ANNAMALAI UNIVERSITY
MASTER OF SCIENCE
M.Sc. Physics
(With effect from 2021– 2022)

The Course of Study and the Scheme of Examination

Sl. No.	*Study Components* / *Course Title*		*ins. hrs / week*	*Credit*	*Title of the Paper*	*Maximum Marks*		
						CIA	*Uni. Exam*	*Total*
SEMESTER I								
1.	Core-Theory	Paper-1	5	4	Mathematical Physics - I	25	75	100
2.	Core-Theory	Paper-2	5	4	Classical and Statistical Mechanics	25	75	100
3.	Core-Theory	Paper-3	5	4	Quantum Mechanics - I	25	75	100
	Core-Practical	Paper-1	4	0	General Practical	0	0	0
	Core-Practical	Paper-2	4	0	Electronics Practical	0	0	0
Internal Elective for same major students (Choose any one)								
4.	**Core Elective**	**Paper-1**	4	3	(to choose one out of 3) A. Electronic Devices and Applications B.Fiber Optic Communication C. Electronics Communication Systems	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
5.	**Open Elective**	**Paper-1**	3	3	(to choose one out of 3) A.Energy Physics B.Basic Physics C. Communication Physics	25	75	100
			30	**18**		**125**	**375**	**500**
SEMESTER II						*CIA*	*Uni. Exam*	*Total*
6.	Core-Theory	Paper-4	5	4	Mathematical Physics - II	25	75	100
7.	Core-Theory	Paper-5	5	4	Electro Magnetic Theory	25	75	100
8.	Core-Theory	Paper-6	4	4	Quantum Mechanics - II	25	75	100
9.	Core-Practical	Paper-1	4	4	General Practical	25	75	100
10.	Core-Practical	Paper-2	4	4	Electronics Practical	25	75	100
Internal Elective for same major students (Choose any one)								
11.	Core Elective	Paper-2	3	3	(to choose one out of 3) A. Nanoscience B.Electronics Instrumentation C. Non- linear optics	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
12.	**Open Elective**	**Paper-2**	3	3	(to choose one out of 3) A. Spectroscopy and Lasers B. Physics for Competitive Exams C. Analog and Digital Electronics	25	75	100
13.	***Field Study**		-	2		100	-	100

14.	**Compulsory Paper**		2	2	**Human Rights & Duties**	25	75	100
			30	**30**		**300**	**600**	**900**
SEMESTER III						***CIA***	***Uni. Exam***	***Total***
15.	Core-Theory	Paper-7	5	5	Condensed Matter Physics	25	75	100
16.	Core-Theory	Paper-8	4	5	Nuclear Physics	25	75	100
17.	Core-Theory	Paper-9	4	4	Microprocessors and Microcontrollers	25	75	100
	Core-Practical	Paper-3	5	-	Advanced General Experiments	0	0	0
	Core-Practical	Paper-4	5	-	Programming& Problem solving skills	0	0	0
Internal Elective for same major students								
18.	Core Elective	Paper-3	4	3	(to choose one out of 3) A. Research methodology B. Material Science C. Numerical Methods and C programming	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
19.	Open Elective	Paper-3	3	3	(to choose one out of 3) A. Electrical and Electronics Appliances B. Physics of Materials C. Geophysics	25	75	100
20.	****MOOC Courses**		-	-	Choose any two courses from the list given	0	0	100
			30	**20**		**125**	**375**	**600**
SEMESTER IV						***CIA***	***Uni. Exam***	***Total***
21.	Core-Theory	Paper-10	6	3	Spectroscopy	25	75	100
22.	Core-Practical	Paper-3	5	4	Advanced General Experiments	25	75	100
23.	Core-Practical	Paper-4	5	4	Programming & Problem solving skills	25	75	100
24.	**Core**	**Project**	5	5	Project with viva voce (Compulsory)	100 (75 Project +25 viva)		100
Internal Elective for same major students								
25.	**Core Elective**	**Paper-4**	**6**	3	(to choose one out of 3) A. Crystal Growth and Thin Films B. Medical Physics C. MATLAB and Python Programming	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
26.	**Open Elective**	**Paper-4**	3	3	(to choose one out of 3) A. Nanophysics B. Astrophysics C. Weather forecasting	25	75	100
			30	**22**		**125**	**475**	**600**
			120	**90**				**2600**

