SRI SANKARA ARTS & SCIENCE COLLEGE

(AUTONOMOUS)

DEPARTMENT OF PHYSICS

(CHOICE BASED CREDIT SYSTEM)

M.SC. PHYSICS DEGREE COURSE

For the Academic Year 2017-2018

REGULATIONS

1. CONDITIONS FOR ADMISSION

M.Sc. PHYSICS

A candidate who has passed the B.Sc Degree Examination in branch III Physics main with Mathematics as one of the ancillary subjects or B.Sc Applied Science of this University with Mathematics as one of the ancillary subjects or an examination of some other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to M.Sc Physics degree course.

2. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than two academic years, passed the examination of all the four semesters prescribed earning **90 credits** and fulfilled such conditions as have been prescribed therefor.

3. DURATION OF THE COURSE

The duration of the course is for two academic years consisting of four semesters.

4. EXAMINATIONS

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and the end of the second academic year, respectively.

5. COURSE OF STUDY AND SCHEME OF EXAMINATIONS

NAME OF THE COURSE - M.Sc. PHYSICS

The scheme of examinations for different semesters shall be as follows:

Vide **APPENDIX-B**

The following procedure to be followed for Internal Marks:

Theory Papers:

Internal Marks – 25 Maximum Marks

i) Best Two tests out of 3	10 marks
ii) Attendance	5 marks
iii) Seminar	5 marks
iv) Assignment	5 marks
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	25 marks

Break-up Details for Attendance

Below 60%	- No marks
60% to 75%	- 3 marks
76% to 90%	- 4 marks
91% to 100%	- 5 marks

Practical:

Internal Marks	40 Maximum Marks	
Attendance		5 marks
Practical Best Test 2 out of 3		30 marks
Record		5 marks
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		40 marks

Project:

Internal Marks	Best 2 out of 3 presentations	20 marks
Viva		20 marks
Project Report		60 marks

6. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS:

(i) Candidates shall register their names for the First semester examination after the admission in the PG courses.

(ii) Candidates shall be permitted to proceed from the First Semester upto the Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current (subject) Semester subjects.

(iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn sufficient attendance as prescribed therefore by the Syndicate from time to time.

Provided in case of candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorised Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the University from time to time.

7. PASSING MINIMUM:

a) There shall be no Passing Minimum for Internal.

b) For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.

c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.

d) Grading shall be based on overall marks obtained (internal + external).

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Candidates who secured not less than 60% of aggregate marks (Internal + External) in the whole examination shall be declared to have passed the examination in the First Class.

All other successful candidates shall be declared to have passed in Second Class.

Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in First Class with Distinction, provided they pass all the examinations (theory papers, practicals, project and viva-voce) prescribed for the course in the First appearance.

9. GRADING SYSTEM:

1. **Passing Minimum** is 50% of the ESE and also 50% of the maximum of that Paper/course.

2. **Minimum Credits to be earned**:

   For TWO year Programme: **Best 90 Credits**

   (Part A (80 Credits): Core, Elective, Non-major Electives and Extra Disciplinary and

   Part B (10 Credits): Soft skills and Internship)

   For THREE year Programme: **Best 135 Credits**.

   (Part A (120 Credits): Core, Elective, Non-major Electives and Extra Disciplinary and

   Part B (15 Credits) : Soft skills and Internship)

3. **Marks and Grades:**

The following table gives the marks, grade points, letter grades and classification to indicate the performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in a Paper /Course)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0	U	Re-appear
ABSENT	0.0	AAA	ABSENT

Ci = Credits earned for course i in any semester.

Gi = Grade Point obtained for course i in any semester.

n refers to the semester in which such courses were credited.

For a Semester:

GRADE POINT AVERAGE [GPA] = $\sum i$ CiGi / $\sum i$ Ci

$$\text{GPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

For the entire programme:

CUMULATIVE GRADE POINT AVERAGE [CGPA] = $\sum n \sum i$ CniGni / $\sum n \sum i$ Cni

$$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

CGPA	**GRADE**	**CLASSIFICATION OF FINAL RESULT**
9.5-10.0	O+	First Class - Exemplary *
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction *
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	

7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

* The candidates who have passed in the first appearance and within the prescribed semester of the PG Programme (Core, Elective, Non-major Electives and Extra-Disciplinary courses alone) are eligible.

10. PATTERN OF QUESTION PAPER:

PART –A (50 words): Answer 10 out of 12 Questions 10 x 1 = 10 marks
PART –B (200 words): Answer 5 out of 7 Questions 5 x 5 = 25 marks
PART –C (500 words): Answer 4 out of 6 Questions 4 x 10 = 40 marks

11. APPEARANCE FOR IMPROVEMENT:

Candidates who have passed in a theory paper / papers are allowed to appear again for theory paper / papers only once in order to improve his/her marks, by paying the fee prescribed from time to time. Such candidates are allowed to improve within a maximum period of 10 semesters counting from his/her first semester of his/her admission. If candidate improve his marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. If the candidate does not show improvement in the marks, his previous marks will be taken into consideration.

Candidate will be allowed to improve marks in the Practical's, Project, Viva-voce, Field work.

12. TRANSITORY PROVISION:

Candidates who have undergone the course of study prior to the academic year 2017-2018 will be permitted to appear for the examinations under those Regulations for a period of three years i.e., up to and inclusive of April/May 2020 Examinations. Thereafter, they will be permitted to appear for the examination only under the Regulations then in force.

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M.Sc. DEGREE COURSE IN PHYSICS

FIRST SEMESTER

S. NO	COURSE COMPONENTS	NAME OF COURSE	SEMESTER	INST. HOURS	CREDITS	EXAM HRS	MAX MARKS	
							CIA	EXTERNAL
1	Core	Paper 1 - Mathematical Physics	I	6	4	3	25	75
2	Core	Paper 2 – Classical Mechanics And Relativity	I	6	4	3	25	75
3	Core	Paper 3 - Quantum Mechanics-I	I	6	4	3	25	75
4	Core	Paper 4 – Integrated Circuits And Microprocessor 8085	I	6	4	3	25	75
5	Core	Paper 5 - Practical-I * Part -1A & 2A– Electronics And Microprocessor 8085	I	4	4	4	40	60
6	Soft Skill - I	Language And Communication Advanced Level	I	2	2	3	40	60
				30	22		180	420

SECOND SEMESTER

S. NO	COURSE COMPONENTS	NAME OF COURSE	SEMESTER	INST. HOURS	CREDITS	EXAM HRS	MAX MARKS	
							CIA	EXTERNAL
7	Core	Paper 6 – Quantum Mechanics –II	II	6	4	3	25	75
8	Core	Paper 7 – Electromagnetic Theory And Plasma Physics	II	6	4	3	25	75
9	Core	Paper 8 – Practical - II* Part-1B & 2B – General	II	4	4	4	40	60
10	Elective – I	Paper 9 – Spectroscopy	II	4	3	3	25	75
11	Elective- II	Paper 10 – Energy Physics	II	4	3	3	25	75
12	Extra Disciplinary I	Paper 11 -Basic Materials Science	II	4	2	3	25	75
13	Soft Skill - II	Spoken And Presentation Skills Advanced Level	II	2	2	3	40	60
				30	22		205	495

*** Practical Examination at the end of even semester**

THIRD SEMESTER

S. NO	Course Components	Name Of Course	SEMESTER	INST. HOURS	CREDITS	EXAM HRS	Max Marks	
							CIA	EXTERNAL
14	Core	Paper 12 – Statistical Mechanics	III	6	4	3	25	75
15	Core	Paper 13 – Nuclear And Particle Physics	III	6	4	3	25	75
16	Core	Paper 14 – Computational Methods And Programming	III	6	4	3	25	75
17	Core	Paper 15 – Practical - III* Part-3A-Advanced Microprocessor 8085 and Computational Methods & 4A – Microprocessor 8086 and Microcontroller 8051	III	4	4	4	40	60
18	Elective- III	Paper 16- Crystal Growth	III	3	3	3	25	75
19	Extra Disciplinary II	Paper 17-Intelligent Instrumentation	III	3	3	3	25	75
20	Soft Skills-III	Life And Managerial Skills Level-II	III	2	2	3	40	60
21		Internship**	III		2			100
				30	26		205	595

**** Internship will be carried out during the summer vacation of the first year and marks should be sent to the University by the College and the same will be included in the Third Semester Marks Statement.**

FOURTH SEMESTER

S. NO	COURSE COMPONENTS	NAME OF COURSE	SEMESTER	INST. HOURS	CREDITS	EXAM HRS	MAX MARKS	
							CIA	EXTERNAL
22	Core	Paper 18 – Condensed Matter Physics	IV	6	4	3	25	75
23	Core	Paper 19 – Practical – IV * Part – 3B & 4B – General	IV	4	4	4	40	60
24	Elective- IV	Paper 20- Microprocessor 8086 And Microcontroller 8051	IV	6	3	3	25	75
25	Extra Disciplinary III	Paper 21- Material Science	IV	6	3	3	25	75
26	Core	Paper 22 – Project	IV	6	4		20	80
27	Soft Skills - IV	Computing Skills - Advanced	IV	2	2	3	40	60
				30	20		175	425

Total credits: 90 (Core 60 + Soft-skill/Internship 10 + Electives/ED 20)

FIRST SEMESTER

S. NO	COURSE COMPONENTS	NAME OF COURSE	SEMESTER	INST. HOURS	CREDITS	EXAM HRS	MAX MARKS	
							CIA	EXTERNAL
1	CORE	PAPER 1 - MATHEMATICAL PHYSICS	I	6 HRS	4	3	25	75
2	CORE	PAPER 2 – CLASSICAL MECHANICS AND RELATIVITY	I	6 HRS	4	3	25	75
3	CORE	PAPER 3 - QUANTUM MECHANICS-I	I	6 HRS	4	3	25	75
4	CORE	PAPER 4 – INTEGRATED ELECTRONICS AND MICROPROCESSOR 8085	I	6 HRS	4	3	25	75
5	CORE	PAPER 5 - PRACTICAL-I * PART -1A & 2A– ELECTRONICS AND MICROPROCESSOR 8085	I	4 HRS	4	4	40	60
6	Skill Based Subject	SOFT SKILL – I	I	2 HRS	2	3	40	60
				30	22		180	420

PAPER 1: MATHEMATICAL PHYSICS

UNIT 1:**LINEAR VECTOR SPACES AND TENSORS**

Linear operators – Vectors in n-dimensions – Matrix representation of vectors and operators in a basis - Linear independence, dimension - Inner product - Schwarz inequality - Orthonormal basis - Gram-Schmidt Process – Eigenvalues and Eigenfunctions of operators/matrices – Hermitian and unitary operators/matrices – Cayley-Hamilton theorem - Diagonalizing matrix.

