PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM – 636011

DEGREE OF MASTER OF SCIENCE

CHOICE BASED CREDIT SYSTEM

(CBCS)

M.Sc. PHYSICS

SYLLABUS

For Candidates admitted in the Colleges affiliated to Periyar University

from the Academic Year 2026-2027 onwards

M.Sc. PHYSICS REGULATIONS

1. PROGRAMME OBJECTIVES AND OUTCOMES

PROGRAMME OBJECTIVES (POs)

PO1: The main aim of the M.Sc (Physics) programme is to have enriched syllabus prepared based on the recent scientific developments in physics and its interdisciplinary areas and to meet out the requirements of today‘s academic, research and industry requirements.

PO2: To impart comprehensive knowledge in theoretical, experimental and computational physics and a better understanding of the subject.

PO3: To teach core subjects of physics to students to acquire knowledge and to have in depth understanding about the laws of physics, concepts, principles and solve analytical problems.

PO4: To enrich knowledge through problem-solving skills, projects, seminars, participation in scientific events and study visits.

PO5: To prepare for careers in Teaching, Research laboratories and public/private sector units and to implant the entrepreneurship character.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On the successful completion of the M.Sc. Physics Programme, the students will

PSO1: Have a deep knowledge of the fundamental concepts of Physics and understand how the various phenomena in nature follow the laws of Physics.

PSO2: Identify, formulate and analyze the scientific problems using the basic principles.

PSO3: Develop problem-solving skills and have the ability to apply mathematical tools to understand and describe physical problems.

PSO4: Be able to handle the laboratory equipments, gain knowledge about advanced experimental techniques and can successfully interpret results required for research and industrial applications.

PSO5: Acquire effective computational skills to apply them to scientific and technological problems.

PSO6: Get familiarized with contemporary research within various fields of Physics.

2. ELIGIBILITY FOR ADMISSION

A candidate who has passed the B.Sc., Degree Examination with Physics as the main subject of this University or an examination of some other universities accepted by the Syndicate as equivalent there to is eligible for admission to the Programme.

3. DURATION OF THE PROGRAMME

The course of study shall be on Semester System. The two year post graduate programme in M.Sc., Physics consists of four semesters under Choice Based Credit System (CBCS).

4. COURSE OF STUDY

The course of study for the Degree of Master of Science in Physics shall be under (Choice Based Credit System) semester system with internal assessment according to the syllabus prescribed from time to time. This Course consists of Core Subjects and Elective Subjects, Skill Enhancement Courses, Soft Skill Course, Internship and Extension Activity.

5. DISTRIBUTION OF CREDIT POINTS

A student must earn a minimum of 92 credits as mentioned in the Course Structure table. The break-up of credits for the programme is as follows:

Core Papers	:	55 credits
Core Practical	:	12 credits
Elective Courses	:	09 credits
Skill Enhancement Course	:	04 credits
Internship	:	01 credit
Project with Viva Voice	:	05 credits
Extension Activity	:	01 credits
Human Rights	:	01 credits
Non Major Elective	:	04 credits
Total	**:**	**92 credits**

M.Sc. DEGREE COURSE IN PHYSICS
COURSE STRUCTURE

FIRST SEMESTER							
COURSE COMPONENTS	**NAME OF THE COURSE**	**HOURS PER WEEK**	**CREDITS**	**EXAM HRS**	**MAX. MARKS**		
					INT.	**EXT.**	**TOTAL**
Core - 1	Mathematical Physics	6	5	3	25	75	100
Core -2	Classical Mechanics and Relativity	6	5	3	25	75	100
Core - 3	Analog and Digital Electronics	6	5	3	25	75	100
Core Practical - I	Practical – I General Physics Experiments	6	4	3	25	75	100
Elective - I	Renewable Energy Sources (or) Non Linear Dynamics	4	3	3	25	75	100
Skill Enhancement Course - I	Atmospheric Physics	2	2	3	25	75	100
SECOND SEMESTER							
Core - 4	Statistical Mechanics	6	5	3	25	75	100
Core - 5	Quantum Mechanics –I	6	5	3	25	75	100
Core - 6	Spectroscopy	6	5	3	25	75	100
Core Practical - II	Practical – II Analog and Digital Experiments	5	4	3	25	75	100
Elective - II	Microprocessor & Microcontroller (OR) Advanced Optics	4	3	3	25	75	100
Non-Major Elective course -I (For other departments)	Bio Physics	2	2	3	25	75	100
Common Subject	Human Rights	1	1	3	25	75	100
	Internship / Industrial Activity	-	-	-	-	-	-

*Internship will be carried out during the summer vacation of the first year and marks will be included in the Third Semester Marks Statement.

THIRD SEMESTER							
Core - 7	Quantum Mechanics- II	6	5	3	25	75	100
Core - 8	Condensed Matter Physics	6	5	3	25	75	100
Core - 9	Electromagnetic Theory	6	5	3	25	75	100
Core Practical - III	Practical -III Microprocessor 8085, Microcontroller 8051 and C++ Programming	6	3	3	25	75	100
Elective -III	Material Science (OR) Artificial Intelligence for Physics	4	3	3	25	75	100
Non-Major Elective course -II (For other departments)	Solar Energy and Utilization	2	2	3	25	75	100
	Internship / Industrial Activity	-	2	-	-	-	-
FOURTH SEMESTER							
Core - 10	Nuclear and Particle Physics	6	5	3	25	75	100
Core - 11	Numerical Methods and Computer Programming	5	4	3	25	75	100
Core - 12	Project with Viva Voce	16	5	-	25	75	100
Skill Enhancement Course - II	Communication Electronics	2	2	3	25	75	100
	Extension Activity	-	1	-	-	-	-
	TOTAL		**92**				**2300**

SUMMARY OF STRUCTURE OF THE PROGRAMME

Part	Types of the Courses	No. of Courses	Credit Distribution	Total No. of Credits	Marks
A	Core Papers	11	5	55	1100
A	Core Practical	3	4	12	300
A	Elective	3	3	09	300
A	Project	1	5	5	100
B1	Skill Enhancement Course	2	2	4	200
B2	Non Major Elective	2	2	4	200
B3	Internship	1	1	1	-
C	Extension Activity	1	1	1	-
D	Common Subject	1	1	1	100
	TOTAL	25	-	92	2300

SEMESTER	PAPER NAME	PAPER CODE
I	Mathematical Physics	26PPH01
I	Classical Mechanics and Relativity	26PPH02
I	Analog and Digital Electronics	26PPH03
I	Practical – I General Physics Experiments	26PPHP01
I	Renewable Energy Sources (or)	26PPHE01
I	Non Linear Dynamics	26PPHE02
I	Atmospheric Physics	26PPHSE01
II	Statistical Mechanics	26PPH04
II	Quantum Mechanics –I	26PPH05
II	Spectroscopy	26PPH06
II	Practical – II Analog and Digital Experiments	26PPHP02
II	Microprocessor & Microcontroller (Or)	26PPHE03
II	Advanced Optics	26PPHE04
II	Bio Physics	26PPHN01
II	Human Rights	26PHR01
III	Quantum Mechanics-II	26PPH07
III	Condensed Matter Physics	26PPH08
III	Electromagnetic Theory	26PPH09
III	Practical -III Microprocessor 8085, Microcontroller 8051 and C++ Programming	26PPHP03
III	Material Science (Or)	26PPHE05
III	Artificial Intelligence for Physics	26PPHE06
III	Solar Energy and Utilization	26PPHN02
III	Internship / Industrial Activity	26PPHIT

IV	Nuclear and Particle Physics	26PPH10
IV	Numerical Methods and Computer Programming	26PPH11
IV	Project with Viva Voce	26PPHPR1
IV	Communication Electronics	26PPHSE02
IV	Extension Activity	26PPHX01

6. EXAMINATION

For the purpose of uniformity, particularly for inter-departmental transfer of credits, there will be a uniform procedure credits, there will be a uniform procedure of examinations to be adopted by all teachers offering courses.

DISTRIBUTION OF MARKS:

(a) The following are the distribution of external and internal marks for Theory papers.

. i) External Exam. : 75 Marks

Passing Minimum : 38 Marks

ii) Internal Exam : 25 Marks

Passing Minimum : 12 Marks

(b) The following are the distribution of Internal marks for Theory papers.

1. Test (One best test out of 3 tests) : 05 Marks
2. End Semester Model Exam : 10 Marks
3. Assignments & Attendance : 05 Marks
4. Seminar : 05 Marks

TOTAL : 25 Marks

(c) The following are the distribution of Internal marks for Practical papers.

1. Record Submission : 10 Marks
   (Minimum 12 experiments)
2. Model Exam : 10 Marks
3. Attendance : 05 Marks

TOTAL : 25 Marks

SUBMISSION OF RECORD NOTEBOOKS FOR PRACTICAL EXAMINATIONS

Candidates taking the Practical Examinations should submit bonafide Record Note Books prescribed for the Practical Examinations with due certification by Staff in-charge and HOD is a must for External Practical Examination (for both Regular and Arrear Candidates). Otherwise, the candidates will not be permitted to take the Practical Examinations.

Allocation of Marks for University Practical Examinations:

Record	10 Marks
Formula and Formula Description	10 Marks
Circuit Diagrams / Diagrams	08 Marks
Observation-Tabulation and Readings	20 Marks
Calculations	15 Marks
Presentation	02 Marks
Result	05 Marks
Viva-Voce	05 Marks
TOTAL	**75 Marks**

PROJECT AND VIVA-VOCE EXAM

Students are required to submit a Project report at the end of Semester - IV and also required to make presentation of the project work during Viva- voce Examination. The Project work shall be based on research-oriented topics both in the fields of theoretical and experimental physics under the guidance of a faculty member of the Department as a Project Supervisor. In the course of the project, the student will refer books, Journals or collect literature/data by the way of visiting research institutes / industries. He/she may even do experimental /theoretical work in his/her college. After completion of the project work by the end of semester IV, each student should submit **THREE** copies of the project report with a minimum of 50 pages not exceeding 70 pages to the Department on or before the date notified for the same.

FORMAT FOR PREPARATION OF PROJECT REPORT

The sequence in which the project should be arranged and bound should be as follows

1. Cover Page and Title Page
2. Certificate
3. Declaration
4. Acknowledgement (not exceeding one page)
5. Contents (12 Font size, Times New Roman with 1.5 or double line spacing)
6. List of Figures / Exhibits / Charts
7. List of tables
8. Symbols and notations
9. Chapters
10. Result and Discussion
11. Conclusion
12. References
13. Xerox Copies of Publications/Certificates of Seminar, Conference Participation The bifurcation of marks for project will be as follows:

    1. Plan of the Project : 25 Marks
    2. Evaluation of the Project Report : 75 Marks
    3. Viva- Voce Examination : 25 Marks

DISTRIBUTION OF MARKS FOR EVALUATION OF PROJECT REPORT & VIVA-VOCE

(a) Execution of the Plan/Collection of Data/ Organisation of Materials / Presentation of the report /Novelty of the project : 40 Marks

(b) Presentation of project in state level/National level Seminar / Publication : 10 Marks

(c). Viva-Voce (Preparation, Presentation of work and Response to questions) : 25 Marks

7. QUESTION PAPER PATTERN

The following question paper pattern shall be followed for the candidates admitted from the academic year 2026–2027 onwards.