*** Field Study**

There will be field study which is compulsory in the first semester of all PG courses with 2 credits. This field study should be related to the subject concerned with social impact. Field and Topic should be registred by the students in the first semester of their study along with the name of a mentor before the end of the month of August. The report with problem identification and proposed solution should be written in not less than 25 pages in a standard format and it should be submitted at the end of second semester. The period for undergoing the field study is 30 hours beyond the instructional hours of the respective programme. Students shall consult their mentors within campus and experts outside the campus for selecting the field and topic of the field study. The following members may be nominated for confirming the topic and evaluating the field study report.

(i). Head of the respective department
(ii). Mentor
(iii). One faculty from other department

****Mooc Courses**
Inclusion of the Massive Open Online Courses (MOOCs) with zero credits available on SWAYAM, NPTEL and other such portals approved by the University Authorities.

Annamalai University, Annamalainagar - 608002
M.Sc. Physics

CORE PAPER-1

Name of the course/subject: M.Sc Physics **Semester: I**
Name of the Paper: Mathematical Physics-I **Credits:4**
Hours of teaching:5 **Paper type: Core**

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Course Objectives

1. To acquire the knowledge about linear vector spaces and matrices.
2. To learn the new aspects of tensors.
3. To teach the concept of differential equations.
4. To impart the knowledge about special functions.
5. To study the fundamentals of Dirac-Delta and Green's functions.

UNIT-1: Linear Vector Spaces and Matrices

Linear Vector Spaces explanation- Examples of linear vector spaces-Linear independence of vectors and dimension – Basis and expansion theorem-Inner products and unitary spaces-Orthonormal sets- Schwarz inequality -Schmidt orthogonalization process- Solved examples-Matrices-Linear transformation-Orthogonal, unitary and similarity transformation-Eigen values, Eigen vectors-Characteristic equation of a matrix-Caley-Hamilton theorem with proof.

UNIT-2: Tensors

Introduction-Coordinate transformation– Indical and summation convention – Dummy and real indices-Kronecker delta symbol-Scalars, Contravariant, Covariant tensors – Tensors of higher ranks-Algebraic operations of Tensors-Addition and subtraction-Contraction of tensors-Inner product-Quotient law-Statement and example- Symmetric and anti-symmetric tensors - Invariant tensors -Levi-Civita Symbol.

UNIT-3: Differential Equations

Order and Degree of a differential equation-Linear differential equation of first order and its solution-Solution of Second order differential equation with constant coefficients- Singular points of differential equations-Self adjoint differential equation-Power series solution-Frobenius' method.

UNIT-4: Special Functions

Special functions – Legendre differential equation and polynomials-Generating functions--Recurrence formulae- Rodrigue's formula for Legendre polynomials-Orthogonal properties of Legendre polynomials- Bessel differential equation and polynomials-Generating functions-Recurrence formulae- for Bessel polynomials-Orthogonality of Spherical Besselfunctions-

HermiteDifferential equation and Polynomials-Generating function of Polynomials-Recurrence formulae-Rodrigue's formula for Hermite polynomials-Orthogonal properties of Hermite polynomialsLaguerre -Differential equation and Polynomials-Generating function of Polynomials-Recurrence formulae-Rodrigue's formula for Laguerre polynomials-Orthogonal properties of Laguerre polynomials.

UNIT-5: Dirac-Delta and Green's Functions

Dirac-Delta function-Properties of Delta function-Fourier and Laplace transform of Delta Function- Green's function Introduction- Green's function for one-dimensional case (solution of Sturm-Liouville equation)-Symmetry property of Green's function-Eigen function - expansion of the Green's function-Green's function for Three dimensional Helmhotz equation.