Tensors: Coordinate transformations – Contravariant and Covariant Vectors – Tensors of higher rank – Einstein's summation convention – Kronecker delta – Product rule – Quotient rule- Levi-Civita tensor in three dimensions.

UNIT 2: **LINEAR DIFFERENTIAL EQUATIONS AND GREEN'S FUNCTION**

Second order linear differential equations – Wronskian - Sturm - Liouville theory - Orthogonality of eigenfunctions - Illustration with Legendre, Laguerre, and Hermite differential equations – Expansion of polynomials - Dirac delta function.

One-dimensional Green's function - Eigenfunction expansion of the Green's function - Reciprocity theorem - Sturm - Liouville type equations in one dimension and their Green's functions.

UNIT 3: **COMPLEX VARIABLES**

Functions of a complex variable - Single and multivalued functions - Analytic functions - Cauchy - Riemann conditions - Singular points - Cauchy's theorem and integral formulae - Taylor and Laurent expansions - Zeros and poles - Residue theorem and its applications

UNIT 4: **LAPLACE AND FOURIER TRANSFORMS**

Laplace transforms - Solution of linear differential equations with constant coefficients - Fourier integral - Fourier transforms (Infinite), Fourier sine and cosine transforms - Convolution theorems.

UNIT 5: **GROUP THEORY**

Basic definitions - Lagrange's Theorem - Invariant subgroup - Homomorphism and Isomorphism between groups - Representation of a group - Unitary representations - Schur's lemmas - Orthogonality theorem - Character table - Simple applications to symmetry groups and molecular vibrations.

BOOKS FOR STUDY:

1. **P. K. Chattopadhyay, 2013**, *Mathematical Physics*, 2nd edition, NEW AGE, Chennai.
2. **G. Arfken and H. J. Weber,** 2012, *Mathematical Methods for Physicists*, 7th Edition, Harcourt (India), New Delhi.
3. **A. W. Joshi,** 1997, *Elements of Group Theory for Physicists*, 4th Edition, New Age International, New Delhi.
4. **A. W. Joshi,** 1995, *Matrices and Tensors in Physics*, 3rd Edition, Wiley Eastern, Madras.
5. **E. Kreyszig,** 2011, *Advanced Engineering Mathematics*, 9th Edition, Wiley, New York.
6. **M. D. Greenberg,** 1998, *Advanced Engineering Mathematics*, 2nd Edition, International Ed., Prentice - Hall International, New Jersey.
7. **F. A. Cotton,** 1990, *Chemical Application of Group Theory*, 3rd Edition, John Wiley and Sons, New York.

BOOK FOR REFERENCE:

1. **Tulsi Dass** and **S. K. Sharma,** 1998**,** *Mathematical Methods in Classical and Quantum Physics*, Universities Press (INDIA), Hyderabad.
2. **Seymour Lipschutz , Marc Lipson,** 2005, *Linear Algebra*, Schaum's Series, McGraw - Hill, New York.
3. **E. Butkov,** 1968, *Mathematical Physics*,Addison - Wesley, Reading, Massachusetts.
4. **P. R. Halmos,** 1993, *Finite Dimensional Vector Spaces*, 2nd Edition, Affiliated East-West, New Delhi.
5. **M. Hamermesh,** 1990, *Group Theory and Its application to Physical Problems*, Reprinted edition, Dover Publications Inc, USA.

6. **C. R. Wylie** and **L.C. Barrett,** 1995, *Advanced Engineering Mathematics*, 6th Edition, International Edition, McGraw-Hill, New York.
7. **W. W. Bell,** 2004, *Special Functions for Scientists and Engineers*, Dover Publications, New York.
8. **M. A. Abramowitz** and **I. Stegun (Editors),** 1972, *Handbook of Mathematical Functions* Dover Publications, New York.

WEB SITES:

1. http://www.mpipks-dresden.mpg.de/~jochen/methods/outline/html
2. http://phy.syr.edu/~trodden/courses/mathmethods/
3. http://dmoz.org/Science/Physics/Mathematical_Physics/
4. http://www.thphys.nuim.ie/Notes/engineering/frame-notes.html
5. http://www.thphys.nuim.ie/Notes/frame-notes.html

PAPER 2: CLASSICAL MECHANICS AND RELATIVITY

UNIT 1: **LAGRANGIAN AND HAMILTONIAN FORMULATIONS**

Hamilton’s variational principle - Lagrange's equations of motion – Canonical momenta – Cyclic coordinates and conservation of corresponding momenta – Legendre transformation and Hamiltonian - Hamilton's equations of motion - Two-body central force problem –Kepler Problem and Kepler's laws - Scattering by central potential - Two-particle scattering - Cross-section in lab frame.

UNIT 2: **MECHANICS OF RIGID BODIES**

Rigid body motion – Kinematics – Euler angles – Infinitesimal rotations – Rate of change of a vector – Coriolis force - Dynamics - Angular momentum and kinetic energy - Moment of inertia tensor - Euler's equations of motion - Torque-free motion - Symmetrical top.

UNIT 3: **CANONICAL TRANSFORMATION**

Canonical transformations and their generators – Simple examples - Poisson brackets – Equations of motion in Poisson bracket formalism - Symmetries and conservation laws - Hamilton-Jacobi theory - Application to harmonic oscillator problem.

UNIT 4: **SMALL OSCILLATIONS**

Formulation of the problem - Transformation to normal coordinates - Frequencies of normal modes - Linear triatomic molecule.

UNIT 5: **RELATIVITY**

Lorentz transformations - Four vectors - Lorentz invariance of the four product of two four vectors - Invariance of Maxwell's equations - Relativistic Lagrangian and Hamiltonian for a free particle.

BOOKS FOR STUDY:

1. **H. Goldstein,** 2011, *Classical Mechanics*, 3rd Edition, C. Poole and J. Safko, Pearson Education, Asia, New Delhi.
2. **S. N. Biswas,** 2000, *Classical Mechanics*, Books and Allied Ltd., Kolkata.
3. **Upadhyaya**, 2012, *Classical Mechanics*, Himalaya Publishing Co., New Delhi.

BOOKS FOR REFERENCE:

1. **L. D. Landau** and **E. M. Lifshitz,** 2010, *Mechanics, Elsevier, Chennai.*
2. **K. R. Symon,** 1971, *Mechanics,* Addison Wesley, London.
3. **J. L. Synge** and **B. A. Griffith,** 1963, *Principles of Classical Mechanics,* McGraw-Hill, New York.
4. **C. R. Mondal**, 2008, *Classical Mechanics,* Prentice-Hall of India, New Delhi.
5. **R. Resnick,** 1979, *Introduction to Special Theory of Relativity,* Wiley Eastern, New Delhi.
6. **R. P. Feynman**, 1998, *Quantum Electrodynamics*, West view Press, Revised edition, Colorado, United States.

WEB SITES

1. http://astro.physics.sc.edu/selfpacedunits/unit56.html
2. http://www.phy.auckland.nz/staff/smt/453310SC.html
3. http://www.damtp.cam.ac.uk/user/tong/dynamics.htm
4. http://farside.ph.utexas.edu/teaching/301/lectures/lectures.html
5. http://www.lancs.ac.uk/depts/physics/teaching/py332/phys332.htm

PAPER 3: QUANTUM MECHANICS - I

UNIT 1: **BASIC FORMALISM**

Interpretation and conditions on the wave function - Postulates of quantum mechanics and the Schroedinger equation - Ehrenfest's theorem- Stationary states - Hermitian operators for dynamical variables – Eigen values and eigen functions - Uncertainty principle.

UNIT 2: **ONE DIMENSIONAL PROBLEMSAND THREE DIMENSIONAL PROBLEMS**

Particle in a box - Square-well potential - Barrier penetration - Simple harmonic oscillator - Ladder operators method.

Orbital angular momentum and spherical harmonics - Central forces and reduction of two-body problem - Particle in a spherical well - Hydrogen atom.

UNIT 3: **GENERAL FORMALISM**

Hilbert space - Dirac notation - Representation theory - Co-ordinate and momentum representations - Time evolution - Schroedinger, Heisenberg and Interaction pictures- Symmetries and conservation laws - Unitary transformations associated with translations and rotations - Parity and time reversal.