Time: 3 Hours Maximum: 75 Marks

Part – A (15 x 1 = 15 Marks)
Answer **ALL** the Questions
Three Questions from each unit
15 multiple choice questions with four options

Part - B (2 x 5 = 10 Marks)
Answer Any **TWO** Questions out of FIVE
One Question from each unit.
All Questions carry equal Marks.

Part - C (5 x 10 = 50 Marks)
Answer **ALL** the Questions.
One Question from each unit with either or Type.
All Questions carry equal Marks.

8. PASSING MINIMUM

In order to pass a paper 50% minimum is compulsory both in the internal and external. A candidate who has secured a minimum 50 marks (Internal - 12 and External - 38) in all the courses prescribed in the programme and earned a minimum of 91 credits will be considered to have passed the Master's Programme.

9. COMMENCEMENT OF THIS REGULATION

This regulation and syllabus shall take effect from the academic year 2026 - 2027, for students who are admitted to the first year of the course during the academic year 2026 - 2027 and thereafter.

10. GRADING

Once the marks of the cumulative internal assessment and end semester examinations are available, they will be added. The mark thus obtained will then be graded as per details given below:

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:

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	RA	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 course was credited

For a Semester:

$$\text{GRADE POINT AVERAGE [GPA]} = \sum i\, Ci\, Gi \,/\, \sum i\, Ci$$

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

For the entire Programme*:*

$$\text{CUMULATIVE GRADE POINT AVERAGE [CGPA]} = \sum n \sum i\, Cni\, Gni \,/\, \sum n \sum i\, Cni$$

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

11. CLASSIFICATION OF SUCCESSFUL CANDIDATES

A candidate who passes all the examinations and securing following CGPA and Grades shall be declared as follows:

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5 - 10.0	O+	First Class with 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 Course, Skill Enhancement, Compulsory Course) are eligible.

12. RANKING

A candidate who qualifies for the M.Sc., Physics, passing all the Examinations in the first attempt, within the minimum period prescribed for the course from the date of admission to the course and secures first or second class shall be eligible for ranking and such ranking will be confined to 10% of the total number of candidates qualified in that particular subject to a maximum of 10 ranks. The improved marks shall not be taken into consideration for ranking.

13. CONFERMENT OF THE DEGREE

No candidate shall be eligible for conferment of the Degree unless he / she has undergone the prescribed course of study for a period of not less than four Semesters in an institution approved by/affiliated to the Periyar University and has passed the Examinations as have been prescribed therefore.

14. TRANSITORY PROVISION

Candidates who have undergone the Course of Study prior to the Academic Year 2026 - 2027 will be permitted to take the Examinations under those Regulations for a period of four years i.e., up to and inclusive of the Examination of April 2030 thereafter they will be permitted to take the Examination only under the Regulations in force at that time.

MATHEMATICAL PHYSICS I YEAR - FIRST SEMESTER

Core Paper-1

UNIT I: LINEAR VECTOR SPACE

Basic concepts – Definitions– examples of vector space – Linear independence – Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure – linear operators – Dual space – ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator – Eigen values and Eigen functions – Direct sum and invariant subspace – orthogonal transformations and rotation.

UNIT II: COMPLEX ANALYSIS

Functions of a Complex Variable – Differentiability – Analytic functions- Harmonic Functions – Complex Integration – Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy‘s Integral Theorem and integral Formula – Taylor‘s Series – Laurent‘s Expansion – Zeros and poles – Residue theorem and its Application: Potential theory – (1) Electrostatic fields and complex potentials – Parallel plates, coaxial cylinders and an annular region (2) Heat problems – Parallel plates and coaxial cylinders.

UNIT III: MATRICES

Types of Matrices and their properties, Rank of a Matrix – Conjugate of a matrix – Adjoint of a matrix – Inverse of a matrix – Hermitian and Unitary Matrices – Trace of a matrix – Transformation of matrices – Characteristic equation – Eigen values and Eigen vectors – Cayley – Hamilton theorem – Diagonalization.

UNIT IV: FOURIER TRANSFORMS & LAPLACE TRANSFORMS

Definitions – Fourier transform and its inverse – Transform of Gaussian function and Dirac delta function – Fourier transform of derivatives – Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium – Wave equation: Vibration of an infinite string and of a semi - infinite string.

Laplace transform and its inverse – Transforms of derivatives and integrals – Differentiation and integration of transforms – Dirac delta functions – Application – Laplace equation: Potential problem in a semi - infinite strip.

UNIT V: DIFFERENTIAL EQUATIONS

Second order differential equation – Sturm – Liouville‘s theory – Series solution with simple examples – Hermite polynomials – Generating function – Orthogonality properties – Recurrence relations – Legendre polynomials – Generating function – Rodrigue formula – Orthogonality properties – Dirac delta function – One dimensional Green‘s function and Reciprocity theorem – Sturm - Liouville‘s type equation in one dimension & their Green‘s function.

TEXT BOOKS

1. George Arfken and Hans J Weber, 2012, Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press.
2. P.K. Chattopadhyay, 2013, *Mathematical Physics* (2^{nd} edition), New Age, New Delhi.
3. A. W. Joshi, 2017, Matrices and Tensors in Physics, 4th Edition (Paperback), New Age International Pvt. Ltd., India.
4. B.D.Gupta, 2009, *Mathematical Physics*(4^{th}edition), Vikas Publishing House, New Delhi.
5. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi.

REFERENCE BOOKS

1. E. Kreyszig, 1983, Advanced Engineering Mathematics, Wiley Eastern, New Delhi.
2. D. G. Zill and M. R. Cullen, 2006, Advanced Engineering Mathematics, 3rd Ed. Narosa, New Delhi.
3. S. Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw - Hill, New York.
4. P. R. Halmos, 1965, Finite Dimensional Vector Spaces, 2nd Edition, Affiliated East West, New Delhi.
5. C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6th Edition, International Edition, McGraw-Hill, New York.

WEB SOURCES

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2. https://youtu.be/LZnRlOA1_2I
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4. https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qaZ
5. https://archive.nptel.ac.in/courses/115/106/115106086

CLASSICAL MECHANICS AND RELATIVITY I YEAR- FIRST SEMESTER

Core Paper-2

UNIT I: PRINCIPLES OF CLASSICAL MECHANICS

Mechanics of a single particle – mechanics of a system of particles – conservation laws for a system of particles – constraints – holonomic & non-holonomic constraints – generalized coordinates – configuration space – transformation equations – principle of virtual work.

UNIT II: LAGRANGIAN FORMULATION

D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.

UNIT III: HAMILTONIAN FORMULATION

Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) motion of particle in a central force field.

UNIT IV: SMALL OSCILLATIONS

Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.

UNIT V: RELATIVITY

Inertial and non-inertial frames – Lorentz transformation equations – length contraction and time dilation – relativistic addition of velocities – Einstein's mass-energy relation – Minkowski's space – four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations.

TEXT BOOKS

1. H. Goldstein, *Classical Mechanics*, 3rd Edition, Pearson Edu., 2002.
2. J. C. Upadhyaya, *Classical Mechanics*, Himalaya Publshing. Co. New Delhi, 2016.
3. R. Resnick, *Introduction to Special Theory of Relativity,* Wiley Eastern, New Delhi, 1968.
4. R. G. Takwala and P.S. Puranik, Introduction to Classical Mechanics – Tata – McGraw Hill, New Delhi, 1980.
5. N. C. Rana and P.S. Joag, Classical Mechanics - Tata McGraw Hill, 2001.

REFERENCE BOOKS

1. K. R. Symon, *Mechanics*, Addison Wesley, London, 1971.
2. S. N. Biswas, *Classical Mechanics*, Books & Allied, Kolkata,1999.
3. Gupta, Kumar and Sharma, *Classical Mechanics*, Pragathi Prakashan, 2017.
4. T.W.B. Kibble, *Classical Mechanics*, McGraw-Hill, New York, 2004.
5. Greenwood, *Classical Dynamics*, Dover Publication, New York, 1985.

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3. https://nptel.ac.in/courses/122/106/122106027/
4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/
5. https://www.britannica.com/science/relativistic-mechanics

ANALOG AND DIGITAL ELECTRONICS I YEAR - FIRST SEMESTER

Core Paper - 3

UNIT – I: SEMICONDUCTOR DEVICES

SCR - DIAC - TRIAC – Construction, operation and V-I characteristics -Tunnel diode – Gunn diode – V-I characteristics. Basic monolithic ICs – Epitaxial growth – Masking – Etching - Impurity diffusion – Fabricating monolithic resistors, diodes, transistors, inductors and capacitors – Circuit layout – Contacts and inter connections.

UNIT – II: OPERATIONAL AMPLIFIER

Wien bridge and phase-shift oscillators – Triangular, saw-tooth and square-wave generators – Schmitt trigger – Voltage controlled oscillator – Phase-locked loops - Weighted resistor and binary R-2R ladder D/A converters - Counter type and successive approximation A/D converters – Solving simultaneous and differential equations.

UNIT – III: 555 TIMER AND PHASE LOCKED LOOP

Introduction – Description and functional diagram of 555 timer – Monostable operation – Frequency divider Astable operation – Frequency Shift Keying (FSK) generator. PLL Basic principle – Analog phase detector – Digital phase detector – PLL applications – Frequency multiplication/division.

Unit – IV: DIGITAL CIRCUITS -I

Digital comparator – Parity generator/checker – Data selector - BCD to decimal decoder – Seven segment decoder – Encoders – RS, JK, D, T and JK master-slave flip-flops.

UNIT – V: DIGITAL CIRCUITS-II

Serial-in serial-out, Serial-in parallel-out and Parallel-in serial-out shift registers – Synchronous, asynchronous, ring and up/down (using mod 10) counters - Multiplexers – De-multiplexers.

REFERENCES:

1. D. P. Leach and A. P. Malvino, Digital Principles and Applications (McGraw Hill, New Delhi, 2006).
2. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits (Pearson, New Delhi, 2021).
3. L. Floyd, Electronic Devices (Pearson, New Delhi, 2021).
4. J. Millman, C. Halkias and C. D. Parikh, Integrated Electronics: Analog and Digital Circuits and Systems (McGraw Hill, New Delhi, 2017).
5. V. Vjayendran, Introduction to Integrated Electronics Digital and Analog (S. Viswanathan Printers and Publishers, Chennai, 2014).
6. R. L. Geiger, P. E. Allen and N. R Strader, VLSI Design Techniques for Analog and Digital Circuits (McGraw Hill, Singapore, 2010).
7. D. R. Choudhury and S. B. Jain, Linear Integrated Circuits (New Age International Publications, New Delhi, 2018).
8. D.Chattopadhyay and P. C. Rakshit, Electronics Fundamentals and Applications (New Age International Publications, New Delhi, 2021).
9. T. F. Schubert and E. M. Kim, Active and Nonlinear Electronics (Wiley, New York, 1996).
10. J. Nagrath, Electronics: Analong and Digital (Prentice Hall of India, New Delhi, 2013).
11. W. D. Stanley, Operational Amplifiers with Linear Integrated Circuits (Pearson, New Delhi, 2002).
12. S. Salivahnan and S. Arivazhagan, Digital Circuits and Design (McGraw Hill, New Delhi, 2018).
13. C. Durkan, Current at the Nanoscale (World Scientific, London, 2013).
14. C. R. Paul, Transmission Lines in Digital and Analog Electronic Systems (Wiley, New York, 2010).
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16. https://nptel.ac.in/courses/108102112
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3. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/
4. https://www.electrical4u.com/applications-of-op-amp/
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

RENEWABLE ENERGY SOURCES I YEAR - FIRST SEMESTER

Elective I

UNIT – I: BASICS OF SOLAR ENERGY

Energy resources- conventional and non-conventional energy sources- World's future energy-energy sources and their availability-prospects of renewable energy sources - Sun as a source of energy - Solar radiation – Effects of atmosphere on solar radiation – Solar radiation at the Earth's surface - Sunshine recorder – Importance of solar energy.