Text Books

Unit -I to Unit -V

1. Satyaprakash, Mathematical Physics with Classical Mechanics Sultan Chand & sons, New Delhi, 2016.

Reference Books

1. P.K. Chattopadhyay, Mathematical Physics, New Age International Publishers, New Delhi, 2016.
2. B.S. Rajput, Mathematical Physics, PragatiPrakashan, Meerut, 2009.
3. H.K. Dass, Dr. Rama Verma, Mathematical Physics, New Delhi, 2014.
4. B.D. Gupta, Mathematical Physics, Vikas publishing house 3rd Edition, New Delhi, 2006.
5. Schaum's Outline Series, (i) Vector and tensor analysis, (ii) Linear Algebra, (iii) Matrices, (iv) Differential Equations

E-Materials

1. http://web.mst.edu/~hale/courses/M402/M402_notes/M402-Chapter1/M402-Chapter1.Fall13b.pdf
2. https://www.youtube.com/watch?v=eeMJg4uI7o0
3. https://www.youtube.com/watch?v=v02D7C7js3g
4. https://www.youtube.com/watch?v=adXPC4HC6ck
5. https://www.youtube.com/watch?v=xNqLZnM-PPY
6. http://electron6.phys.utk.edu/qm1/modules/m4/Vector_space.htm
7. https://en.wikipedia.org/wiki/Tensor
8. https://www.youtube.com/watch?v=uaQeXi4E7gA
9. https://www.grc.nasa.gov/www/k-12/Numbers/Math/documents/Tensors_TM2002211716.pdf
10. http://www.physics.wm.edu/~finn/home/MathPhysics.pdf

Course Outcomes

1. After studied unit-1, the student will be able to explain linear vector spaces and matrices and can solve the problems.
2. After studied unit-2, the student will be able to describe tensors in detail.
3. After studied unit-3, the student will be able to solve the differential equations.
4. After studied unit-4, the student will be able to formulate the differential equations for special functions.
5. After studied unit-5, the student will be able to understand Dirac-Delta function, Introduction on Green functions and Green's function for one dimensional and three dimensional cases.

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CORE PAPER-2

Name of the course/subject: M.Sc Physics Semester: I
Name of the Paper: Classical and Statistical Mechanics Credits: 4
Hours of teaching: 5 Paper type: Core

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Course Objectives

1. To make learning of Classical Mechanics interesting and interesting
2. To teach and understand the Lagrangian and Hamiltonian formalisms and study their applications in mechanical systems and solving of problems.
3. To teach the theory of small oscillations and the Hamilton Jacobi
4. To teach and impart the knowledge associated with Rigid body dynamics
5. To teach Thermodynamics and Classical Statistics
6. To introduce Quantum Statistics and explain the theoretical backgrounds
7. To review the fundamental concepts of thermodynamics and to create an understanding of the principles of classical and quantum Statistical Mechanics and their applications.

UNIT-1: Lagrangian and Hamiltonian formalisms and canonical transformation

Lagrangian formalism: Constrains-classification-D-Alembert's principle-Lagrange's equation from D-Alembert's principle- Applications: Spherical pendulum,Cylinder rolling down an inclined plane.
Hamiltonian formalism: Cyclic coordinates and conservation theorem - Hamilton's equations –Hamilton's variational principle-Hamilton's equation of motion fromvariational principle-Applications:Linear harmonic oscillator and projectile in space.
Canonical transformations: Generating function- condition for a function to be canonical-simple example-Poisson's brackets-properties-Hamilton's equation of motion in Poisson's bracket-invariance of Poisson's bracket under canonical transformation.

UNIT-2:Hamilton - Jacobi Theory and Theory of Small Oscillations

Hamilton-Jacobi equations:Hamilton's characteristic function- Application to Linear harmonic oscillator problem - Action Angle variables –Action angle variable in a system of one degree of freedom-Application to Kepler's problem - Oscillatory motion: Theory of small oscillation - Linear triatomic molecule - Stability of Oscillatory motion - Forced Harmonic Oscillator.

UNIT-3: Rigid body dynamics

Rigid body motion: Degrees of freedom-independent coordinates-Orthogonal transformation-Euler's angles - Angular momentum and kinetic Energy – Moment of inertia tensor - Euler's equations of motion-Torque-free motion of a rigid body - Motion of a symmetrical top under the action of gravity -Precession and nutation.

UNIT-4: Thermodynamics and Classical statistics

Thermodynamic parameters – Thermodynamic potentials – Gibbs phase rule – First and second order phase transitions –Entropy – fluctuations and irreversible process - Random walk - Brownian motion - Langevin theory.