UNIT 4: **APPROXIMATION METHODS**

Time-independent perturbation theory for non-degenerate and degenerate levels - Variation method, simple applications - WKB approximation - Connection formulae (no derivation) - WKB quantization rule - Application to simple harmonic oscillator - Hydrogen molecule, covalent bond and hybridization.

UNIT 5: **ANGULAR MOMENTUM AND IDENTICAL PARTICLES**

Eigenvalue spectrum from angular momentum algebra - Matrix representation - Spin angular momentum - Non-relativistic Hamiltonian including spin - Addition of angular momenta - Clebsch - Gordan Coefficients. Symmetry and anti-symmetry of wave functions - Spin and Pauli matrices.

BOOKS FOR STUDY:

1. **P. M. Mathews** and **K. Venkatesan**, *2010, A Text book of Quantum Mechanics*, Reprint,Tata McGraw-Hill, New Delhi.
2. **L. I. Schiff**, *2014, Quantum Mechanics*, 4th Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo.
3. **V. Devanathan,** 2011, *Quantum Mechanics*, 2nd edition, Narosa Publishing House, New Delhi.

BOOKS FOR REFERENCE:

1. **E. Merzbacher**, 2011, *Quantum Mechanics*, 2nd edition, Alpha Science International Ltd, 2nd Revised edition ,UK.
2. **V. K. Thankappan**, *2012, Quantum Mechanics*, 2nd Edition, Wiley Eastern Ltd, New Delhi.
3. **P. A. M. Dirac**, 2013, *The Principles of Quantum Mechanics*, Oxford University Press, London.
4. **L. D. Landau** and **E. M. Lifshitz**, 2013, *Quantum Mechanics*, Pergomon Press, Oxford.
5. **S. N. Biswas**, 2012, *Quantum Mechanics*, 2nd Edition, Books and Allied Ltd., Kolkata.
6. **G. Aruldhas**, 2008, *Quantum Mechanics*, 2nd Edition, Prentice Hall of India, New Delhi.
7. **A. Ghatak and S. Lokanathan**, 2004, *Quantum Mechanics: Theory and Applications*, Springer, Chennai.
8. **J. S. Bell, Gottfried** and **M.Veltman**, 2001, *The Foundations of Quantum Mechanics*, World Scientific, Singapore.
9. **R. P. Feynman, R. B. Leighton, and M. Sands**, 2016, *The Feynman Lectures on Physics*, Vols. 3, Narosa, New Delhi.
10. **V. Devanathan,** 2010, *Angular Momentum Techniques in Quantum Mechanics,* Kluwer Academic Publishers, Dordrecht.

WEB SITES

1. http://www.netsa.org.lk/OcwWeb/Physics/index.htm
2. http://www.theory.caltech.edu/people/preskill/ph229/

3. http://www.nscl.msu.edu/~pratt/phy851/lectures/lectures.html
4. http://walet.phy.umist.ac.uk/QM/LectureNotes/
5. http://www.ks.uiuc.edu/Services/Class/PHYS480/
6. http://www.mat.univie.ac.at/~gerald/ftp/book-schroe/index.html
7. http://people.deas.harvard.edu/~jones/ap216/lectures/lectures.html
8. http://www.netsa.org.lk/OcwWeb/Chemistry/5-73Introductory-Quantum-Mechanics-IFall2002/LectureNotes/index.htm
9. http://www.glue.umd.edu/~fivel/
10. http://www.phys.ualberta.ca/~gingrich/phys512/latex2html/phys512.html
11. http://www.eas.asu.edu/~vasilesk/EEE434.html
12. http://minty.caltech.edu/Ph125a/
13. http://walet.phy.umist.ac.uk/QM/LectureNotes/

PAPER 4: INTEGRATED CIRCUITS AND MICROPROCESSOR 8085

UNIT – I LINEAR ICS AND APPLICATIONS

Operational Amplifier: Solution of simultaneous equations and differential equations – Instrumentation amplifier – Log and Antilog amplifiers – Analog multiplication and division.

Generation of square, triangular and sine waves – pulse generation – Schmitt trigger – Active filters (Second order Butterworth design).

Timer 555: Internal architecture and working – Schmitt trigger – Astable and monostable multivibrators – Phase Locked Loop.

UNIT – II DATA COUNTERS

Binary weighted and R/2R ladder DAC – Accuracy and resolution – Dual slope DAC- ADC – Simultaneous conversion – Counter method – Successive approximation.

UNIT – III COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS

4-bit binary adder and subtractor- Encoder and Decoder – Multiplexer and Demultiplexer. Flip – Flops: RS, D-type, JK and M/S JK Flip-Flops, Counters – Asynchronous , Synchronous and Modulus counters – BCD counter – Shift registers – Ring counter – Johnson counter.

UNIT – IV 8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING

Instruction set -Addressing modes – Programming techniques – Memory mapped I/O scheme – I/O mapped I/O scheme – Memory and I/O interfacing – Data transfer schemes – Interrupts of 8085 – Programmable peripheral interface (PPI) – Control group and control word – Programmable DMA controller – Programmable interrupt controller – Programmable communication interface – Programmable counter/interval timer.

UNIT – V 8085 INTERFACING APPLICATIONS

Seven segment display interface – Interfacing of Digital to Analog converter and Analog to Digital converter – Stepper motor interface – Measurement of electrical quantities (voltage and current) – Measurement of physical quantities (temperature and strain).

BOOKS FOR STUDY:

1. **Millman** and **Halkias**, 2009, *Integrated Electronics*,Tata McGraw-Hill Education,India
2. **R. A. Gayakwad**, 2015,*Op-Amps and Integrated Circuits*,Pearson Education,India.
3. **Taub** and **Shilling**, 2008,*Digital Integrated Electronics, McGraw Hill, New Delhi.*
4. **Malvino and Leech,2011,***Digital Electronics,7th edition,* Tata McGraw Hill Education Private limited, New Delhi.
5. **J. Millman**, 1987,*Digital and Analog Circuits and Systems*, McGraw Hill, London.
6. **R. S. Gaonkar**, 2000,*Microprocessor Architecture, Programming and Application with the 8085*, 3rdEdition, Penram International Publishing, Mumbai**.**
7. **B. Ram,** *2012, Fundamentals of Microprocessors and Microcontrollers*, DhanpatRai Publications, New Delhi.
8. **V. Vijayendran**, 2009,*Fundamentals of Microprocessor 8085 – Architecture,Programming and Interfacing*,Viswanathan, S. Printers & Publishers Pvt Ltd, Chennai.

BOOKS FOR REFERENCE:

1. **S. M. Sze**, 2015, 2nd Edition, *Semiconductor Devices – Physics and Technology*, Wiley India Pvt Ltd.
2. **R. F. Coughlin** and **F.F. Driscol**, 1998, *Op-Amp and linear integrated circuits*, Printice Hall of India, New Delhi.
3. **M.S. Tyagi**, 2008, *Introduction to Semiconductor Devices*, Wiley, New York.
4. **P.Bhattacharya**, 2002, *Semiconductor Optoelectronics Devices*, 2ndEdition. Printice Hall of India, New Delhi.
5. **B. Somanathan Nair**, 2006, *Digital Electronics and Logic Design*, Prentice Hall of India,New Delhi.
6. **R.L. Boylestad** and **L.Nashelsky**, 2012, *Electronic Devices and Circuit Theory*, 8thEdition, Pearson Education,India.

PAPER 5: PRACTICAL – I

Part – 1A:ELECTRONICS AND MICROPROCESSOR 8085(Any TEN Experiments)

1. FET CS amplifier – Design, Frequency response, input impedance, output impedance
2. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
3. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
4. Design of a Schmitt trigger circuit using IC 741 for a given hysteresis – application of squarer.
5. Design of a square wave oscillator using IC 741 – Triangular wave oscillator.
6. Construction of pulse generator using the IC 741 – application as frequency divider.
7. OP-Amp. – 4 bit Digital to Analog converter [R / 2R ladder network].
8. Study of R-S, clocked R-S and D-flip flops using NAND / NOR gates.
9. Study of J-K, D and T flip flops using IC 7476 / 7473.
10. Arithmetic operations using IC 7483 – 4 bit binary addition and subtraction.
11. IC 7490 as a scalar and display using IC 7447.

MICROPROCESSOR 8085

12. 8 –bit addition and subtraction, multiplication and division.
13. Sum of a set of N data (8 – bit numbers), Picking up the smallest and largest number in an array. Sorting in ascending and descending order.
14. Code conversion (8 – bit numbers) : (a) Binary to BCD and (b) BCD to Binary.
15. Addition of multibyte numbers, Factorial.

Part – 1B : General (Any FIVE Experiments)

1. Cornu's Method – Young's modulus and Poisson's ratio by Elliptic fringes.
2. Stefan's constant.
3. Bang gap energy – Thermistor / Semiconductor.
4. Hydrogen spectrum – Rydberg's constant.

5. Thickness of the enamel coating on a wire – by diffraction.
6. Coefficient of linear expansion – Air wedge method.
7. Permittivity of a liquid using an RFO.
8. L-G plate.
9. Lasers: Study of laser beam parameters.
10. Arc spectrum: Copper.

BOOK FOR REFERENCE:

1. **D. Chattopadhyay**, **P. C. Rakshit**, and **B. Saha**, 2013, *An Advanced Course in Practical Physics*, 8th Edition, New central book agencies, Kolkata.