UNIT – II: SOLAR THERMAL AND PHOTOVOLTAIC SYSTEMS

Solar thermal power plant – OTEC- Solar cookers – Solar hot water systems – Solar greenhouses – Space heating - Conversion of solar energy into electricity – Photovoltaic effect – Solar photovoltaic cell – Electrical characteristics - Efficiency
- Solar photovoltaic applications – Battery chargers – Domestic lighting – Street lighting – Water pumping and irrigation - Solar cooling.

UNIT – III: WIND ENERGY

Basic principles – Global wind – Local wind – Nature of wind - Basic components of wind energy conversion systems - Wind turbine sitting – Energy estimation - Major applications of wind power – Horizontal axis wind turbine – Environmental aspects.

UNIT – IV: BIOMASS ENERGY

Introduction – Useful forms of biomass, their composition and fuel properties – Biomass resources – Biomass gasification – Wet and dry process - Biogas production from waste biomass – Advantages of anaerobic digestion - Availability of raw materials and gas yield.

UNIT – V: GEOTHERMAL ENERGY

Introduction – Applications – Origin and distribution of geothermal energy – Tidal energy - Origin and nature of tidal energy – Limitations of tidal energy – Ocean thermal energy – Ocean thermal energy conversion technology-OTEC – Open cycle and closed cycle.

TEXT BOOKS

1. G.D. Rai, Non – convention sources of, 4th edition, Khanna publishers, New Delhi (1996).
2. S. Rao and Dr.ParuLekar, Energy technology, Khanna publishers (1994).
3. M.P. Agarwal, Solar Energy, S. Chand and Co., New Delhi (1983).
4. Solar energy, principles of thermal collection and storage by S. P. Sukhatme, 2nd edition, Tata McGraw-Hill Publishing Co. Lt., New Delhi (1997).
5. Ramesh C Bansal and Ahmed F Zobaa, Handbook Of Renewable Energy Technology & System,World Scientific(2021).

REFERENCE BOOKS

1. Renewable energy resources, John Twidell and Tonyweir, Taylor and Francis group, London and New York.
2. Applied solar energy, A. B. Meinel and A. P. Meinal.
3. John Twidell and Tony Weir, Renewable energy resources, Taylor and Francis group, London and New York.
4. Renewal Energy Technologies: A Practical Guide for Beginners C.S. Solanki-PHI Learning.
5. Introduction to Non-Conventional Energy Resources -Raja et. al., Sci. Tech Publications.

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1. https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable=1
2. https://www.nationalgeographic.org/encyclopedia/tidal-energy/
3. https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy
4. https://www.reenergyholdings.com/renewable-energy/what-is-biomass/
5. https://www.acciona.com/renewable-energy/solar-energy/

NON-LINEAR DYNAMICS I YEAR - FIRST SEMESTER

Elective II

UNIT I: GENERAL

Linear waves-ordinary differential equations(ODEs)-Partial differential equations(PDEs)- Methods to solve ODEs and PDEs.- Numerical methods – Linear and Nonlinear oscillators-Nonlinear waves-Qualitative features.

UNIT II: COHERENT STRUCTURES

Linear and Nonlinear dispersive waves - Solitons – KdV equation – Basic theory of KdV equation –Ubiquitous soliton equations – AKNS Method, Backlund transformation, Hirotabi linearization method, Painleve analysis - Perturbation methods- Solitons in Optical fibres - Applications.

UNIT III: BIFURCATIONS AND ONSET OF CHAOS

One dimensional flows – Two dimensional flows – Phase plane – Limit cycles – Simple bifurcations – Discrete Dinamical system – Strange attractors – Routes to chaos.

UNIT IV: FRACTALS

Self-similarity - Properties and examples of fractals - Fractal dimension - Construction and properties of some fractals - Middle one third cantor set - Koch curve - Sierpinski triangle – Julia set – Mandelbrot set - Applications of fractals.

UNIT V: APPLICATIONS

Soliton based communication systems – Solition based computation – Synchronization of chaos – Chaos based communication – Cryptography – Image processing – Stochastic – Resonance – Chaos based computation – Time Series analysis.

TEXT BOOKS

1. M. Lakshmanan and S. Rajasekar, Nonlinear Dynamics: Integrability, Chaos and Patterns. Springer, 2003.
2. A. Hasegawa and Y. Kodama, Solitons in Optical Communications. Oxford Press, 1995.
3. Drazin, P. G. Nonlinear Systems. Cambridge University Press, 2012. ISBN: 9781139172455.
4. Wiggins, S. Introduction to Applied Nonlinear Dynamical Systems and Chaos. Springer, 2003. ISBN: 9780387001777.
5. Strogatz, Steven H. Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering,West view Press, 2014. ISBN: 9780813349107.

REFERENCE BOOKS

1. G. Drazin and R. S. Johnson. Solitons: An Introduction. Cambridge University Press, 1989.
2. M. Lakshmanan and K. Murali. Chaos in Nonlinear Oscillators. World Scientific, 1989.
3. S. Strogatz**.** Nonlinear Dynamics and Chaos. Addison Wesley, 1995.
4. HaoBai-Lin, Chaos, World Scientific, Singapore, 1984.
5. Kahn, P. B., Mathematical Methods for Scientists & Engineers, Wiley, NY, 1990.

EB SOURCES

1. https://www.digimat.in/nptel/courses/video/108106135/L06.html
2. http://digimat.in/nptel/courses/video/115105124/L01.html
3. https://www.digimat.in/nptel/courses/video/108106135/L01.html
4. http://complex.gmu.edu/neural/index.html
5. https://cnls.lanl.gov/External/Kac.php

PRACTICAL I - GENERAL PHYSICS EXPERIMENTS I YEAR - FIRST SEMESTER

Core Practical -I

(ANY TWELVE EXPERIMENTS)

1. Determination of Young‘s modulus and Poisson‘s ratio by Elliptical fringes - Cornu‘s Method.
2. Determination of Young‘s modulus and Poisson‘s ratio by Hyperbolic fringes - Cornu‘s Method.
3. Charge of an Electron by Spectrometer.
4. Determination of Viscosity of the given liquid – Meyer‘s disc.
5. Measurement of Coefficient of linear expansion- Air wedge Method.
6. B-H loop using Anchor ring.
7. Determination of Thickness of the enamel coating on a wire by diffraction.
8. Determination of Rydberg‘s Constant - Hydrogen Spectrum.
9. F. P. Etalon-Spectrometer- Determination of Thickness.
10. Determination of Thickness of air film - Solar spectrum – Hartmann‘s formula- Edser and Butler fringes.
11. Measurement of Band gap energy – Thermistor.
12. Determination of Planck‘s Constant – LED Method.
13. Determination of Specific charge of an electron – Thomson‘s method.
14. Determination of Compressibility of a liquid using Ultrasonics Interferrometer.
15. Determination of Wavelength, Separation of wavelengths – Michelson Interferometer.
16. GM counter - Characteristics, inverse square law and absorption coefficient.
17. Measurement of Resistivity of semiconductor - Four probe method.
18. Arc spectrum - Iron/Copper.
19. Molecular spectra - AlO band.
20. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
21. Determination of Diffraction pattern of light with circular aperture using Diode/ He-Ne laser.
22. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
23. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square, Receiver end transmitter behavior, Radiation Pattern - Microwave test bench.
24. Susceptibility measurement by Quinke‘s method.
25. Susceptibility determination of solid by Gouy‘s method
26. Determination of Stefan‘s constant.
27. Study the temperature characteristics and determine the band gap of given thermistor.

28. Study the spectrum of hydrogen atom.
29. I-V Characteristics of Solar cell and determine its maximum efficiency.
30. Determination of Hall Effect in a semiconductor and measurement of Hall Coefficient.
31. Characterization of LVDT.
32. e/m-Zeeman effect.
33. Characteristics of laser and tunnel diode.
34. Determination of Solar constant.

TEXT BOOKS

1. Practical Physics, Gupta and Kumar, Pragati Prakasan, 2020.
2. An Advanced Course in Practical Physics, D.Chattopadhyay, P,C.Rakshit, New Central Book Agency(P) Ltd., 2007.
3. Kit Developed for doing experiments in Physics-Instruction manual, R. Srinivasan K.R Priolkar, Indian Academy of Sciences.
4. A Textbook of Advanced Practical Physics, S.K.Ghosh, New Central, Fourth Edition, 2000.

REFERENCE BOOKS

1. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
2. An advanced course in Practical Physics, D. Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd.
3. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.

ATMOSPHERIC PHYSICS I YEAR – FIRST SEMESTER

Skill Enhancement Course – I

UNIT I: INTRODUCTION

The atmosphere as a physical system - Atmospheric models - Two simple atmospheric models - Some atmospheric observations - Weather and climate.

UNIT II: ATMOSPHERIC THERMODYNAMICS

The ideal gas law - Atmospheric composition - Hydrostatic balance - Entropy and potential temperature - Parcel concepts - tephigram - Cloud formation.

UNIT III: ATMOSPHERIC RADIATION

Atmospheric radiation - Basic physical concepts – Plank‘s and Boltzmann - Basic spectroscopy of molecules – vibrational and rotational states – Line shapes – Transmittance.

UNIT IV: BASIC FLUID DYNAMICS

Mass conservation - The material derivative - An alternative form of the continuity equation - The Navier – Stokes equation - Equations of motion in coordinate form – Spherical - thermodynamic energy equation.

UNIT V: ATMOSPHERIC REMOTE SOUNDING

Atmospheric remote sounding from space - Thermal emission measurements - Backscatter measurements - Atmospheric remote sounding from the ground - The Dobson ozone spectrophotometer – Radars – Lidars.

TEXT BOOKS

1. David G. Anderws, 2000, An Introduction to Atmospheric Physics Second Edition, Cambridge University Press.
2. Murry L. Salby, 1995, Fundamentals of Atmospheric Physics, Academic Press.
3. R. M. Goody and Y. L. Yung, 1989, Atmospheric Radiation Theoretical Basis Second Edition, Library of Congress Cataloging-in-Publication.
4. D. G. Andrews, 2000, *An Introduction to Atmospheric Physics,* Cambridge University Press.
5. C. F. Bohren and B. A. Albrecht 1998, *Atmospheric Thermodynamics,* Oxford University Press, New York,

REFERENCE BOOKS

1. Shaun Lovejoy 2019, Weather, Macroweather, and the Climate: Our Random Yet Predictable Atmosphere, Oxford University Press Inc.
2. Neil C. Wells, 2011, The Atmosphere and Ocean: A Physical Introduction, John Wiley and Sons Inc.

3. John E Frederick**,** 2007, Principles of Atmospheric Science, Jones & Bartlett Publishers.
4. J.V.Iribarne, H.R.Cho, 1980, Atmospheric Physics, D.Reidel Publishing Company, London,
4. Blundell, S.J. and Blundell,K.M, 2009, Concepts in Thermal Physics, Oxford University Press, 2nd edition.

