - KR Rao (Educational) APT, Bombay, 1978
7. Phonons in condensedmatter Physics-RKSingh & S.P.Sanyal, Welly Eastern Ltd, 1990
8. Advances in Phonon Physics - Philip (Ed) - Edu.Pub. & Distributors, Kochi, 2000

07MPH211

Course IV: LATTICE DYNAMICS

Dr. NL

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 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 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 rigid 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 scattering - 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 – Green'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 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 etal, 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, Newyork and London, 1960.
4. An introduction to Lattice Dynamics by A. K. Ghatak, L. S Kothari,Addison pub1971
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-RKSingh&S.P.Sanyal, Weilly Eastern Ltd. 1990
8. Advances in Phonon Physics - Philip (Ed) - Edu.Pub. & Distributors, Kochi 2000

07MPH212

Course IV: CHEMICAL PHYSICS

Dr. JN

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 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 -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 3: LIQUID THEORIES BASED ON HARD SPHERE MODEL

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

Unit 4: 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 5: ULTRASONICS OF BIOLOGICALSUBSTANCES AND BIOCHEMIC-ALS

Introduction - solutions -Amino acids - Polypeptides - Proteins - carbohydrates - Bases, Nucliolides and nucleosides, Nuclicacids, Lipids

Books for study and reference

1. Theory of Simple Liquids by Hansen and McDonald (for UnitS I, II, III and IV) 2 nd 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

07MPH213

Course IV: MICROPROCESSOR AND ITS APPLICATIONS

Dr. APP

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.

07MPH214

Course IV: INSTRUMENTATION AND CONTROL

Dr. BK

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

07MPH215

Course IV: CRYSTAL GROWTH

Prof. B K & Prof. SD

Unit 1: 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 2: 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 3: 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 4: MODERN CRYSTAL GROWTH TECHNIQUES

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

Unit 5: PHYSICAL PROPERTIES OF CRYSTALS

Effect of symmetry on physical properties - Elastic properties - Thermal properties - Electrical properties - Magnetic properties - Dielectric 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.

07MPH216

Paper III: THIN FILM TECHNOLOGY AND ITS APPLICATIONS

Mr. JC

Unit 1: 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 2: 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 3: THIN FILM ANALYSIS

Structural Characterisation- X-ray Diffraction - SEM - TEM - UV Visible Specturm - FTIR and NMR Studies for Organic samples - X-ray Photo Electron Spectroscopy (XPES) - Energy Dispersive of Atomic Xray 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 Spectrophotometer (Refractive Index - Absorption Edge - Transmission and Absorbance) - Energy Band Gap - Magneto Resistance - Ferro Magnetic Domain Studies - Meisner Effect - Super Conducting 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 Reference

1. Hand Book of Thin Film Technology: L.I.Maissel and R. Gland McGraw Hill, NewYork 1970.
2. Thin film fundamentals -A.Goswami ,New age internations pub.,2003
3. Thin Film Phenomena: K.L.Chopra McGraw Hill NewYork 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.

07MPH217

Course III: CRYSTAL GROWTH PROCESSES & ITS CHARACTERIZATION TECHNIQUES

Prof. CR

Unit 1: 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

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