SECOND SEMESTER

S. NO	COURSE COMPONENTS	NAME OF COURSE	SEMESTER	INST. HOURS	CREDITS	EXAM HRS	MAX MARKS	
							CIA	EXTERNAL
6	CORE	PAPER 6 – QUANTUM MECHANICS –II	II	6 HRS	4	3	25	75
7	CORE	PAPER 7 – ELECTROMAGNETIC THEORY AND PLASMA PHYSICS	II	6 HRS	4	3	25	75
8	CORE	PAPER 8 – PRACTICAL - II* PART-1B & 2B - GENERAL	II	4 HRS	4	4	40	60
9	ELECTIVE – I	PAPER 9 - SPECTROSCOPY	II	4 HRS	3	3	25	75
10	ELECTIVE- II	PAPER 10 – ENERGY PHYSICS	II	4 HRS	3	3	25	75
11	Extra Disciplinary I	PAPER 11 – BASIC MATERIALS SCIENCE	II	4 HRS	2	3	25	75
12		SOFT SKILL – II	II	2 HRS	2	3	40	60
				30	22		225	495

PAPER 6: QUANTUM MECHANICS II

UNIT 1: **SCATTERING THEORY**

Scattering amplitude - Cross sections - Born approximation - Partial wave analysis -Effective range theory for S-wave - Transformation from centre of mass to laboratory frame.

UNIT 2: **PERTURBATION THEORY**

Time dependent perturbation theory - Constant and harmonic perturbations - Transition probabilities - Adiabatic approximation - Sudden approximation - The density matrix - Spin density matrix and magnetic resonance - Semi-classical treatment of an atom with electromagnetic radiation - Selection rules for dipole radiation.

UNIT 3: **RELATIVISTIC QUANTUM MECHANICS**

Klein-Gordon equation - Dirac equation - Plane-wave solutions - Interpretation of negative energy states - Antiparticles - Spin of electron - Magnetic moment of an electron due to spin - Energy values in a Coulomb potential.

UNIT 4: **DIRAC EQUATION**

Covariant form of Dirac equation - Properties of the gamma Matrices - Traces -Relativistic invariance of Dirac equation – Probability density-current four vector – Bilinear covariants - Feynman's theory of positron (Elementary ideas only without propagation formalism).

UNIT 5: **SECOND QUANTIZATION**

Second quantization of Klein-Gordon field - Creation and annihilation operators - Commutation relations - Quantization of electromagnetic field - Creation and annihilation operators - Commutation relations.

BOOKS FOR STUDY:

1. **P. M. Mathews** and **K. Venkatesan**, *2010, A Text book of Quantum Mechanics, Reprint,* Tata McGraw-Hill, New Delhi.
2. **L. I. Schiff**, *2014, Quantum Mechanics,* 3rd Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo.
3. **E. Merzbacher**, 2011, *Quantum Mechanics,* 2nd edition, Alpha Science International Ltd; 2nd Revised edition,UK.
4. **V. K. Thankappan**, *2012, Quantum Mechanics,* 2nd Edition, Wiley Eastern Ltd, New Delhi.
5. **J.D. Bjorken** and **S.D. Drell**, 2013, *Relativistic Quantum Mechanics,* Mac Graw-Hill, New York.
6. **V. Devanathan,** 2011, *Quantum Mechanics,* Narosa Publishing House, New Delhi.

BOOKS FOR REFERENCE:

1. **P. A. M. Dirac**, 2013, *The Principles of Quantum Mechanics,* Oxford University Press, London.
2. **L. D. Landau** and **E. M. Lifshitz**, 2013, *Quantum Mechanics,* Pergomon Press, Oxford.
3. **S. N. Biswas**, 2012, *Quantum Mechanics,* 2nd Edition, Books And Allied Ltd., Kolkata.
4. **G. Aruldhas**, 2008, *Quantum Mechanics,* 2nd Edition, Prentice Hall of India, New Delhi.
5. **J. S. Bell, Gottfried** and **M.Veltman**, 2001, *The Foundations of Quantum Mechanics,* World Scientific, Singapore.
6. **V. Devanathan,** 2010, *Angular Momentum Techniques in Quantum Mechanics,* Kluwer Academic Publishers, Dordrecht.

PAPER 7: ELECTROMAGNETIC THEORY AND PLASMA PHYSICS

UNIT 1: **ELECTROSTATICS**

Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar co ordinates – Examples of solutions for boundary value problems.

Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Molecular polarisability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion.

UNIT 2: **MAGNETOSTATICS**

Biot-Savart Law - Ampere's law - Magnetic vector potential and magnetic field of a localised current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magnetostatic energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetised sphere.

UNIT 3: **MAXWELL EQUATIONS**

Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem - Lorentz force - Conservation laws for a system of charges and electromagnetic fields.

UNIT 4: **WAVE PROPAGATION**

Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface - Waves in a conducting medium - Propagation of waves in a rectangular wave guide. Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole.

UNIT 5: **ELEMENTARY PLASMA PHYSICS**

The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations - The Debye shielding problem - Plasma confinement in a magnetic field - Magneto-hydrodynamic waves - Alfven waves and magnetosonic waves**.**

BOOKS FOR STUDY:

1. ***D. J. Griffiths,*** *2015, Introduction to Electrodynamics, 4th Edition, Pearson Education India Learning Private Limited, New Delhi.*
2. **J. R. Reitz, F. J. Milford and R. W. Christy,** 2010,*Foundations of Electromagnetic Theory,4th Edition, Pearson Education India Learning Private Limited, New Delhi.*
3. ***J. D. Jackson,*** *2007, Classical Electrodynamics, Wiley Eastern Ltd. New Delhi.*
4. **J. A. Bittencourt,** 2010, *Fundamentals of Plasma Physics,* Springer, Chennai

BOOKS FOR REFERENCE:

1. ***W. Panofsky*** *and* ***M. Phillips, 2006,*** *Classical Electricity and Magnetism,* Addison Wesley, London.
2. **J. D. Kraus** and **D. A. Fleisch,** 2010, *Electromagnetics with Applications,* 5th Edition, WCB McGraw-Hill, New York.
3. **B. Chakraborty**, 2002, *Principles of Electrodynamics,* Books and Allied, Kolkata.
4. **R. P. Feynman, R. B. Leighton** and **M. Sands**, 2012, *The Feynman Lectures on Physics,* Vols. 2, Pearson Education India Learning Private Limited, New Delhi.

WEB SITES:

1. http://www.plasma.uu.se/CED/Book/index.html
2. http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html
3. http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html
4. http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/

PAPER 8: PRACTICAL - II

Part – 2A:ELECTRONICS AND MICROPROCESSOR 8085(Any TEN Experiments)

1. Design of UJT relaxation oscillator for a frequency – Generation of positive and negative triggering pulses.
2. Solving simultaneous equations - IC 741 / IC LM324.
3. Op-Amp. – Active filters: Low pass, High pass and Band pass filters (Second Order).
4. Construction of square wave generator using IC 555 – study of VCO.
5. Design of Schmitt trigger circuit using IC 555 for a given hysteresis – Application as squarer.
6. Construction of pulse generator using the IC 555 – Application as frequency divider.
7. IC 7476 / IC 7473 – Study of binary up / down counters
8. IC 7476 – Shift register, ring counter and Johnson counter (twisted ring counter).

MICROPROCESSOR 8085

9. Clock program – 12 / 24 hours.
10. LED interface – single LED on / off, binary, BCD, ring and Johnson counters.
11. Interfacing of seven segment display.
12. Interfacing R / 2R ladder DAC (IC 741) – Wave form generation.
13. DAC 0800 interface and wave form generation.

Part – 2B: GENERAL (Any FIVE Experiments)

1. Cornu's Method – Young's modulus and Poisson's ratio by hyperbolic fringes.
2. Determination of strain hardening coefficient.
3. Viscosity of liquid – Meyer's disc.
4. F. P. Etalon using spectrometer.
5. Solar constant.
6. Solar spectrum – Hartmann's formula.

7. Arc spectrum – Iron.
8. Edser and Butler fringes – Thickness of air film.
9. B-H loop using Anchor ring.
10. Specific charge of an electron – Thomson's method.

Note: Practical Examination 1 – Questions from both Part 1A and Part 2A

Practical Examination 2 – Questions from both Part 1B and Part 2B

BOOK FOR REFERENCE:

1. **D. Chattopadhyay**, **P. C. Rakshit**, and **B. Saha**, 2013, *An Advanced Course in Practical Physics*, 8th Edition, New central book agencies, Kolkata.

PAPER 9: SPECTROSCOPY

UNIT 1: **MICROWAVE SPECTROSCOPY**

Rotational spectra of diatomic molecules - Polyatomic molecules - Linear and symmetric top molecules - Hyperfine structure and quadrupole moment of linear molecules - Experimental techniques - Stark effect.

UNIT 2: **NORMAL COORDINATE ANALYSIS**

Selection rules for Raman and IR vibrational normal modes – Normal for Raman and IR activity C2V and C3V point groups – Representation of Molecular Vibrations in Symmetry co-ordinates – Normal coordinate analysis for H2O molecule

UNIT 3: **INFRARED SPECTROSCOPY**

Vibrations of diatomic and simple polyatomic molecules - Anharmonicity – Fermi Resonance – Hydrogen Bonding – Normal Modes of Vibration in a crystal – Solid State Effects – Interpretation of Vibrational Spectra – Instrumentation techniques – FTIR spectroscopy

UNIT 4: **RAMAN SCATTERING**

Vibrational and Rotational Raman spectra – Mutual Exclusion principle – Raman spectrometer – Polarization of Raman Scattering light. Structure Determination through IR and Raman spectroscopy – Phase transitions – Resonance Raman Scattering

UNIT 5: **NMR AND ESR SPECTROSCOPY**

Quantum theory of NMR – Bloch equations – Design of CW NMR Spectrometer – Principle and block diagram of PT NMR – Chemical Shift – Application to molecular structure.