WEB RESOURCES

1. http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/home.rxml
2. https://www.britannica.com/science/atmospheric-pressure
3. http://site.ebrary.com/lib/berkeley/Doc?id=10378944
4. http://www.sciencedirect.com/science/book/9780127329512
5. https://www.embibe.com/exams/atmospheric-pressure/

STATISTICAL MECHANICS I YEAR - SECOND SEMESTER

Core Paper-4

UNIT I: PHASE TRANSITIONS

Thermodynamic potentials - Phase Equilibrium - Gibb‘s phase rule - Phase transitions and Ehrenfest‘s classifications –Third law of Thermodynamics.Order parameters – Landau‘s theory of phase transition - Critical indices - Scale transformations and dimensional analysis.

UNIT II: STATISTICAL MECHANICS AND THERMODYNAMICS

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

UNIT III: 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 IV: CLASSICAL AND QUANTUM STATISTICS

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

UNIT V: 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‘s theory - Fluctuation-dissipation theorem - The Fokker-Planck equation

TEXT BOOKS

1. S. K. Sinha, 1990, Statistical *Mechanics,* Tata McGraw Hill, New Delhi.
2. B. K. Agarwal and M. Eisner, 1998, *Statistical Mechanics,* Second Edition New Age International, New Delhi.
3. J. K. Bhattacharjee, 1996, *Statistical Mechanics*: An Introductory Text, Allied Publication, New Delhi.
4. F. Reif, 1965, *Fundamentals of Statistical and Thermal Physics,* McGraw -Hill, New York.

5. M. K. Zemansky, 1968, *Heat and Thermodynamics*, 5th edition, McGraw-Hill New York.

REFERENCE BOOKS

1. R. K. Pathria, 1996, *Statistical Mechanics*, 2nd edition, Butter WorthHeinemann, New Delhi.
2. L. D. Landau and E. M. Lifshitz, 1969, *Statistical Physics*, Pergamon Press, Oxford.
3. K. Huang, 2002, *Statistical Mechanics*, Taylor and Francis, London.
4. W. Greiner, L. Neiseand H.Stoecker, *Thermodynamics and Statistical Mechanics*, Springer Verlang, New York.
5. A. B. Gupta, H. Roy, 2002, *Thermal Physics*, Books and Allied, Kolkata.

WEB SOURCES

1. https://byjus.com/chemistry/third-law-of-thermodynamics/
2. https://web.stanford.edu/~peastman/statmech/thermodynamics.html
3. https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics
4. https://en.wikipedia.org/wiki/Grand_canonical_ensemble
5. https://en.wikipedia.org/wiki/Ising_model

QUANTUM MECHANICS – I I YEAR - SECOND SEMESTER

Core Paper - 5

UNIT-I: FOUNDATIONS OF WAVE MECHANICS

Postulates of Quantum Mechanics. Time independent Schrödinger equation, time dependent Schrödinger equation – Schrödinger equation in momentum representation. Ehrenfest's Theorem – Linear vector space – Linear operator – Eigen values and Eigen functions. Hermitian operator – Expectation values of observables – Simultaneous measurability – General uncertainty relation.

UNIT II: ENERGY EIGEN VALUE PROBLEMS

The Square-well potential - Rectangular potential barrier – Application of barrier penetration (α-decay)- Particle in a box – Linear Harmonic Oscillator- Particle moving in a spherically symmetric potential – System of two interacting particles- Rigid rotator -Hydrogen atom.

UNIT III: GENERAL FORMALISM

Dirac notation- Equation of motion – Schrödinger, Heisenberg and interaction representation – Dirac vectors- Co-ordinate and momentum representation-Projection operator – Unitary transformation.

UNIT IV: APPROXIMATE METHODS

Time independent perturbation theory for non-degenerate case, first order correction– Degenerate case – Stark effect in Hydrogen atom- Variation method – Ground state of Helium- WKB approximation and its validity – Connection formulae (No derivation).

UNIT V: ANGULAR MOMENTUM

Angular momentum operator – Spin angular momentum -Total angular momentum operators- Commutation relation of total angular momentum with components. Ladder operators – Matrix representation - Addition of angular momenta – CG Coefficients – Properties – Recursion relation of CG coefficients.

TEXT BOOKS

1. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2nd edition(37th Reprint),Tata McGraw-Hill, New Delhi, 2010.
2. G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009.
3. David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
4. SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S.Chand& Co., New Delhi, 1982.
5. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4thEdition, Macmillan, India, 1984.

REFERENCE BOOKS

1. E. Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970.
2. V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985.
3. L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976.
4. S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata, 1999.
5. V. Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford, 2011.

WEB SOURCES

1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf
2. http://www.feynmanlectures.caltech.edu/III_20.html
3. http://web.mit.edu/8.05/handouts/jaffe1.pdf
4. https://hepwww.pp.rl.ac.uk/users/haywood/Group_Theory_Lectures/Lecture_ 1.pdf
5. https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf

SPECTROSCOPY I YEAR - SECOND SEMESTER

Core Paper - 6

UNIT I: MICROWAVE SPECTROSCOPY

Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules.

UNIT II: INFRA-RED SPECTROSCOPY

Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch- Fundamental modes of vibration of H_2O and CO_2 -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy .

UNIT III: RAMAN SPECTROSCOPY

Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- SR branch -Raman activity of H_2O and CO_2 -Mutual exclusion principle- determination of N_2O structure -Instrumentation technique and block diagram.SERS. Application of SERS in medicine.

UNIT IV: RESONANCE SPECTROSCOPY

Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance- Chemical shift and its measurement - NMR of Hydrogen nuclei - MRI Scan. Electron Spin Resonance: Basic principle – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors – Instrumentation - Medical applications of ESR.

UNIT V: UV SPECTROSCOPY

Origin of UV spectra - Laws of absorption – Lambert Bouguer law – Lambert Beer law - molar absorptivity – transmittance and absorbance - Color in organic compounds- Absorption by organic Molecule - Chromophores -Effect of conjugation on chromophores - Double beam UV-Spectrophotometer - Simple applications.

TEXT BOOKS

1. C. N. Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi.
2. G. Aruldhas, 1994, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi.
3. D.N. Satyanarayana, 2001, Vibrational Spectroscopy and Applications, New Age International Publication.
4. B.K. Sharma, 2015, Spectroscopy, Goel Publishing House Meerut.

5. P.S.Kalsi, 2016, Spectroscopy of Organic Compounds (7^{th} Edition), New Age International Publishers.

REFERENCE BOOKS

1. J. L. McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
2. J. M. Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge.
3. B. P. Straughan and S. Walker, 1976, Spectroscopy Vol. I, Chapman and Hall, New York.
4. K. Chandra, 1989, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi.
5. W.Demtroder, Laser Spectroscopy: Basic concepts and Instrumentation, Springer.

WEB SOURCES

1. https://www.youtube.com/watch?v=0iQhirTf2PI
2. https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5
3. https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee
4. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
5. https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu

MICROPROCESSOR AND MICROCONTROLLER

I YEAR – SECOND SEMESTER

Elective - III

UNIT – I: MICROPROCESSOR ARCHITECTURE AND INTERFACING

Intel 8085 microprocessor architecture – Pin configuration – Instruction cycle – Timing diagram – Instruction and data formats – Addressing modes - Memory mapping and I/O mapping I/O scheme - Memory mapping I/O interfacing - Data transfer schemes - Synchronous and asynchronous data transfer – Interrupt driven data transfer - Interrupts of Intel 8085.

UNIT – II: ASSEMBLY LANGUAGE PROGRAMS (8085 ONLY)

BCD arithmetic - Addition and subtraction two 8-bit and 16-bit numbers - Largest and smallest numbers in a data set – Ascending order and descending order – Sum of a series of a 8-bit numbers – Sum of a series of multibyte decimal numbers – Square root of a number – Block movement of data - Time delay – Square-wave generator.

UNIT – III: PERIPHERAL DEVICES AND MICROPROCESSOR APPLICATIONS

Generation of control signals for memory and I/O devices - I/O ports - Programmable peripheral interface - Architecture of 8255A - Control word - Programmable interrupt controller (8259) - Programmable counter - Intel 8253 - Architecture, control word and operation – Block diagram and interfacing of analog to digital converter (ADC 0800) – Digital to analog converter (DAC 0800) – Stepper motor – Traffic control.

UNIT– IV: MICROCONTROLLER 8051

Features of 8051 – Architecture – Pin configuration – Memory organization --External data and program memory - Counters and timers – Serial data input/output - Interrupt structure – External interrupts – Addressing modes - Comparison between microprocessor and microcontroller.

UNIT – V: 8051 INSTRUCTION SET AND PROGRAMMING

Instruction set – Data transfer, arithmetic and logical instructions – Boolean variable manipulation instructions – Program and machine control instructions – Simple programs – Addition and subtraction of two 8-bit and 16-bit numbers – Division – Multiplication - Largest number in a set – Sum of a set of numbers

REFERENCE BOOKS

1. B. Ram, Fundamentals of Microprocessor and Microcomputers (Dhanpat Rai Publication, New Delhi, 2006).
2. M. A. Mazidi, J. G. Mazidi and R. Mckinlay, The 8051 Microcontroller and Embbeded Systems using Assembly and C (Pearson, New Delhi, 2007).
3. A. P. Godse and D. A. Godse, Microprocessors and Microcontrollers (Technical Publications, Pune, 2021).
4. R. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085 (Penram International Publishing, Mumbai, 2013).
5. K. Kant, Microprocessors and Microcontroller (Prentice Hall of India, New Delhi, 2013).
6. P. S. Manoharan, Microprocessors and Microcontroller (Charulatha Publications, Chennai, 2019).
7. K. Ayala, The Microcontroller (Cengage Learning, New Delhi, 2013).
8. V. Vijayendran, Fundamentals of Microprocessor 808 Architecture, Programming and Interfacing (Viswanathan Publication, Chennai, 2002).
9. R. S. Gaonkar, Microprocessor Architecture, Programming and Application with the 8085 (Penram International Publishing, Mumbai, 2013).
10. M. Spinks, Microprocessor System Design (Newnes, Oxford, 1992).
11. U. M. Baese, Embedded Microprocessor System Designusing FPGAs (Springer, Switzerland, 2021).

WEB SOURCES

1. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html
2. http://www.electronicsengineering.nbcafe.in/peripheral-mapped-io-interfacing/
3. https://www.geeksforgeeks.org/programmable-peripheral-interface-8255/
4. http://www.circuitstoday.com/8051-microcontroller
5. https://www.elprocus.com/8051-assembly-language-programming/

ADVANCED OPTICS I YEAR – SECOND SEMESTER

Elective - IV

UNIT I: POLARIZATION AND DOUBLE REFRACTION

Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu's law – Production of polarized light – Wire grid polarizer and the polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction – Normal and oblique incidence – Interference of polarized light: Quarter and half wave plates – Analysis of polarized light – Optical activity

UNIT II: LASERS

Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action – Types of lasers and its applications – Solid state lasers – Ruby laser – Nd:YAG laser – gas lasers – He-Ne laser – CO_2 laser – Chemical lasers – HCl laser – Semiconductor laser

UNIT III: FIBER OPTICS

Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical fibers – Ray dispersion in multimode step index fibers – Parabolic-index fibers – Fiber-optic sensors: precision displacement sensor – Precision vibration sensor

UNIT IV: NON-LINEAR OPTICS

Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self-focusing of light

UNIT V: MAGNETO-OPTICS AND ELECTRO-OPTICS

Magneto-optical effects – Zeeman effect – Inverse Zeeman effect – Faraday effect – Voigt effect – Cotton-mouton effect – Kerr magneto-optic effect – Electro-optical effects – Stark effect – Inverse stark effect – Electric double refraction – Kerr electro-optic effect – Pockels electro-optic effect

TEXT BOOKS

1. B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) Ltd.
2. Ajoy Ghatak, 2017, Optics, 6th Edition, McGraw – Hill Education Pvt. Ltd.
3. William T. Silfvast, 1996, Laser Fundamentals Cambridge University Press, New York.
4. J. Peatros, Physics of Light and Optics, a good (and free!) electronic book.
5. B. Saleh, and M. Teich, Fundamentals of Photonics, Wiley-Interscience,

REFERENCE BOOKS

1. F. S. Jenkins and H. E. White, Fundamentals of Optics, (4^{th} Edition), McGraw – Hill International Edition,1981.
2. Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH.
3. Lipson, S. G. Lipson and H. Lipson,Optical Physics, 4^{th} Edition, Cambridge University Press, New Delhi, 2011.
4. Y. B. Band, Light and Matter, Wiley and Sons (2006).
5. R. Guenther, Modern Optics, Wiley and Sons (1990).