Classical Statistics: Postulates - Maxwell Boltzmann distribution- application to diatomic molecule - Phase space - ensembles - Micro Canonical, Canonical and Grand Canonical ensembles -Liouville theorem and its significance- Partition function and its thermo dynamical properties - Translational partition functions - Gibb's Paradox - Sackur- Tetrode equation.

UNIT-V: Quantum Statistics

Quantum Statistics of ideal gas - Ideas of Bose – Einstein-Bose-Einstein condensation of gases – liquid helium- Fermi-Dirac distribution- Degeneracy of gases - - Photon gas - Planck's law of radiation and its limitation - Thermionic emission - Pauli's theory of Para magnetism.

Text Books

Unit-1

1. SathyaPrakash and J.P Agarwal, Statistical Mechanics, 7th Edition, KedarNath and Ram Nath& Co, Meerut, 1994.
2. J.K.Bhattacharjee, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi, 1996.

Unit-2

1. Gupta Kumar Sharma, Classical Mechanics, PragatiPrakashan, Meerut, 2004.
2. SathyaPrakash and J.P Agarwal, Statistical Mechanics, 7th Edition, KedarNath and Ram Nath& Co, Meerut, 1994.
3. J.K.Bhattacharjee, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi, 1996.

Unit-3

1. SathyaPrakash and J.P Agarwal, Statistical Mechanics, 7th Edition, KedarNath and Ram Nath& Co, Meerut, 1994.
2. J.K.Bhattacharjee, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi, 1996.

Unit-4

1. S.N. Biswas, Classical Mechanics, Books and Allied Ltd., Kolkata, 1998.
2. Upadhyaya, Classical Mechanics, Himalaya Publishing Co., New Delhi, 1999.
3. Gupta Kumar Sharma, Classical Mechanics, PragatiPrakashan, Meerut, 2004.

Unit-5

1. B.K. Agarwal and M. Eisner, Statistical Mechanics, 2nd Edition, New Age International, New Delhi, 1998.
2. SathyaPrakash and J.P Agarwal, Statistical Mechanics, 7th Edition, KedarNath and Ram Nath& Co, Meerut, 1994.

Reference Items: books, Journal

1. H. Goldstein, Classical Mechanics. 3rd Edition. Pearson Education, Asia, New Delhi, 2002.
2. K. Huang, Statistical Mechanics, Wiley Eastern Ltd., New Delhi, 1975.
3. L.D. Landau and E.M. Lifshitz, Mechanics, Pergomon Press, Oxford, 1969.
4. K.R. Symon, Mechanics, Addison Wesley, London, 1971.
5. J.L. Synge and B.A Griffith, Principles of Classical Mechanics, Mc.Graw-Hill, NewYork, 1949.
6. C.R.Mondal, Classical Mechanics, Prentice - Hall of India, New Delhi.
7. L.P. Kadanoff, Statistical Physics - Statics, Dynamics and Renormalization, World Scientific, Singapore, 2001.
8. M. Glazer and J. Wark, Statistical Mechanics, Oxford University Press, Oxford, 2001.

E- Materials

1. http://www.freebookcentre.net/physics-books-download/Notes-On-Statistical-Mechanics-by-K.P.N.-Murthy.html
2. http://www.freebookcentre.net/physics-books-download/Statistical-Mechanics-by-Henri-J.F.-Jansen.html
3. http://www.freebookcentre.net/physics-books-download/Lecture-Notes,-Statistical-Mechanics.html
4. http://www.freebookcentre.net/physics-books-download/Classical-Mechanics-Lecture-Notes-byTom-Kirchner.html
5. http://www.atmosp.physics.utoronto.ca/~shahnas/Courses/Classical_Mech_Grad/Classical_Mech_Grad_Chap01.pdf
6. http://www.freebookcentre.net/physics-books-download/Classical-Mechanics-by-Eric-D-Hoker.html
7. http://hyperphysics.phy-astr.gsu.edu/hbase/quantum/disfd.html
8. https://www.youtube.com/watch?v=fdS12EaXH3A
9. https://www.youtube.com/watch?v=rDHQ60CXDbU
10. https://en.wikipedia.org/wiki/Statistical_ensemble_(mathematical_physics)

Course Outcomes

1. After studying unit-1, the student will
   havedepth knowledge about Lagrangian and solve problems in mechanical systems using Lagrangian formulation.
   Understand conservation theorems and its relevance in classical formulation.
   Learn Hamiltonian formulations and solve problems using Hamiltonian formulation.