Quantum Theory of ESR – Design of ESR Spectrometer – Hyperfine Structure – Anisotropic systems – Triplet state study of ESR – Applications – Crystal defects -Biological studies

BOOKS FOR STUDY:

1. ***C. N. Banwell*** *and* ***E. M. McCash****, 2016, Fundamentals of Molecular Spectroscopy, 4th Edition, TMH, New Delhi.*
2. **G. Aruldas**, 2007, *Molecular Structure and Spectroscopy*, Prentice Hall of India Pvt. Ltd. New Delhi.
3. ***D. N. Satyanarayana,*** *2004, Vibrational Spectroscopy and Applications*, New Age International Publication, India.

BOOKS FOR REFERENCE:

1. **D. D. Jyaji** and **M. D Yadav,** 1991, *Spectroscopy*, Anmol Publications, India.
2. **Atta-ur-Rahman,** 2012, *Nuclear Magnetic Resonance*, Springer Verlag, Chennai
3. **D. A. Lang, 1977,** *Raman Spectroscopy*, McGraw-Hill International, USA.
4. **Raymond Chang,** 1970, *Basic Principles of Spectroscopy*, McGraw-Hill Kogakusha, Tokyo.

PAPER 10: ENERGY PHYSICS

UNIT – I

Introduction to energy sources - Energy sources and their availability – prospects of renewable energy sources – Energy from other sources – chemical energy – Nuclear energy – Energy storage and distribution.

UNIT – II

Energy from the oceans – Energy utilization – Energy from tides – Basic principle of tidal power – utilization of tidal energy.

UNIT – III

Basic principles of wind energy conversion – power in the wind – forces in the Blades – Wind energy conversion – Advantages and disadvantages of wind energy conversion systems (WECS) Energy storage – Applications of wind energy.

UNIT – IV

Energy from Biomass: Biomass conversion Technologies – wet and dry process – Photosynthesis.

Biogas Generation: Introduction – basic process and energetic – Advantages of anaerobic digestion – factors affecting bio digestion and generation of gas - biogas from waste fuel – properties of biogas- utilization of biogas.

UNIT – V

Solar radiation and its measurements – solar, cells : Solar cells for direct conversion of solar energy to electric powers – solar cell parameter – solar cell electrical characteristics – Efficiency – solar water Heater – solar distillation – solar cooking – solar green house.

BOOKS FOR REFERENCE:

1. **G.D. Rai**, 2004, *Non-conventional energy sources*, 4th edition, Khanna Publishers, New Delhi.
2. **S. Rao** and **Dr. Parulekar, 2009,** *Energy Technology: Non-conventional, Renewable & Conventional*, Khanna Publishers, New Delhi.
3. **John Twidell** and **Tony weir**, 2015, *Renewable energy resources*, Taylor and Francis group, London and New York.
4. **M.P. Agarwal**, 1983, *Solar energy*, S. Chand and Co, Chennai.
5. ***A.B. Meinel*** *and* ***A.P. Meinal****, 1976, Applied solar energy*, Addison-Wesley Educational Publishers Inc,UK.
6. **S.P. Sukhatme** ,2008,*Solar energy, principles of thermal collection and storage*, 2nd edition, Tata McGraw-Hill publishing co. Ltd, New Delhi.

PAPER 11: BASIC MATERIALS SCIENCE

Unit 1 – INTRODUCTION

Classification of materials – materials for engineering applications – different types of chemical bonds – crystal structure s of important engineering materials – crystal imperfection and types of imperfections

Unit 2 – PHASE DIAGRAM:

Systems – components – phases – solid solutions – Hume - Rothery's rule and Gibbs' Phase rule – Lever rule – construction of phase diagrams – eutectic, peritectic, eutectoid and peritectoid systems

Unit 3 – PHASE TRANSFORMATION:

Mechanism – nucleation and growth – applications of phase transformations – cooling, casting, solidification and heat treatment – TTT diagram – martensitic transformation

Unit 4 – ELECTRON THEORY OF METALS:

Classical free electron theory – density of states – electron energies in a metal – energy band and Fermi energy in solids – distinction between metals, insulators and semiconductors on the basis of Fermi level – effect of temperature on Fermi level

Unit 5 – ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS:

Electrical resistivity and conductivity of materials – dielectric materials – electrical polarization – piezo, pyro and ferroelectric materials – electrostriction – classification of magnetic materials – domain structure – magnetostriction – soft and hard magnetic materials

BOOKS FOR STUDY:

1. V. Raghavan, 2015, *Materials Science and Engineering*, 4th Edition, PHI, India, (for units 2, 3, 4 and 5).

2. **G.K. Narula**, **K.S. Narula** and **V.K. Gupta**, 2001, *Materials Science*, Tata McGraw- Hill, India.

3**. M. Arumugam**, 2010, *Materials Science*, 3rd revised Edition, Anuradha Agencies, India.

BOOKS FOR REFERENCE:

1. Lawrence H. Van Vlack, 2002, *Elements of Materials Science and Engineering*, 6th Edition, Pearson,India.

2. **H. Iabch and H.Luth**, 2001, *Solid state Physics – An introduction to principles of Material Science*, 2nd Edition, Springer, Chennai.

THIRD SEMESTER

S. NO	COURSE COMPONENTS	NAME OF COURSE	SEMESTER	INST. HOURS	CREDITS	EXAM HRS	MAX MARKS	
							CIA	EXTERNAL
14	CORE	PAPER 12 – STATISTICAL MECHANICS	III	6 HRS	4	3	25	75
15	CORE	PAPER 13 – NUCLEAR AND PARTICLE PHYSICS	III	6 HRS	4	3	25	75
16	CORE	PAPER 14 – COMPUTATIONAL METHODS AND PROGRAMMING	III	6 HRS	4	3	25	75
17	CORE	PAPER 15 – PRACTICAL - III* PART-3A-ADVANCED MICROPROCESSOR 8085 AND COMPUTATIONAL METHODS & 4A – MICROPROCESSOR 8086 AND MICROCONTROLLER 8051	III	4 HRS	4	4	40	60
18	ELECTIVE- III	PAPER 16- CRYSTAL GROWTH	III	3 HRS	3	3	25	75

19	EXTRA DISCIPLINARY II	PAPER 17- INTELLIGENT INSTRUMENTATION	III	3 HRS	3	3	25	75
20	SOFT SKILLS-III	LIFE AND MANAGERIAL SKILLS LEVEL- II	III	2 HRS	2	3	40	60
21		INTERNSHIP	III		2			100
				30	26		205	595

PAPER 12: STATISTICAL MECHANICS

UNIT 1**: PHASE TRANSITIONS**

Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics.

Order parameters - Landau theory of phase transition - Critical indices - Scale transformations and dimensional analysis.

UNIT 2: **STATISTICAL MECHANICS AND THERMODYNAMICS**

Foundations of statistical mechanics - Specification of states of a system - Microcanonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an ideal gas using the microcanonical ensemble - Entropy of mixing and Gibb's paradox.

UNIT 3: **CANONICAL AND GRAND CANONICAL ENSEMBLES**

Trajectories and density of states - Liouville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations.

UNIT 4: **CLASSICAL AND QUANTUM STATISTICS**

Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzman statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT 5: **REAL GAS**, **ISING MODEL AND FLUCTUATIONS**

Cluster expansion for a classical gas - Virial equation of state – Calculation of the first virial coefficient in the cluster expansion - Ising model - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one-dimension.

Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin theory - Fluctuation-dissipation theorem - The Fokker-Planck equation.

BOOKS FOR STUDY:

1. **S.K.Sinha** , 2009 , *Statistical Mechanic*s , Narosa, New Delhi.

2. B. K. Agarwal and M. Eisner, 2016, *Statistical Mechanics*, 3rd Edition, New Age International, New Delhi.

3. J. K. Bhattacharjee, 2001, *Statistical Mechanics*: *An Introductory Text*, Allied Publication,New Delhi.

4. F. Reif, 2011, *Fundamentals of Statistical and Thermal Physics*, Mac Graw-Hill, NewYork.

5. C. Kittel, 1987, *Thermal Physics*, 2nd edition, CBS Publication, New Delhi.

6. M. K. Zemansky, 2011, *Heat and Thermodynamics*, 8th edition, McGraw-Hill, New York.

BOOKS FOR REFERENCE:

1. **R. K. Pathria,** 2011, *Statistical Mechanics*, 3rd edition, Academic Press, USA.
2. **L. D. Landau and E. M. Lifshitz,** 1996, *Statistical Physics, 3rd Edition*, Butterworth-Heinemann, UK.
3. **K. Huang,** 2009, *Statistical Mechanics, 2nd Edition*, Taylor and Francis, London.

4. **W. Greiner, L. Neise** and **H. Stoecker, 1995,** *Thermodynamics and Statistical Mechanics*, Springer Verlang, New York.
5. **A. B. Gupta, H. Roy**, 2010, *Thermal Physics*, 3rd Edition, Books and Allied, Kolkata.
6. **A. Kalidas, M. V. Sangaranarayanan**, 2002, *Non-Equilibrium Thermodynamics*, Macmillan India, New Delhi.
7. **M. Glazer** and **J. Wark**, 2001, *Statistical Mechanics*, Oxford University Press, Oxford.
8. **L. P. Kadanoff**, 2001, *Statistical Physics - Statics, Dynamics and Renormalization*, World Scientific, Singapore.
9. **F. W. Sears** and **G. L. Salinger**, 1998, *Thermodynamics, Kinetic Theory and Statistical Thermodynamics*, 3rd Edition, Narosa, New Delhi.