WEB SOURCES

1. https://www.youtube.com/watch?v=WgzynezPiyc
2. https://www.youtube.com/watch?v=ShQWwobpW60
3. https://www.ukessays.com/essays/physics/fiber–optics–and–it-applications.php
4. https://www.youtube.com/watch?v=0kEvr4DKGRI
5. http://optics.byu.edu/textbook.aspx

PRACTICAL - II ANALOG AND DIGITAL EXPERIMENTS
I YEAR - SECOND SEMESTER

Core Practical - II

1. Construction of relaxation oscillator using UJT
2. FET CS amplifier- Frequency response, input impedance, output impedance
3. Study of important electrical characteristics of IC741.
4. V- I Characteristics of different colours of LED.
5. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
6. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
7. Design of monostable multivibrator using IC 741 and 555 timer.
8. Construction of Schmidt trigger circuit using IC 741.
9. Construction of square wave and Triangular wave generator using IC 741.
10. Construction of a quadrature wave using IC 324.
11. Construction of pulse generator using the IC 741.
12. Construction of half adder and full adder circuits using NAND gates.
13. Construction of half subtractor and full subtractor circuits using NAND gates.
14. Construction of Op-Amp - 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
15. Study of R-S, clocked R-S and D-Flip flop using NAND gates
16. Study of J-K, D and T flip flops using IC 7476/7473
17. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
18. Study of Arithmetic logic unit using IC 74181.
19. Construction of Encoder and Decoder circuits using ICs.
20. IC 7490 as scalar and seven segment display using IC7447
21. Solving simultaneous equations – IC 741 / IC LM324
22. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
23. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
24. Construction of second order butter worth multiple feedback narrow band pass filter
25. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
26. Construction of square wave generator using IC 555.

27. Construction of Schmidt trigger circuit using IC555.Construction of pulse generator using the IC 555.
28. BCD to Excess- 3 and Excess 3 to BCD code conversion.
29. Study of binary up / down counters - IC 7476 / IC7473.
30. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474.
31. Study of synchronous parallel 4-bit binary up/down counter using IC 74193.
32. Study of asynchronous parallel 4-bit binary up/down counter using IC 7493.
33. Study of Modulus Counter.
34. Construction of Multiplexer and Demultiplexer using ICs.

TEXT BOOKS

1. Practical Physics, Gupta and Kumar, Pragati Prakasan.
2. Kit Developed for doing experiments in Physics- Instruction manual, R. Srinivasan, K.R Priolkar, Indian Academy of Sciences.
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. Electronic lab manual Vol I, K ANavas, Rajath Publishing.
5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition.

REFERENCE BOOKS

1. An advanced course in Practical Physics, D. Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd.
2. Advanced Practical Physics, S.P Singh, PragatiPrakasan.
3. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd.
4. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing.
5. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi.

INTERNSHIP/ INDUSTRIAL ACTIVITY

I/II YEAR- II/ III SEMESTER

Internship will be carried out during the summer vacation of the first year and the Internship report will be submitted in the Third Semester when the date fixed by the University.

The Internship/ Industrial Activity report must contain the following:

1. TITLE/COVER PAGE
2. CERTIFICATE OF THE CANDIDATE FROM THE DEPARTMENT
3. OFFER LETTER
4. INTERNSHIP COMPLETION REPORT
5. ACKNOWLEDGEMENT
6. TABLE OF CONTENTS
7. EXECUTIVE SUMMARY
8. INTRODUCTION- ABOUT THE ORGANIZATION
9. DESCRIPTION OF DUTIES AND ACCOMPLISHMENTS
10. SKILLS LEARNED
11. CHALLENGES FACED
12. CONCLUSION
13. APPENDICES
14. USE THE STAR TECHNIQUE

BIO PHYSICS I YEAR – SECOND SEMESTER

Non Major Elective - I

UNIT I: CELLULAR BIOPHYSICS

Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape – Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system – Extracellular matrix - Molecular mechanisms of Vesicular traffic - Electrical activities of cardiac and neuronal cells.

UNIT II: MOLECULAR BIOPHYSICS

Macromolecular structure: Protein structure – amino acids, peptide bonds, primary, secondary, tertiary and quaternary structures of proteins. Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation. Special Bio-macromolecules: Metalloproteins, nucleoproteins, ribozymes, chaperons and prions.

UNIT III: MEMBRANE AND NEURO BIOPHYSICS

Models membranes - Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels. Nervous system: Organization of the nervous system –Membrane potential – Origins of membrane potential - Electrochemical potentials – Nernst equation – Goldman equation.

UNIT IV: RADIATION BIO PHYSICS

X Ray: Effects on bio-macromolecules – Gamma Radiation: Molecular effects of gamma adiation, Radiation effects on nucleic acids and membranes, Effects on cell and organelles – UV radiation: Effects on bio-macromolecules and proteins – Radiation hazards and protection – use of radiations in cancer.

UNIT V: PHYSICAL METHODS IN BIOLOGY

Spectroscopy: UV-Visible absorption spectrophotometry – Optical Rotatory Dispersion (ORD) – Structure Determination: X-ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Thin layer chromatography (TLC), Gas liquid chromatography (GLC) – Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel electrophoresis, polyacrylamide gel electrophoresis.

TEXT BOOKS

1. The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013.
2. Biophysics, VasanthaPattabhi, N. Gautham, Narosa Publishing, 2009.
3. Biophysics, P. S. Mishra VK Enterprises, 2010.
4. Biophysics, M. A Subramanian, MJP Publishers, 2005.
5. Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006.

REFERENCE BOOKS

1. Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008).
2. Essential cell biology by Bruce Albert et al (Garland Science)
3. Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983).
4. Membrane Biophysics by Mohammad Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media).
5. Biological spectroscopy, Iain D. Campbell, Raymond A. Dwek, Benjamin-Cummings Publishing,1984.

WEB SOURCES

1. General Bio: http://www.biology.arizona.edu/DEFAULT.html
2. Spectroscopy: http://www.cis.rit.edu/htbooks/nmr/inside.htm
3. Electrophoresis:http://learn.genetics.utah.edu/content/labs/gel/
4. Online biophysics programs: http://mw.concord.org/modeler/
5. https://blanco.biomol.uci.edu/WWWResources.html

QUANTUM MECHANICS – II II YEAR - THIRD SEMESTER

Core Paper-7

UNIT I: SCATTERING THEORY

Scattering amplitude - cross sections – Transformation from centre of mass to Laboratory frame – General formulation of the scattering theory – Expression in terms of Green's function – Born approximation and its validity — Scattering by a screened Coulomb potential –Yukawa potential -Partial wave analysis – Phase shifts – Optical Theorem – Scattering length and effective range theory.

UNIT II: TIME DEPENDENT PERTURBATION THEORY

Constant perturbation – Transition Probability – Fermi-Golden rule - Harmonic Perturbation- Adiabatic and sudden approximation – A charged particle in an EM field- Application of the time dependent perturbation theory to semiclassical theory of radiation – Selection rules.

UNIT III: RELATIVISTIC QUANTUM MECHANICS

Klein-Gordon equation – Charge and current densities – KG equation in EM Field – Dirac equation- Dirac matrices - Plane wave solutions – Negative energy states -Spin of the electron – Magnetic moment of the electron.

UNIT IV: MANY ELECTRON SYSTEMS

Indistinguishable particles – Pauli's Principle – Central field approximation – Thomas-Fermi Statistical Model – Hartree's self-consistent field method- The cordon state rules-The Born-Oppenheimer approximation-The Hydrogen molecule ion H_2^+.

UNIT V: SECOND QUANTIZATION

The Lagrangian and Hamiltonian formulation of classical fields – Quantization of the non-relativistic Schrödinger equation – Creation, annihilation and number operators- Second quantization of Klein-Gordon equation.

TEXT BOOKS

1. P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics,2nd Edition, Tata McGraw-Hill, New Delhi, 2010.
2. G. Aruldhas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi,2009
3. L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill Kogakusha, Tokyo, 1968
4. V. Devanathan, Quantum Mechanics, 1st Edition, Narosa Publishing House, New Delhi, 2005.
5. NouredineZettili, Quantum mechanics concepts and applications, 2nd Edition, Wiley, 2017.

REFERENCE BOOKS

1. P. A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition, Oxford University Press, London, 1973.
2. B. K. Agarwal&HariPrakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009.
3. Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics, 1st edition,I.K.International Publishing house Pvt. Ltd., 2006
4. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi.
5. E. Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970.

WEB SOURCES

1. https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf
2. http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf
3. http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf
4. https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf
5. https://web.mit.edu/dikaiser/www/FdsAmSci.pdf

CONDENSED MATTER PHYSICS II YEAR - THIRD SEMESTER

Core Paper-8

UNIT I: 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). Structure and properties of liquid crystals. 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 II: 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 III: 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 IV: 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 V: 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 – Bardeen Cooper Schrieffer (BCS) Theory – BCS to Bose – Einstein Condensation (BEC) regime- Nature of paring and condensation of Fermions. Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS.

TEXT BOOKS

1. C. Kittel, 1996, *Introduction to Solid State Physics*, 7th Edition, Wiley, New York.
2. Rita John, Solid State Physics, Tata Mc-Graw Hill Publication.
3. A. J. Dekker, *Solid State Physics*, Macmillan India, New Delhi.
4. M. Ali Omar, 1974, *Elementary Solid State Physics – Principle and Applications,* Addison - Wesley
5. H. P. Myers, 1998, *Introductory Solid State Physics*, 2nd Edition Viva Book, New Delhi.

REFERENCE BOOKS

1. J. S. Blakemore, 1974 , *Solid state Physics*, 2nd Edition, W.B. Saunder, Philadelphia
2. H. M. Rosenburg, 1993, *The Solid State*, 3rd Edition, Oxford University Press, Oxford.
3. J. M. Ziman, 1971, Principles *of the Theory of Solids*, Cambridge University Press, London.
4. C. Ross-Innes and E. H. Rhoderick, 1976, *Introduction to Superconductivity,* Pergamon, Oxford.
5. J. P. Srivastava, 2001, *Elements of Solid State Physics*, Prentice-Hall of India, New Delhi.