2. After studying unit-2, the student will be able to
   Apply Hamilton's characteristic function to solve problems
   Understand Action Angle variables and solve one degree of freedom and Kepler's problem
   Acquire knowledge about oscillatory motion and stability of oscillatory motion

3. After studying unit-3, the student will
   have knowledge about fundamentals of rigid body motion.
   Explain Moment of inertia tensor.
   Derive and solve Euler's angles Euler's equations of motion.
   Able to solve problems on force free motion of a rigid body and symmetrical top.

4. After studying unit-4, the student will be able to
   Explain different statistical ensembles, their distribution functions, ranges of applicability and the corresponding thermodynamic potentials.
   Calculate basic thermo dynamical quantities in classical and quantum statistical models.
   Understand and solve problems on partition and translational partition function.

5. After studying unit-5, the student will be able to
   Apply quantum distribution laws and solve Bose-Einstein condensation of gases and Photon gas.
   Signify the results of Planck's law of radiation and its limitation.
   Explain Thermionic emission and Pauli's theory of Para magnetism.

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CORE PAPER-3

Name of the course/subject: M.Sc Physics **Semester: I**
Name of the Paper:Quantum Mechanics-1 **Credits: 4**
Hours of teaching:5 **Paper type: Core**

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Course Objectives

The primary objective is to teach the students the physical and mathematical basis of quantum mechanics for non-relativistic systems

UNIT-1:Basic formalism

Schrodinger equation – Max Born's interpretation of wave function – Normalisation, scattering states and bound states – admissibility conditions for a quantum mechanical wave function – Equation of continuity and conservation of probability – Time independent Schrodinger equation – stationary eigen states – particle in a box – square well potential – Rectangular potential Barrier – tunnelling.

UNIT-2: Abstract formulation of Quantum Mechanics

Mathematical properties of linear vector spaces – Dirac's bra and ket notation – Hermitian operators, eigenvalues and eigenvectors – Postulates of quantum mechanics. Position and momentum representations, connection with wave mechanics – Commuting operators – Generalised uncertainty principle. Change of basis and unitary transformation. Expectation values – Ehrenfest theorem.

UNIT-3: Quantum Dynamics

Schrodinger picture – Heisenberg picture – Heisenberg equation of motion, Classical limit. Solution of simple harmonic oscillator problem by the operator method – General view of symmetries and conservation laws.

UNIT-4: Symmetries in Quantum Mechanics

Hydrogen like atoms and spherical harmonics – Spatial translation, continuousand discrete, Time translation – Parity – Time reversal – Density matrices - properties, pureand mixed density matrices, expectation value of an observable, time-evolution, reduceddensity matrix

UNIT-5: Angular Momentum

Commutation relations of angular momentum operators – Eigenvalues, eigenvectors – Ladder operators and their matrix representations – Addition of angular momenta, Clebsch-Gordan coefficients – Wigner-Eckart theorem.

Text Books

Unit 1 to Unit 5

1. P. M. Mathews and K. Venkatesan, 1976, A Text book of Quantum Mechanics, Tata McGraw-Hill, New Delhi.
2. L. I. Schiff, 1968, Quantum Mechanics, 3rd Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo.
3. V. Devanathan, 2005, Quantum Mechanics, Narosa Publishing House, New Delhi.
4. G. Aruldhas, 2002, Quantum Mechanics, Prentice Hall of India, New Delhi.
5. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India.

Reference Books

1. E. Merzbacher, 1970, Quantum Mechanics 2nd edition, John Wiley and Sons, New York.
2. V. K. Thankappan, 1985, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi.
3. P. A. M. Dirac, 1973, The Principles of Quantum Mechanics, Oxford University Press, London.
4. L. D. Landau and E. M. Lifshitz, 1976, Quantum MechanicsPergomon Press, Oxford.
5. S. N. Biswas, 1999, Quantum Mechanics, Books And Allied Ltd., Kolkata.
6. J. S. Bell, Gottfried and M.Veltman, 2001, The Foundations of Quantum Mechanics World Scientific, Singapore.
7. R. P. Feynman, R. B. Leighton, and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 3, Narosa, New Delhi.
8. J.J. Sakurai, Modern Quantum Mechanics, Addison-Wesley, 1993