WEB SITES

1. http://www.nyu.edu/classes/tuckerman/stat.mech/lectures.html
2. http://www.abo.fi/~mhotokka/mhotokka/lecturenotes/sm.html
3. http://www-f1.ijs.si/~vilfan/SM/cont.html
4. http://web.mit.edu/8.334/www/lectures/
5. http://cs.physics.sunysb.edu/verbaarschot/html/lectures/phy306-05/notes.html

PAPER 13: NUCLEAR AND PARTICLE PHYSICS

UNIT 1 – **NUCLEAR INTERACTIONS**

Nucleon-nucleon interaction – Tensor forces – Meson theory of nuclear forces – Yukawa potential – Nucleon-Nucleon scattering – Effective range theory – Spin dependence of nuclear forces – Charge independence and charge symmetry of nuclear forces – Isospin formalism

UNIT 2 – **NUCLEAR REACTIONS**

Types of reactions and conservation laws – Energetics of nuclear reactions –Dynamics of nuclear reactions – Q-value equation – Scattering and reaction cross sections – Compound nucleus reactions – Direct reactions – Resonance scattering – Breit-Wigner one level formula

UNIT 3 – **NUCLEAR MODELS**

Liquid drop model – Bohr-Wheeler theory of fission – Experimental evidence for shell effects – Shell model – Spin-orbit coupling - Magic numbers – Angular momenta and parities of nuclear ground states – Qualitative discussion and estimate of transition rates – Magnetic moments and Schmidt lines – Collective model of Bohr and Mottelson

UNIT 4 – **NUCLEAR DECAY**

Beta decay – Fermi theory of beta decay – Shape of the beta spectrum – Total decay rate - Mass of the neutrino – Angular momentum and parity selection rules – Allowed and forbidden decays – Comparative half-lives – Neutrino physics – Non-conservation of parity – Gamma decay – Multipole transitions in nuclei – Angular momentum and parity selection rules – Internal conversion – Nuclear isomerism

UNIT 5 – **ELEMENTARY PARTICLE PHYSICS**

Types of interaction between elementary particles – Hadrons and leptons – Symmetries and conservation laws – Elementary ideas of CP and CPT invariance – Classification of hadrons – SU(2) and SU(3) multiplets – Quark model - Gell-Mann-Okubo mass formula for octet and decuplet hadrons – Charm, bottom and top quarks

BOOKS FOR STUDY

1. **K. S. Krane**, *2008, Introductory Nuclear Physics,* Wiley, New York.
2. **D. Griffiths**, 2008, *Introduction to Elementary Particle Physics,* Wiley, 2nd revised edition, Germany**.**
3. **R. R. Roy** and **B.P. Nigam**, 1996, *Nuclear Physics*, New age Intl., New Delhi.

BOOKS FOR REFERENCE:

1. **H. A. Enge**, 1983, *Introduction to Nuclear Physics,* Addison-Wesley, Tokyo.
2. **Y. R. Waghmare**, 1981, *Introductory Nuclear, Physics,* Oxford-IBH, New Delhi.
3. **S.N. Ghoshal**, 2010, Atomic *and Nuclear Physics,* Vol. 2, S. Chand & Co Ltd, New Delhi.
4. **J. M. Longo**, 1971, *Elementary particles,* McGraw-Hill, New York.
5. **R. D. Evans**, 1972 *Atomic Nucleus,* McGraw-Hill, New York.
6. **I. Kaplan**, 2012, *Nuclear Physics,* 2nd edition, Narosa, New Delhi.
7. **B. L. Cohen**, 2001, *Concepts of Nuclear Physics*, 1st edition, TMH, New Delhi.
8. **M. K. Pal**, 1983, *Theory of Nuclear Structure*, 1st edition, Scientific and Academic Editions, Chennai.
9. **W. E. Burcham** and **M. Jobes**, 1995, *Nuclear and Particle Physics,* 2nd revised edition, John Wiley & Sons Inc., India.

WEB SITES

1. http://ocw.mit.edu/OcwWeb/Physics/8-701Spring 2004/Lecture notes
2. http://faraday.physics.utoronto.ca/General Interest/D.Bailey/SubAtomic/ Lectures/ Lect.html

PAPER 14: COMPUTATIONAL METHODS AND PROGRAMMING

UNIT 1: **SOLUTIONS OF EQUATIONS**

Determination of zeros of polynomials –Roots of nonlinear algebraic equations and transcendental equations – Bisection and Newton-Raphson methods – Convergence of solutions.

UNIT 2: **LINEAR SYSTEMS**

Solution of simultaneous linear equations – Gaussian elimination – Matrix inversion – Eignenvalues and eigenvectors of matrices – Power and Jacobi Methods.

UNIT 3: **INTERPOLATION AND CURVE FITTING**

Interpolation with equally spaced and unevenly spaced points (Newton forward and backward interpolations, Lagrange interpolation) – Curve fitting – Polynomial least – squares fitting.

UNIT 4: **DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS**

Numerical differentiation – Numerical integration – Trapezoidal rule – Simpon's rule – Error estimates – Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite and Gauss-Chebyshev quadratures – Numerical solution of ordinary differential equations – Euler and Runge Kutta methods.

UNIT 5: **PROGRAMMING WITH FORTRON/C**:

Flow-charts – Integer and floating point arithmetic expressions – Built-in functions – Executable and non-executable statements – Subroutines and functions – Programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials/non-linear equations by the Newton-Raphson method, (c) Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.

BOOKS FOR STUDY:

1. **V.Rajaraman**, 2013, *Computer oriented Numerical Methods*, 3rd Edition, PHI, New Delhi.
2. **M. K .Jain**, **S. R. Iyengar** and **R. K. Jain**, 2014, *Numerical Methods for Scientific and Engineering Computation*, 6th Edition, New Age Intl., New Delhi.
3. **S. S. Sastry**, 2012, *Introductory Methods of Numerical analysis*, 5th edition, PHI, New Delhi.
4. **F. Scheid**, 1998, *Numerical Analysis*, 2nd Edition, Schaum's series, McGraw Hill, New York.
5. **W. H. Press, S. A. Teukolsky, W. T. Vetterling** and **B. P. Flannery**, 2007, *Numerical Recipes in FORTRAN*, 3rd Edition, Cambridge Univ. Press,UK.
6. **W. H. Press, S. A. Teukolsky, W. T. Vetterling** and **B. P. Flannery**, 1992, *Numerical Recipes in C*, 2nd Edition, Cambridge Univ. Press,UK.
7. **V. Rajaraman**, 1997, *Programming in FORTRAN / Programming in C*, 4th edition, PHI, New Delhi.
8. **E. Balagurusamy**, 1999, *Numerical Methods*, 1st edition, TMH, New Delhi.

BOOKS FOR REFERENCE:

1. **S. D. Conte** and **C. de Boor**, 1981, *Elementary Numerical analysis-an algorithmic approach*, 3rd Edition, Mc - Graw Hill, India.
2. **B. F. Gerald**, and **P. O. Wheatley**, 2003, *Applied Numerical analysis*, 7th Edition, Pearson India Ltd., India.
3. **B. Carnagan**, **H. A. Luther** and **J. O. Wilkes**, 1969, *Applied Numerical Methods*, Wiley, New York.
4. **S. S. Kuo**, 1996, *Numerical Methods and Computers*, Addison-Wesley, India.

WEB SITES

1. http://www.sst.ph.ic.ac.uk/angus/Lecturs/compphys/comphys.html
2. http://www.library.cornell.edu/nr (numerical recipes online book on C & FORTRAN)

Paper 15: PRACTICAL III

COMPUTATIONAL METHODS – FORTRAN / C PROGRAMMING

Part – 3A: Advanced Microprocessor 8085 and Computational Methods (Any TEN Experiments)

Advanced Microprocessor 8085

1. ADC 0809 interface.
2. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action.
3. Interfacing of Temperature Controller and Measurement
4. Water level detector

Computational Methods

5. Lagrange interpolation with Algorithm, Flow chart, FORTRAN / C PROGRAM, and output.
6. Newton forward interpolation with Algorithm, Flow chart, FORTRAN / C PROGRAM, and output.
7. Newton backward with Algorithm, Flow chart, FORTRAN / C PROGRAM, and output.
8. Curve-fitting: Least squares fitting with Algorithm, Flow chart, FORTRAN / C PROGRAM, and output.
9. Numerical integration by the trapezoidal rule with Algorithm, Flow chart, FORTRAN / C PROGRAM, and output.
10. Numerical integration by Simpson's rule with Algorithm, Flow chart, FORTRAN / C PROGRAM, and output.
11. Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart, FORTRAN / C PROGRAM, and output.
12. Numerical solution of ordinary first-order differential equations by the Runge-Kutta method with Algorithm, Flow chart, FORTRAN / C PROGRAM, and output.

Part – 3B: GENERAL (Any FIVE Experiments)

1. GM counter – Characteristics, inverse square law, absorption coefficient.
2. GM counter – Feather's analysis: Range of Beta rays.
3. Hall Effect.
4. Susceptibility by Quincke's method.
5. B-H curve using CRO.
6. Thermal diffusivity of brass.
7. Thermal relaxation of bulb.
8. Conductivity measurement using four probe method.
9. Laser Experiments : (i) Diffraction at straight edge, (ii) Interference of laser beams – Lloyds single mirror method, (iii) Interference using an optically plane glass plate, (iv) Diffraction at a straight wire and (v) Diffraction at a circular aperture.
10. Experiments on optical fibers.
11. FFT and DFT of certain signals.