WEB SOURCES

1. http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html
2. http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html
3. https://www.britannica.com/science/crystal
4. https://www.nationalgeographic.org/encyclopedia/magnetism/
5. https://www.brainkart.com/article/Super-Conductors_6824/

ELECTROMAGNETIC THEORY II YEAR - THIRD SEMESTER

Core Paper-9

UNIT I: ELECTROSTATICS

Boundary value problems and Laplace equation –Laplace equation in three dimension – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems. Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric.

UNIT II: MAGNETOSTATICS

Biot-Savart‘s Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magneto static energy - Magnetic induction and magnetic field in macroscopic media.

UNIT III: 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.

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UNIT IV: WAVE PROPAGATION

Plane waves in non-conducting media - Linear and circular polarization, reflection - 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 V: ELEMENTARY PLASMA PHYSICS

The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations - The Debye shielding problem - Plasma confinement in a magnetic field .

TEXT BOOKS

1. D. J.Griffiths , 2002, Introductionto Electrodynamics, 3rd Edition, Prentice-Hall of India, New Delhi.
2. J. R. Reitz, F. J. Milford and R. W. Christy, 1986, Foundations of Electromagnetic Theory, 3rd edition, Narosa Publishing House, New Delhi.
3. J. D. Jackson, 1975, Classical Electrodynamics, Wiley Eastern Ltd. New Delhi.
4. J. A. Bittencourt, 1988, Fundamentals of Plasma Physics, Pergamon Press, Oxford.
5. Gupta, Kumar and Singh, Electrodynamics, S. Chand & Co., New Delhi

REFERENCE BOOKS

1. W. Panofsky and M. Phillips, 1962, *Classical Electricity and Magnetism*, Addison Wesley, London.
2. J. D. Kraus and D. A. Fleisch, 1999, *Electromagnetics with Applications*, 5th Edition, WCB McGraw-Hill, New York.
3. B. Chakraborty, 2002, *Principles of Electrodynamics*, Books and Allied, Kolkata.
4. P. Feynman, R. B. Leighton and M. Sands, 1998, *The Feynman Lectures on Physics*, Vols. 2, Narosa Publishing House, New Delhi.
5. Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA

WEB SOURCES

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/
5. https://www.cliffsnotes.com/study-guides/physics/electricity-and-magnetism/electrostatics

MATERIALS SCIENCE II YEAR - THIRD SEMESTER

Elective - V

UNIT I: METAL ALLOYS

Elastic deformation– Stress-Strain behaviour- Elasticity- Elastic properties- tensile properties- Hardness Mechanism of strengthening in metals- Binary Phase diagrams- Phase transformation- microstructural and property changes in Iron-carbon alloy- types of metal alloys- fabrication - thermal processing of metals Applications.

UNIT II: CERAMICS

Ceramic structure- crystal structure-silicate ceramics- Carbon-Ceramic Phase diagrams-mechanical properties- Stress-Strain Behaviour -mechanics of Plastic deformation- types of ceramic-fabrication and processing of ceramics- glasses and glass-ceramics- clay- powder pressing-tape casting- 3D printing Applications of ceramics.

UNIT III: POLYMERS

Hydrocarbon molecules- Polymer molecules-chemistry of polymer molecules – molecular weight-shapestructure- Thermoplastics and thermos settings- -stress strain behaviour-polymer types-Glass transition temperature – polymerization-polymeric biomaterials-Advanced polymeric materials.

UNIT IV: COMPOSITES

Particle-Reinforced Composites-Fibre- Reinforced Composites-Polymer -matrix composites-metal matrix composites- ceramic matrix composites- carbon -carbon composites-hybrid composites- - Processing of Fibre- Reinforced Composites -laminar composites- sandwich panels – Nanocomposites.

UNIT V: MATERIAL CHARACTERIZATION

Principle and Instrumentation: X-Ray Photoelectron spectroscopy and Auger Electron Spectroscopy Scanning Tunnelling Microscopy and Atomic Force Spectroscopy– X-Ray Diffraction- Transmission Electron Microscopy- Scanning Electron Microscopy - Infrared Spectroscopy and UV/Vis Spectroscopy - Macro and Micro Thermal Analyses.

TEXT BOOKS

1. Jasprit Singh, Electronic and optoelectronic properties of semiconductor structures, Cambridge University Press, 2007.
2. P. K. Mallick. Fiber-Reinforced Composites. CRC Press, 2008.
3. V. Raghavan, 2003, Materials Science and Engineering, 4th Edition, Prentice- Hall India, New Delhi(For units 2,3,4 and 5)
4. G.K. Narula, K.S. Narula and V.K. Gupta, 1988, Materials Science, Tata McGraw-Hill
5. M. Arumugam, 2002, Materials Science, 3rd revised Edition, Anuratha Agencies

REFERENCE BOOKS

1. B. S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday. Textbook of Nanoscience and Nanotechnology. Springer- Verlag, 2012.
2. K. Yamauchi, I. Ohkata, K. Tsuchiya and S. Miyazaki (Eds). Shape Memory and Super Elastic Alloys: Technologies and Applications. Wood head Publishing Limited, 2011.
3. Lawrence H. Van Vlack, 1998. Elements of Materials Science and Engineering, 6th Edition, Second ISE reprint, Addison-Wesley.
4. H. Iabch and H. Luth, 2002, Solid State Physics – An Introduction to Principles of Materials Science, 2nd Edition, Springer.
5. D. Hull & T. W. Clyne, An introduction to composite materials, Cambridge University Press, 2008.

WEB SOURCES

1. https://onlinecourses.nptel.ac.in/noc20_mm02/preview
2. https://nptel.ac.in/courses/112104229
3. https://archive.nptel.ac.in/courses/113/105/113105081
4. https://nptel.ac.in/courses/113/105/113105025/
5. https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_(Materials_Science)/Electronic_Properties/Lattice_Vibrations

ARTIFICIAL INTELLIGENCE FOR PHYSICS

Elective - VI **II YEAR - THIRD SEMESTER**

UNIT I: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

History and evolution of AI - Types of AI: Narrow AI - General AI - Machine Learning - Deep Learning - Supervised and unsupervised learning - Neural networks - Key algorithms: Linear regression, decision trees, clustering, and classification.

UNIT II: DATA ANALYSIS IN PHYSICS

Experimental physics and large data sets - particle accelerators - astronomical observatories - noisy data - filtering - cleaning and normalizing data - dimensionality reduction.

UNIT III: MACHINE LEARNING ALGORITHMS FOR PHYSICS DATA

Regression and classification in physical systems - decision trees - random forests - support vector machines (SVM) - Cross-validation, bias-variance – trade off - overfitting - Loss functions and optimization techniques.

UNIT IV: NEURAL NETWORKS AND DEEP LEARNING FOR PHYSICS

Introduction to Convolutional Neural Networks (CNN) - Recurrent Neural Networks (RNN) - Training deep networks using backpropagation - deep learning in image analysis, time-series data, and physics-based predictions - Particle collision prediction in high-energy physics - Image recognition in astrophysics.

UNIT V: MATERIAL SCIENCE AND CONDENSED MATTER PHYSICS

Predicting material properties using machine learning - High-throughput screening of new materials - Spin models, phase transitions, and AI approaches - AI for simulating electron interactions and lattice dynamics - black hole imaging - quantum simulations.

BOOKS FOR REFERENCE:

1. Christopher M. Bishop, *Pattern Recognition and Machine Learning*,
2. Yoshua Bengio, and Aaron Courville, *Deep Learning by Ian Goodfellow*,
3. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*,
4. Ray LaFlamme, *Introduction to Quantum Computing*,
5. R. C. V. K. Rao, *Computational Physics: Fortran and C*,

WEBSITES AND LEARNING SOURCES:

1. https://link.springer.com/article/10.1007/s10462-024-10874-4
2. https://medium.com/@irshadhuzaifa/unlocking-the-cosmos-how-artificial-intelligence-is-transforming-physics-b49e248d04cdhttps://news.mit.edu/2024/scientists-use-generative-ai-complex-questions-physics-0516
3. https://www.fz-juelich.de/en/news/archive/announcements/2024/ai-as-a-physicist
4. https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/06/artificial-intelligence-in-science_4f3d6efd/a8d820bd-en.pdf

PRACTICAL – III MICROPROCESSOR 8085, MICROCONTROLLER 8051 AND C++ PROGRAMMING EXPERMENTS

Core Practical - III **II YEAR - THIRD SEMESTER**

(Any Eighteen experiments without omitting any part)

MICROPROCESSOR (8085)

1. 16 bit Addition, Subtraction, Multiplication and Division.
2. Number conversion: (i) BCD to Binary (ii) Binary to BCD (iii) ASCII to HEX (iv) HEX to ASCII using 8085.
3. Ascending and descending order of numbers.
4. Square and square root of a given number.
5. Factorial of a given number and largest and smallest number in a set of numbers.
6. ADC and DAC Interfacing.
7. Digital Thermometer.
8. Stepper Motor Interface.
9. Traffic Light Control Interface.
10. Digital Clock.

MICROCONTROLLER (8051)

1. 16 bit Addition, Subtraction, Multiplication and Division.
2. Generation of square, triangular, saw tooth, staircase and sine waves.
3. DC Motor Control Interface.
4. HEX key board Interface.
5. Switching an array of LED'S.

C++ PROGRAMMING

1. Matrix addition, subtraction and multiplication.
2. Eigen values of a given matrix.
3. Transpose and inverse of a matrix.
4. Evaluating a root of non - linear equation by Newton - Raphson method.
5. Solution of simultaneous equations.
6. Straight line fit using the method of least squares.
7. Exponential fit using the method of least squares.
8. Newton's and Lagrange's Interpolation.
9. Numerical integration by Simpson's rule and Trapezoidal rule.
10. Solution of Differential equation by Fourth order Runge - Kutta Method.

TEXT BOOKS

1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata McGraw Hill Publications (2008).
2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).
3. V.Vijayendran, 2005, Fundamentals of Microprocessor-8085, 3rd Edition, S. Visvanathan Pvt, Ltd.
4. The 8085 Microprocessor, Architecture, Programming and Interfacing – K. Udaya Kumar, S. Uma Shankar, Pearson.
5. Fundamentals of Microprocessors and Microcontrollers - B. Ram, DhanpatRai Publications.

REFERENCE BOOKS

1. W. A. Tribel, Avtar Singh, The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications, Prentice-Hall of India, New Delhi.
2. Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications
3. Microprocessor Architecture, Program And Its Application With 8085 - R.S. Gaonkar, New Age International (P) Ltd
4. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi.
5. J.Uffrenbeck, The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications, Prentice-Hall of India, New Delhi.

SOLAR ENERGY AND UTILIZATION

Non Major Elective - II **II YEAR – THIRD SEMESTER**

UNIT I: HEAT TRANSFER & RADIATION ANALYSIS

Conduction, Convection and Radiation – Solar Radiation at the earth‘s surface - Determination of solar time – Solar energy measuring instruments.

UNIT II: SOLAR COLLECTORS

Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.

UNIT III: SOLAR HEATERS

Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.

UNIT IV: SOLAR ENERGY CONVERSION

Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo - electric conversion - process flow of silicon solar cells- different approaches on the process- texturization, diffusion, Antireflective coatings, metallization.

UNIT V: NANOMATERIALS IN FUEL CELL APPLICATIONS

Use of nanostructures and nanomaterials in fuel cell technology - high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of Nano technology in hydrogen production and storage.