PAPER 16: CRYSTAL GROWTH

UNIT – 1 **NUCLEATION**

Nucleation concept – Kinds of nucleation – Classical theory of nucleation - Spherical nucleus – Induction period – Measurement - Heterogeneous nucleation – Equilibrium concentration of embryos – Energy of formation of a critical nucleus - Free energy of formation of a critical heterogeneous cap shaped and disc shaped nuclei –Nucleation rate.

UNIT – 2 **CRYSTALGROWTH THEORIES**

Surface energy theory – Diffusion theory – Adsorption layer theory – Volmer theory – Bravais theory – Kossel theory – Two dimensional nucleation theory – Free energy of formation of a two dimensional nucleus – Possible shapes – Rate of nucleation

UNIT – 3 **CRYSTAL GROWTHS FROM SOLUTION**

Low temperature solution growth – Solution and Solubility – Preparation of solution - Principle of low temperature solution growth - Mier's solubility diagram – Measurement of solubility – Measurement of Ostwald-Mier's metastable zone width – Achievement of super saturation.

Crystal Growth methods – Slow cooling method – Holden's rotary crystallizer - Mason Jar method – Slow evaporation method – Johnson's rotating crystal method - Temperature gradient method – Kruger and Fink U tube method.

UNIT – 4 **MELT GROWTH AND VAPOUR GROWTH**

Growth of crystal from melt – Bridgman method – Czochralski method – LEC growth of III – V materials – Verneuil method – Phase diagram principle of zone refining - Zone melting method.

Physical vapour deposition – Chemical vapour deposition – Open and closed systems –

Physical and thermo - chemical factors affecting growth process.

UNIT – 5 **GEL GROWTH AND FLUX GROWTH**

Gel growth – Different gel medium – Specific gravity – Silica gel – Agar gel – Basic growth procedure – Single diffusion technique – Double diffusion technique – Reaction method-Chemical reduction method.

High temperature solution growth (Flux growth) – Principle of flux growth – Slow cooling method – Slow evaporation method – Top seeded solution growth.

BOOKS FOR STUDY

1. **M. Ohora** and **R. C. Reid**, 1973, *Modeling of Crystal Growth Rates from Solution*, PHI , New Delhi.

2. **J. C. Brice**, 1986, *Crystal Growth Processes*, Blackie Academic & Professional (an Imprint of Chapman & Hall), 1st Edition, UK.

3. **J. C. Brice**, 1965, *The Growth of Crystals from Melt*, North Holland Publishing Company, Holland.

4. **D. Elwell** and **H. J. Scheel**, 2011, *Crystal Growth from High Temperature Solution*, AcademicPress,London.

5. **Heinz K. Henish**, 1988, *Crystal Growth in Gels*, Cambridge University Press, UK.

BOOK FOR REFERENCE

1. **P. Ramasamy** and **F. D. Gnanam**, 1983, *UGC Summer School Notes*, Anna University, Chennai.

2. **P. SanthanaRaghavan** and **P. Ramasamy**, 2000, *Crystal Growth Processes*, 1stEdition, KRU Publications, Kumbakonam.

PAPER 17- INTELLIGENT INSTRUMENTATION

UNIT 1 – TRANSDUCERS AND INPUT ELEMENTS

Classification of Transducers – Selecting a transducer – Strain gauges – Gauge factor – Metallic sensing elements – Gauge configuration – Displacement Transducers – Capacitive, inductive and LVDT, Piezo electric and Potentiometric transducers – Thermocouples and thermistor – Photosensitive devices.

UNIT 2 - BRIDGE MEASUREMENTS

Wheatstone Bridge – Kelvin Bridge – AC Bridges – Maxwell Bridge – Hay Bridge – Schering Bridge – Wien Bridge – Wagner ground connection.

UNIT 3 - ANALOG AND DIGITAL PRINCIPLES

Operational amplifier ideal characteristics – Closed loop properties – Virtual ground concept - Three modes of operation – Difference amplifier – Transducer bridge Type instrumentation amplifier- Digital Principles – Logic gates – Flip Flops – Counters – Registers – Digital to Analog conversion – Weighted resistor type DAC – Analog to digital conversion concept – Flash type , Counter type and dual slope ADC – Successive approximation technique ADC .

UNIT 4 – INSTRUMENTATION SYSTEM

Analog data acquisition system – Digital data acquisition system – Interfacing Transducers to Electronic and measuring systems – Multiplexing – Digital to analog multiplexing – Analog to digital multiplexing.

UNIT 5 – MICROPROCESSOR BASED INSTRUMENTATION

8085 Architecture – Addressing modes – Basic Instructions – Data Transfer and I/O – Interrupts and Interrupt circuit – I/O operation – Interfacing keyboard, LED display, ADC , DAC and stepper motor (Functional Block diagrams and FLOW chart only) – Microprocessor based data acquisition system – Temperature controller, Lift operation, Traffic lights control.

BOOKS FOR STUDY

1. Albert D. Helfrich and William D. Cooper, 2015, *Modern Electronic Instrumentation and Measurement Techniques*, 5th Edition, - Pearson education, India.
2. Milman and Halkias, 2009, *Integrated Electronics*, TMH, India.

BOOKS FOR REFERENCE

1. Malvino Leech, 2014, *Digital Principles*, McGraw Hill, India.
2. R. S. Gaonkar, 2013, *Microprocessor Architecture, Programming and Applications with 8085*, 6th Edition, Penram International Publishing, Mumbai.

FOURTH SEMESTER

S. NO	COURSE COMPONENTS	NAME OF COURSE	SEMESTER	INST. HOURS	CREDITS	EXAM HRS	MAX MARKS	
							CIA	EXTERNL
1	CORE	PAPER 18– CONDENSED MATTER PHYSICS	IV	6	4	3	25	75
2	CORE	PAPER 19 – PRACTICAL – IV PART – 3B & 4B – GENERAL	IV	4	4	4	40	60
3	ELECTIVE- IV	PAPER 20- MICRPROCESSOR 8086 AND MICROCONTROLLER 8051	IV	6	3	3	25	75
4	EXTRA DISCIPLINARY III	PAPER 21- MATERIAL SCIENCE	IV	6	3	3	25	75
5	CORE	PAPER 22 – PROJECT	IV	6	4		**	**
6	SKILL BASED SUBJECT	SOFT SKILLS-IV	IV	2	2	3	40	60
				30	20	16	155	345

PAPER 18: CONDENSED MATTER PHYSICS

UNIT 1: **CRYSTAL PHYSICS**

Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures – Atomic Packing Factor- Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc) – Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).

UNIT 2: **LATTICE DYNAMICS**

Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umkalapp processes.

UNIT 3: **THEORY OF METALS AND SEMICONDUCTORS**

Free electron gas in three dimensions - Electronic heat capacity - Wiedemann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration – Temperature Dependence - Mobility - Impurity conductivity – Impurity states - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies - de Hass-van Alphen effect .

UNIT 4: **MAGNETISM**

Diamagnetism - Quantum theory of paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.

UNIT 5: **SUPERCONDUCTIVITY**

Experimental facts: Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors.

Theoretical Explanation: Thermodynamics of super conducting transition - London equation - Coherence length – Isotope effect - Cooper pairs - BCS Theory - Single particle tunneling – Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors - SQUIDS.

BOOKS FOR STUDY:

1. **C. Kittel**, 2004, *Introduction to Solid State Physics*, 8th Edition, Wiley, New York.
2. **M. Ali Omar**, 1994, *Elementary Solid State Physics - Principles and Applications*,4th Edition, Addison – Wesley, India.
3. **H. P. Myers**, 1998, *Introductory Solid State Physics*, 2nd Edition, Viva Book, New Delhi.

BOOKS FOR REFERENCE:

1. **N. W. Aschroft** and **N. D. Mermin**, 1976, *Solid State Physics*,Rhinehart and Winton, New York.
2. **J. S. Blakemore**, 1985, *Solid state Physics*, 2nd Edition, W.B. Saunder, Philadelphia,USA.
3. **A. J. Dekker**, 1970, *Solid State Physics*, Macmillan India, New Delhi.
4. **H. M. Rosenburg**, 1988, *The Solid State*, 3rd Edition, Oxford University Press, Oxford.
5. **S. O. Pillai**, 2009, *Solid State Physics*, New Age International, New Delhi.
6. **S. O. Pillai**, 2009, *Problems and Solutions in Solid State Physics*, New Age International, New Delhi.
7. **S. L. Altmann**, 1970, *Band Theory of Metals*, Pergamon, Oxford.
8. **J. M. Ziman**, 2002, *Principles of the Theory of Solids*, 2nd Edition, Cambridge University Press, London.
9. **C. Ross-Innes** and **E. H. Rhoderick,** 1978, *Introduction to Superconductivity*, Pergamon, Oxford.

10. **M. Tinkham**, 2004, *Introduction to Superconductivity*, 2nd Edition, McGraw-Hill, New York.
11. **J. P. Srivastava,** 2015, *Elements of Solid State Physics*, 4thEdition, Prentice-Hall of India, New Delhi.

WEB SITES

1. http://www.physics.brocku.ca/courses/4p70/
2. http://www.physics.brocku.ca/courses/4p70/
3. http://web.mit.edu/afs/athena/course/6/6.732/www/texts.html
4. http://jas.eng.buffalo.edu/education/semicon/fermi/functionAndStates/functionAndStates.html
5. http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html
6. http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html

PAPER 19: PRACTICAL IV

ANY TWO PARTS OUT OF PARTS A, B and C.

Part – 4A: MICROPROCESSOR 8086 (MASM) AND MICROCONTROLLER 8051 (Any TEN Experiments)

(Compulsory for those who take the Elective: Microprocessor and Microcontroller)

Microprocessor 8086 Programs using MASM

1. Addition, Subtraction, Multiplication and Division (8 bit numbers)
2. Multibyte addition and subtraction (64 and 128 bit numbers)
3. Square and square root of 8 bit number
4. Sum of a set of N data (8 – bit numbers), average of N numbers.
5. Sorting in ascending and descending order. Picking up the smallest and largest number in an array.
6. Generation of Fibonacci series.

Micro controller 8051

7. Addition, subtraction, multiplication and division of two 8-bit numbers.
8. Sum of a series of 8-bit numbers, average of N numbers.
9. Factorial of number, Fibonacci series of N terms.
10. Sorting in ascending and descending order – Picking up smallest and largest number.
11. LED interface – Binary up/down counter, BCD up/down counter, Ring and twisted ring counter.
12. Interfacing seven segment display.
13. DAC 0800 / 1408 interface and wave form generation.
14. ADC interfacing. Stepper motor interfacing.

Part – B – ADVANCED EXPERIMENTS I

(Compulsory for those who take the Elective: Materials Science)

(Any FIVE Experiments)

1. Michelson Interferometer – Wavelength, separation of wavelengths.
2. Michelson Interferometer – Thickness of mica sheet.
3. Susceptibility by Guoy's method.
4. Ultrasonics – Compressibility of a liquid.
5. Miscibility measurements using ultrasonic diffraction method.
6. Dielectric measurements in Microwave test bench.
7. Iodine absorption spectra
8. Molecular spectra – AlO band
9. Molecular spectra – CN bands
10. UV-visible spectroscopy – Verification of Beer-Lambert's law and identification of wave-length maxima – Extinction coefficient.

Note: Practical Examination 3 – Questions from both Part 3A and Part 4A

Practical Examination 4 – Questions from both Part 3B and Part 4B

Book for Reference:

1. **D. Chattopadhyay**, **P. C. Rakshit**, and **B. Saha**, 2013, *An Advanced Course in Practical Physics,* 8thEdition, New Central book Agencies, Kolkata.

Part - C – ADVANCED EXPERIMENTS II

(Compulsory for those who take the Elective: Advanced Spectroscopy)

Any **SIX** Experiments:

1. Iodine Absorption Spectrum.

2. Molecular spectra – CN bands.

3. UV – Visible Spectroscopy – verification of Beer-Lambert's law and identification of wavelength maxima – Extinction Coefficient.

4..UV- Visible Spectroscopy – Identification and measurement of a component in a mixture.

5. Infrared and Raman Spectra and Vibrational band assignments of Organic, Inorganic and Crystalline materials.

6. Infrared and Raman Spectra – Normal coordinate analysis of XY2 bent symmetrical and XY3 pyramidal molecules.

7. Spectroflurometer – Characerization of materials.
8. Experiments on Optical fibers.
9. Laser Experiments
    (a) Diffraction at straight edge.
    (b) Interference of laser beams – Llyods single mirror method.
    (c) Interference using an optically plane glass plate and a laser
    (d) Laser diffraction at a straight wire
    (e) Laser diffraction at a circular aperture.
10. Study of vibrational spectra – IR and Raman studies of Organic compounds.
11. Characterization of Organic Compounds using UV- Visible spectrometer.
12. Microwave bench – Microwave measurements.

PAPER 20: MICROPROCESSOR 8086 AND MICROCONTROLLER 8051

UNIT - 1 **8086 ARCHITECTURE AND PROGRAMMING**

8086 Architecture – Min.Mode, Max.Mode – Software Model – Segmentation- Segmentation of address – Pipe line Processing.

Addressing Modes – Instruction Set- Constructing Machine Code – Instruction Templates for MOV Instruction– Data Transfer Instructions– Arithmetic, Logic, Shift, rotate instructions- Flag Control instructions- Compare, Jump Instructions– Loop and String instructions -Assembly programs- Block move, Sorting, Averaging, Factorial – Code Conversion : Binary to BCD , BCD to Binary.

UNIT - 2 **8051 MICROCONTROLLER HARDWARE**

Introduction – Features of 8051 – 8051 Microcontroller Hardware : Pin-out of 8051, Central Processing Unit (CPU), Internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input / Output pins, Ports and Circuits – External data memory and Program memory : External program memory, External data memory.

UNIT – 3**8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING**

Addressing modes – Data moving (Data transfer) instructions : Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions : byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions : Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions : Jump and Call program range, Jump, CALL and subroutines – Programming.

UNIT – 4 **INTERRUPT PROGRAMMIG**

8051 Interrupts – Interrupt vector table – Enabling and disabling an interrupt – Timer interrupts and programming – Programming external hardware interrupts – Serial communication interrupts and programming – Interrupt priority in the 8051 : Nested interrupts, Software triggering of interrupt.

UNIT – 5 **INTERFACING TO EXTERNAL WORLD**

Interfacing keyboard: Simple keyboard interface, Matrix keyboard interface – Interfacing displays: Interfacing seven segment LED displays, Interfacing LCD display – Interfacing DAC to 8051– Interfacing ADC to 8051 – Interfacing sensors – Interfacing stepper motor.

BOOKS FOR STUDY

1. A. P. Godse and D. A. Godse, 2011,2nd edition, *Microprocessors & its Applications,* Technical Publications, Pune.
2. Kenneth Ayala, 2015, *The 8051 Microcontroller,* Third Edition, Delmar Cengage Learning pvt.Ltd., New Delhi.
3. W.A. Triebel and Avatar Singh, 2002, *The 8086 /8088 Microprocessors-Programming, Software, Hardware and application,* Prentice Hall of India, New Delhi. (Unit 2)

BOOKS FOR REFERENCE

1. Douglas V. Hall, 1992, *Microprocessors and Interfacing programming and Hardware*, Tata McGraw Hill, (Unit 1), New Delhi.
2. B. Brey, 2008, *Intel Microprocessors 8086/8088, 80186,80286,80486,80486, Architecture, Programming and Interfacing,* Pearson Education,India.
3. Yu – Cheng and Glenn A. Gibson, 1986, *The 8086 / 8088 family Architecture, Programming and Design*, Prentice-Hall of India.
4. Muhammed Ali Mazidi and Janice Gillespie Mazidi, 2012, *The 8051 Microcontrollerand Embedded Systems*, Fourth Indian Reprint, Pearson Education,India.
5. V.Vijayendran,2009,Fundamentals *of Microprocessor–8086- Architecture, Programming (MASM) & interfacing*,Viswanathan printers, Chennai.

PAPER 21: MATERIALS SCIENCE

UNIT 1**: CERAMICS AND COMPOSITES:**

Structural features – production of ceramics – forming and post forming process – mechanical properties – commercial ceramic system : Si-Al system technical ceramics – Zr and Si alloys – cement and concrete – composite materials – continuous and discontinuous fibre composites.

UNIT 2**: POLYMERS:**

Classification of polymers – structural features – mechanism – thermoplastics – rubber and elastomers – physical, chemical and mechanical properties – cellular plastics – liquid crystal polymers.

UNIT 3**: DIELECTRICS:**

Electrical polarisation – mechanism of polarization – optical, molecular and interfacial polarizability – classification of dielectric materials – piezoelectric, pyroelectric and ferroelectric materials – temperature and frequency effects on dielectric materials – applications of these materials.

UNIT 4**: ELECTRONIC MATERIALS:**

Purification of electronic materials – single crystal growth – pulling method – wafer manufacture – oxidation – photolithography – doping technique – epitaxial growth – metallization – circuits and process simulation and integration – junction formation – junction lasers – contact formation.

UNIT 5**: MAGNETIC MATERIALS:**

Classification of magnetism – origin and size of domain structure – hard magnetic materials – permanent magnetic alloys – magnetic steels and Al-Ni / Al-Ni-Co alloys – fine particle alloys – rare earth cobalt alloys – applications of permanent magnets – soft magnets – Si-Fe and nanocrystaline magnetic metals – microwave ferrites and garnets – magnetic bubbles.

BOOKS FOR STUDY:

1. **V. Raghavan**, 2015, *Materials Science and Engineering*, 4th Edition, Printice-Hall India, New Delhi. (for units 2, 3, 4 and 5)
2. **C.M. Srivastava** and **C. Srinivasan**, 1987, *Science of engineering materials*, New Age Intl, New Delhi. (for units 1, 3 and 5)
3. **J. C. Anderson, K.D. Leaver, R.D. Rawlings** and **J.M. Alexander**, 1990, *Material Science*, 4th Edition, Chapman & Hall, London.
3. **M. Arumugam**, 2010, *Materials Science*, 3rd revised Edition, Anuradha Agencies, Chennai.

BOOKS FOR REFERNCE:

1. **G.K. Narula, K.S.Narula** and **V.K.Gupta**, 1989, *Materials Science*, Tata McGraw-Hill, New Delhi.
2. **Lawrence H. Van Vlack**, 1998, *Elements of Materials Science and Engineering*, 6thEdition, second ISE reprint, Addison-Wesley,India.
3. **H. Iabch and H.Luth**, 2013, *Solid state Physics – An introduction to principles of Material Science*, 2nd Edition, Springer, Chennai.