Industrial visit – data collection and analysis - presentation

TEXT BOOKS

1. Solar energy utilization -G.D. Rai –Khanna publishers – Delhi 1987.
2. Maheshwar Sharon, Madhuri Sharon, Carbon ―Nano forms and Applications‖, McGraw-Hill, 2010.
3. Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems‟, Academic Press, London, 2009.
4. Tiwari G.N, ―Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
5. Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

REFERENCE BOOKS

1. Energy – An Introduction to Physics – R.H.Romer, W.H.Freeman, 1976.
2. Solar energy thermal processes – John A.Drife and William. 1974.
3. John W. Twidell & Anthony D.Weir, Renewable Energy Resources, 2005.
4. John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, John Wiley and Sons, 2013.
5. Duffie, J.A., Beckman, W.A., Solar Energy Thermal Process, John Wiley and Sons, 2007.

WEB SOURCES

1. https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb
2. https://books.google.vg/books?id=l-XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read
3. www.nptel.ac.in/courses/112105051
4. www.freevideolectures.com
5. http://www.e-booksdirectory.com

NUCLEAR AND PARTICLE PHYSICS

Core Paper-10 **II YEAR - FOURTH SEMESTER**

UNIT I: NUCLEAR MODELS

Liquid drop model – Weizacker mass formula – Isobaric mass parabola –Mirror Pair - Bohr Wheeler theory of fission – shell model – spin-orbit coupling – magic numbers – angular momenta and parity of ground states – magnetic moment – Schmidt model – electric Quadrapole moment - Bohr and Mottelson collective model – rotational and vibrational bands.

UNIT II: NUCLEAR FORCES

Nucleon – nucleon interaction – Tensor forces – properties of nuclear forces – ground state of deuteron – Exchange Forces - Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering – effective range theory – spin dependence of nuclear forces - charge independence and charge symmetry – isospin formalism.

UNIT III:NUCLEAR REACTIONS

Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – four factor formula.

UNIT IV: NUCLEAR DECAY

Beta decay – Continuous Beta spectrum – Fermi theory of beta decay - Comparative Half-life – Fermi Kurie Plot – mass of neutrino – allowed and forbidden decay — neutrino physics – Helicity - Parity violation - Gamma decay – multipole radiations – Angular Correlation - internal conversion – nuclear isomerism – angular momentum and parity selection rules.

UNIT V: ELEMENTARY PARTICLES

Classification of Elementary Particles – Types of Interaction and conservation laws – Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks –SU (2) and SU (3) groups-Gell Mann matrices– Gell Mann Okuba Mass formula-Quark Model. Standard model of particle physics – Higgs boson.

TEXT BOOKS

1. D. C. Tayal – Nuclear Physics – Himalaya Publishing House (2011).
2. K. S. Krane – Introductory Nuclear Physics – John Wiley & Sons (2008).
3. R. Roy and P. Nigam – Nuclear Physics – New Age Publishers (1996).
4. S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011).
5. S. Glasstone – Source Book of Atomic Energy – Van Nostrand Reinhold Inc.,U.S.- 3rd Revised edition (1968).

REFERENCE BOOKS

1. L. J. Tassie – The Physics of elementary particles – Prentice Hall Press (1973).
2. H. A. Enge – Introduction to Nuclear Physics – Addison Wesley, Publishing Company. Inc. Reading. New York, (1974).
3. Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002).
4. Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001).
5. B.L. Cohen, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.

WEB SOURCES

1. http://bubl.ac.uk/link/n/nuclearphysics.html
2. http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdfhttp://www.scholarpedia.org/article/Nuclear_Forces
3. https://www.nuclear-power.net/nuclear-power/nuclear-reactions/
4. http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.html
5. https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.html

NUMERICAL METHODS AND COMPUTER PROGRAMMING

Core Paper- 11 **II YEAR - FOURTH SEMESTER**

UNIT I: SOLUTIONS OF EQUATIONS

Zeros of polynomials –Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods – Convergence of solutions in Bisection and Newton-Raphson methods – Limitations of Bisection and Newton-Raphson methods.

UNIT II: LINEAR SYSTEM OF EQUATIONS

Simultaneous linear equations and their matrix representation – Gauss elimination method – Gauss-Jordan method – Inverse of a matrix by Gauss elimination method - Eigen values and eigen vectors of matrices – Direct method - Power method and Jacobi Method to find the Eigen values and Eigen vectors.

UNIT III: INTERPOLATION AND CURVE FITTING

Interpolation with equally spaced points - Newton forward and backward interpolation - Interpolation with unevenly spaced points - Lagrange interpolation – Curve fitting – Method of least squares – Fitting a polynomial.

UNIT IV: SOLUTION OF DIFFERENTIAL AND INTEGRAL EQUATIONS

Numerical differentiation – Forward difference, Backward Difference, Finite Different Operators. Numerical integration – Trapezoidal rule – Simpson‘s rule – Error estimates – Solution of ordinary differential equations – Euler and Runga- Kutta methods.

UNIT V: PROGRAMMING WITH 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, Solution of first order differential equations by Euler‘s method.

TEXT BOOKS

1. V. Rajaraman, 1993, Computer oriented Numerical Methods, 3rd Edition. PHI, New Delhi.
2. M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi.
3. S. S. Sastry, Introductory Methods of Numerical analysis, 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, 1992, Numerical Recipes in FORTRAN, 2nd Edition, Cambridge Univ. Press.

REFERENCE BOOKS

1. S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis-an algorithmic approach, 3rd Edition, McGraw Hill.
2. B. F. Gerald, and P. O. Wheatley, 1994, Applied Numerical analysis, 5th Edition, Addison-Wesley, MA.
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.
5. V. Rajaraman, Programming in FORTRAN / Programming in C, PHI, New Delhi.

WEB SOURCES

1. https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-V-RajaRaman
2. https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/referencespapers.aspx?referenceid=1682874
3. https://nptel.ac.in/course/122106033/
4. https://nptel.ac.in/course/103106074/
5. https://onlinecourses.nptel.ac.in/noc20_ma33/preview

COMMUNICATION ELECTRONICS

Skill Enhancement Course -II **II YEAR –FOURTH SEMESTER**

UNIT I: ANTENNAS AND WAVE PROPAGATION

Radiation field and radiation resistance of short dipole antenna-grounded antenna-ungrounded antenna-antenna arrays-broadside and end side arrays-antenna gain-directional high frequency antennas-sky wave-ionosphere- Ecles and Larmor theory- Magnento ionic theory-ground wave propagation.

UNIT II: MICROWAVES

Microwave generation—multi cavity Klystron-reflex klystron-magnetron travelling wave tubes (TWT) and other microwave tubes-MASER-Gunn diode-wave guides-rectangular wave guides- standing wave indicator and standing wave ratio(SWR).

UNIT III: RADAR AND TELEVISION

Elements of a radar system-radar equation-radar performance Factors radar transmitting systems- radar antennas-duplexers-radar receivers and indicators-pulsed systems-other radar systems- colour TV transmission and reception-colour mixing principle-colour picture tubes- Delta gun picture tube-PIL colour picture tube-cable TV, CCTV and theatre TV.

UNIT IV: OPTICAL FIBER

Propagation of light in an optical fibre-acceptance angle-numerical aperture-step and graded index fibres-optical fibres as a cylindrical wave guide-wave guide equations-wave guide equations in step index fibres - fibre losses and dispersion-applications.

UNIT V: SATELLITE COMMUNICATION

Orbital satellites-geostationary satellites-orbital patterns-satellite system link models-satellite system parameters-satellite system link equation link budget-INSAT communication satellites.

TEXT BOOKS

1. Hand book of Electronics, Gupta and Kumar, 2008 edition.
2. Electronic communication systems – George Kennedy and Davis, Tata McGraw Hill, 4th edition, 1988.
3. Taub and Schilling, principles of communication systems, second edition, Tata Mc Graw Hill, 1991.
4. M. Kulkarani, Microwave and radar engineering, Umesh Publications, 1998.
5. Mono Chrome and colour television, R. R. Ghulathi, Prabhat Prakasan, 1990.

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1. Electronic communications, Dennis Roody and Coolen, Prentice Hall of India, IV edition, 1995.
2. Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall of India, 1998.
3. Dennis Roddy and Coolen, 1995, *Electronics communications*, Prentice Hall of India IV Edition.
4. Wayne Tomasi, 1998 *"Advanced Electronics communication System"* 4th edition, Prentice Hall of India, 1998.
5. S. Salivahanan, N. Suersh Kumar & A. Vallavaraj, 2009, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition.

WEB SOURCES

1. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
2. https://www.polytechnichub.com/difference-analog-instruments-digital-instruments/
3. http://nptel.iitm.ac.in/
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5. http://nptel.iitm.ac.in/

PROJECT WITH VIVA VOCE

Core Paper 12 **II YEAR -FOURTH SEMESTER**

Each candidate shall be required to take up a research project under the supervision of the qualified teachers in the department. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the student in the beginning of the final year. At the end of fourth semester student should submit project report on or before the date fixed by the University. The Project will be evaluated by the project Guide as an internal examiner and an external examiner nominated by the University. The viva – voce examination will be conducted to assess the knowledge of the candidate and the results of the title of the project. The candidate concerned will have to defend his/her Project through a Viva-voce.

ASSESSMENT /EVALUATION /VIVA-VOCE:

DISTRIBUTION OF MARKS:

I. Assessment of the Project (CIA) : 25 Marks

II. Evaluation of the Project report : 50 Marks

III. Viva voce examination: : 25 Marks

Total : 100 Marks

I. ASSESSMENT OF THE PROJECT (Internal):

a) Plan of the project submission : 20 Marks

b) Individual Initiative : 05 Marks

Total : 25 Marks

II. EVALUATION OF THE PROJECT REPORT (Internal and External):

a) Execution of the Plan/Collection of Data/ Organisation of Materials / Presentation of the report /Novelty of the project : 40 Marks

b) Presentation of project in state level/National level Seminar / Publication : 10 Marks

Total : 50 Marks

III. VIVA VOCE EXAMINATION (Internal and External) :

Preparation, Presentation of work and response to questions : 25 Marks

A candidate shall be declared to have passed in the Project work if he/she gets not less than 50% in each of the Project Report and Viva-voce and also not than 50% in the aggregate of both the marks for Project Report and Viva-voce.

A candidate who gets less than 50% in the Project must resubmit the Project Report. Such candidates need to defend the resubmitted Project at the Viva-voce when the date fixed by the University.

MODEL QUESTION PAPER PATTERN

M.Sc., PHYSICS DEGREE EXAMINATION

SEMESTER : III

TITLE OF THE PAPER CONDENSED MATTER PHYSICS

Time : 3 Hours **Maximum Marks : 75**

Part – A (15 x 1 = 15 Marks)
Answer All Questions

1. Miller indices for octahedral plane in cubic crystal _____
   a. (100) b. (110) c. (111) d. (101)

2. The Bragg's angle theta is fixed in _____
   a. Roentgen diffraction method b. Debye-Scherrer's diffraction method
   c. Laue diffraction method d. All of the above3.In

3. In the BCC structure, the packing fraction is _____
   a. 0.068 b. 0.68 c. 6.8 d. None of the these

4. The effective number of lattice points in a primitive unit cell is_____
   a. one b. two c. zero d. four

5. The Total number of states in first Brillouin zone of one-dimensional crystal of length L willbe (a-distance between lattice points)
   a. L/a b.$2L^2/a$ c. L^2/a d. La

6. In Debye's theory of specific heat of solids, the frequency of vibrations of lattice has_____
   a.continuous spectrum up to a finite value b. Some discrete value
   c. Fixed value d. None of these

7. The Widemann-Franz law connects the
   a. Thermal conductivity and electrical conductivity of a material
   b. Thermal conductivity and specific heat of a material
   c. Thermal intertia and specific heat of a material
   d. None of the above

8. In a good conductor, the energy gap between the conduction band and the valance band is_____
   a. infinite b. wide c. narrow d. zero

9. Which of the following quantities cannot be measured using Hall Effect?

a. Mobility of change caviers b. Carrier concentration
c. Type of semiconductors (p or n) d. Diffusion constant

10. For paramagnetic materials, magnetic susceptibility (X) is_____

a. Positive & small b. Negative & small
c. Negative & large d. Positive & large

11. Which one of the following is not a ferromagnetic material?

a. Cobalt b. Iron c. Nickel d. Bismuth

12. Curie-Weiss law is_____

a. $X_m = C/T$ b. $X_m = C/\Theta$.

c. $X_m = C/(T- \Theta)$ d. $X_m = CT$

13. Energy band gap of an insulting material is_____

a. 0 eV b. greater than 5 eV c. less than 5eV d. none14.The

London equation in a super conductor is__

a. $\nabla^2 B = B (m c^2) / (4 \pi n q^2)$

b. $\nabla^2 B = B (m c^2) / (4 \pi n q^2)^{1/2}$

c. $\nabla^2 B = B (m c^2) / (4 \pi n q^2)^2$

d. $\nabla B = B (m c^2) / (4 \pi n q^2)$

15. SQUIDS are used to measure_____associate with brain and chest.

a. Power b. Energy c. Stress d. Voltages

Part-B (2x5=10Marks)
Answer Any Two Questions

16. What are miller indices? Illustrate with examples.

17. What is Phonon? Derive an expression for phonon momentum.

18. Explain the Widemann-Franz law.

19. Explain the Quantum theory of Ferromagnetism.

20. Describe the Meissner effect. Mention the applications of Superconductors.

Part-C (5x10=50Marks)
Answer All the Questions

21. a). Derive Bragg's law. Describe and explain X-ray spectrometer method of determining the wavelength of X-rays.

(or)

b). Write a detail note on inert gas crystals?

22. a). What are Brillouin Zones? Describe and give the sketches of the first Brillouin zonesof BCC & FCC lattices.

(or)

b). What is Umkalpp Phonon process? Give the importance of V-process in explainingthe thermal conductivity in non-metallic solids.

23. a). Discuss Kronig-penney model for a linear lattice. How does it lead to the formationof energy bands in solids?

(or)

b). Give an account of the de Hass-van Alphen effect. Explain how it provides a Powerful method for the study of Fermi surface.

24. a). Discuss Quantum theory of Para magnetism.

(or)

b). Give thedetails of Ferromagneticdomains and its types.

25. a). Give the qualitative description of the BCS theory. How does it account for the superconducting state?

(or)

b) Write notes on following:

i. DC Josepson effect.

ii. AC Josepson effect.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE EXAMINATION
SEMESTER : IV

CORE PAPER - 12 NUCLEAR AND PARTICLE PHYSICS

Time : 3 Hours **Maximum Marks : 75**

Part – A (15 x 1 = 15 MARKS)

Answer All Questions

1. Which of the following explain the process of Nuclear-Fission?

(a) Liquid drop model (b) Proton-proton cycle

(c) Independent particle model of the nucleus (d) Somerfield model

2. An isotope without any neutron is

(a) Tritium (b) Deuterium (c) Protium (d) None of these

3. How many neutrons are in the $_{11}Na^{23}$ atom?

(a) 12 (b) 11 (c) 18 (d) 24

4. Which of the following is correct for the nuclear force?

(a) Nuclear forces are charge independent

(b) Nuclear forces are the central force

(c) Both 1 and 2

(d) None of these

5. What is the force that bind proton and neutrons in a nucleus?

(a) Electromagnetic force (b) Weak force

(c) Gravitational force (d) Strong nuclear force

6. According to yukawa‘s theory of nuclear forces, the origin of nuclear force between nucleons is due to the exchange of

(a) mesons (b) protons (c) electrons (d) None of these

7. The mass number of an element is not changed, when it emits_____radiations.

(a) □ & □ (b) □, □ & □ (c) □ & □ (d) □ & □

8. 1 amu is equivalent to?

(a) 931 Mev (b) 93.1 ev (c) 9.31 ev (d) 931 J

9. What type of reaction takes place in sun?

(a) Nuclear fusion (b) Nuclear fission

(c) Spontaneous fission (d) Double beta decay

10. A free neutrons decays spontaneously into proton, an electron and _____

(a) A neutrino (b) An antineutrino (c) Both (d) None of these

11. The decay of the proton to neutron is

(a) Not possible as proton mass is less than the neutron mass.

(b) Possible only inside the nucleus

(c) Always possible as it is associated only with β^+ decay

(d) Not possible

12. The unit of Radioactivity

(a) Becqueral (b) Gauss (c) Kelvin (d) Newton

13. An antiproton is an atomic particle that has

(a) the mass of a proton and the charge of an electron

(b) the mass of an electron and the charge of a proton

(c) the mass of a neutron and charge of a proton

(d) None of these

14. The quark model content of neutron is

(a) uud (b) uuu (c) udd (d) ddd

15. Which of the following is not Bosons?

(a) Pion (b) Photon (c) muon (d) None of these

Part – B (2x 5 = 10 Marks)
Answer any two questions out of Five

16. Explain the weizacker mass formula.

17. Explain the meson theory of nuclear forces.

18. Explain the Reciprocity theorem.

19. Explain the nuclear isomerism.

20. Explain the four types of interactions.

Part – C (5x10=50Marks)
Answer all questions

21. a) Explain in detail about the liquid drop model.

(or)

b) Explain in detail about the shell model.

22. a) Explain the ground state of deuteron.

(or)

b) Explain the nucleon-nucleon interaction.

23. a) Explain the Breit wigner one level formula

(or)

b) Explain the nuclear chain reaction.

24. a) Explain in detail about Fermi theory of □ decay.

(or)

b) Explain the allowed and forbidden decay.

25. a) Explain the classification of elementary particles.

(or)

b) Explain in detail about Quark model for Baryons and mesons.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE PRACTICAL EXAMINATIONS
SEMESTER : I

TITLE OF THE PAPER PRACTICAL I – GENERAL PHYSICS EXPERIMENTS

Time : 3 Hours **Maximum Marks : 75**

1. Determine the Young‘s modulus of glass plate and Poisson‘s ratio of the given glass plate by forming Elliptical fringes.
2. Determine (i). Thickness of a wire (ii). Diameter of a circular aperture and (iii) Wavelength of He-Ne Laser/Diode laser using diffracting grating.
3. Determine the Refractive index of two liquids using Laser.
4. Determine the value of Refractive index of a liquid using Biprism.
5. Determine (i) the thickness of Fabry-Perot Etalon (ii)the change in wavelength for shift of one fringe and (iii)the change in wavelength of a satellite line associated with a main line.
6. Determine the wavelength of the given monochromatic source using Michelson‘s Interferometer.
7. Determine the velocity of Ultrasonic waves in the given liquid using Ultrasonic Interferometer. Also determine the compressibility of the given liquid. Also determine the Compressibility of the given liquid.
8. Calculate the Charge of an Electron using Spectrometer.
9. Determine the following using Hall effect in Semiconductor:(i). Charge of the carriers (ii).Hall voltage (iii).Hall Coefficient (iv).Carrier density.
10. Determine the band gap energy and temperature coefficient of a thermistor.
11. Determine the Absorption coefficient using GM Counter.
12. Using the given experimental setup, determine the value of Stefan's constant.
13. Determine the magnetic susceptibility of the given liquid by Guoy‘s method.
14. Determine the resistivity of a Semiconductor by Four Probe Method.
15. Using Quincke‘s method, determine volume susceptibility and mass susceptibility of a paramagnetic solution.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE PRACTICAL EXAMINATIONS
SEMESTER : II

TITLE OF THE PAPER **PRACTICAL II - ANALOG AND DIGITAL EXPERIMENTS**

Time : 3 Hours **Maximum Marks : 75**

1. Construct adder, subtractor, differentiator and integrator circuit using the given OP-AMP and verify its outputs.
2. Construct an FET amplifier circuit, based on its output draw the characteristiccurve.
3. Construct a monostable multivibrator using IC 555 and measure the pulse width for different R and C values. Also, Construct and study the behaviour of bistable multivibrator using IC 555 timer.
4. Study the Voltage–Ampere characteristic curve of the Tunnel Diode.
5. Obtain the Voltage–Ampere characteristic curve of the UJT and hence calculate the intrinsic stand-off ratio.
6. Construct a single and multistage RC coupled amplifier and study its frequencyresponse.
7. Construct an astable multivibrator using IC 555 and study its operation.
8. Study the operation and characteristics of SCR and determine the forward breakover voltage.
9. Construct a multiplexer and demultiplexer circuits and verify their truth tables.
10. Using NAND gates, construct a half-adder and full-adder circuit and verify itsoutputs.
11. Using IC 7476, construct a Shift register and verify its truth table.
12. Construct the half adder and full adder circuits using NAND gates.
13. Construct the BCD counter circuit and verify its operation.
14. Construct Flip flops – RS, JK, Master Slave and T flip flops and study theirperformance.
15. Construct a decimal to BCD encoder using IC 7432 OR gates and study itsperformance.

MODEL QUESTION PAPER PATTERN
M.Sc., PHYSICS DEGREE PRACTICAL EXAMINATIONS
SEMESTER : III

TITLE OF THE PAPER PRACTICAL III - MICROPROCESSOR 8085 MICROCONTROLLER 8051 AND C++ PROGRAMMING

Time : 3 Hours **Maximum Marks : 75**

1. Write an ALP to find (i).square of a given number (ii).square root of given number.
2. Write a program to convert ASCII to HEX using microprocessor 8085 and store their results in the desired locations.
3. Write and execute the program for sum of _n' numbers using 8085 microprocessor.
4. Write and execute the program to find out ascending and descending order of numbers.
5. Write and execute the programs for interfacing of DAC with 8085 microprocessors to generate square, saw tooth and triangular waves.
6. Write and execute the program for largest and smallest number in a set of numbers.
7. Write an assembly language program to interface the stepper motor using microprocessor8085 and verify the function of the stepper motor.
8. Write an assembly language program to interface the water level detector using microprocessor 8085 and verify the function of the water level detector.
9. Write and execute the 8 bit Multiplication and Division programs in 8085 microprocessor.
10. Write an assembly language program to determine the factorial of a given number using microprocessor 8085 and store the results in the desired locations.
11. Write and execute the program for largest and smallest number in a set of numbers**.**
12. Write and execute the 16-bit Multiplication and Division programs in 8051 microprocessor.
13. Write and execute the program for searching a number or character in a string.
14. Write and execute the program to count number of vowels in a given string.
15. Write and execute the program to determine the sum of elements in an array.
16. Write and execute the program for Timer and Counter programming using Microcontrollers
17. Write a C++ programme to find the straight line fit by the method of least squares.
18. Write a C++ programme to find the transpose and inverse of a matrix.

19. Write a C++ programme to find the solution of differential equation by Fourth order Runge- Kutta Method

20. Write a C++ Programme to find Newton‘s (Forward/backward difference) and Lagrange‘s Interpolation.

21. Write a C++ Programme for calculation of standard deviation of a given range.