E-Materials

1. http://www.netsa.org.lk/OcwWeb/Physics/index.htm
2. http://www.theory.caltech.edu/people/preskill/ph229/
3. http://www.nscl.msu.edu/~pratt/phy851/lectures/lectures.html
4. http://walet.phy.umist.ac.uk/QM/LectureNotes/
5. http://www.ks.uiuc.edu/Services/Class/PHYS480/
6. http://www.mat.univie.ac.at/~gerald/ftp/book-schroe/index.html
7. http://people.deas.harvard.edu/~jones/ap216/lectures/lectures.html
8. http://www.netsa.org.lk/OcwWeb/Chemistry/5-73Introductory-Quantum-Mechanics-IFall2002/LectureNotes/index.htm
9. http://www.glue.umd.edu/~fivel/
10. http://www.phys.ualberta.ca/~gingrich/phys512/latex2html/phys512.html

Course Outcomes:

1. The interpretation of wave function of quantum particle and quantum theory formulation is introduced through Schrodinger equation, student gets exposed to the behaviour of quantum particle encountering a i) barrier, ii) potential well.
2. Understand the general formulation of quantum mechanics which deal with the abstract object such as kets, bras, and operators.
3. Acquire knowledge about unitary transformation and able to analyse Schrodinger and Heisenberg interaction pictures.
4. Gain the knowledge of solving non-relativistic hydrogen atom, expectation value and density matrix.
5. Gain the knowledge about spin, angular momentum states, addition rules and identical particles.

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COREELECTIVEPAPER- 1
(to choose 1 out of 3)

Name of the course/subject: M.Sc Physics **Semester: I**
Name of the Paper: A. Electronics Devices & Applications **Credits:3**
Hours of teaching: 4 **Paper type: Core Elective**

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Course Objectives

1. To introduce structures, physical operations and circuit applications of basic semiconductor devices and display devices.
2. To develop the ability to analyse and design electronic circuits and to grasp the basic ideas of op-amps and its applications.
3. To provide an exposure to the wide applications of logic families, optoelectronic devices, Operational amplifiers, 555 Timer and Phase Locked Loops.
4. To study the basics of transducers and its types.
5. To familiarize the basic principles and advantages of pulse and digital communications.

UNIT-1: Logic families and Opto electronic devices

Logic Families: TTL Inverter-TTL NAND - P MOS-N MOS-CMOS and I2L logics (Inverter and NAND)
Opto electronic devices: Light emitting diode - Surface emitting LED - Edge Emitting LED - Seven segment display - LDR - Photo diode - p-i-n Photo diode - Photo transistors - Solar cells – Photo detectors: IR and UV detectors.

Unit-2: OP-AMP Applications

Op-amp - characteristics - Difference amplifier - CMRR - Integrator - differentiator - comparator- Zero crossing detector- Log and Antilog amplifier-Multiplier and divider- Instrumentation amplifier - V to I and I to V converters - Sample and Hold circuits- Electronic analog computation: Solving Simultaneous equations and Second order differential equations.

UNIT-3: 555 Timer and Phase Locked Loop

555 Timer - Description - Monostable operation - Applications: Pulse width modulator- Frequency divider - Astable operation - Applications: Schmitt trigger - FSK generator.
Phase Locked Loops: - PLL IC 565 - Description - Lock-in range - capture range - pull-in time (Basic principles) - Applications: Frequency multiplication and Translation.

UNIT-4: Transducers

Classification of Transducers - Principle, construction and working of Thermistor - LVDT, Electrical strain gauges and capacitive transducers, Photoelectric transducer, Piezoelectric transducer – Photovoltaic transducer, Photo emissive transducer**,** Measurement of non-electrical quantities - Strain, Displacement, temperature, Pressure, Magnetic fields, vibration, optical and particle detectors.

UNIT-5: Pulse and digital Communication

Pulse communications - Modulation and Demodulation: Pulse Amplitude Modulation (PAM) - Pulse Time Modulation (PTM): Pulse Width Modulation (PWM) - Pulse Position Modulation (PPM) - Pulse Code Modulation (PCM) - Quantizing noise- Frequency-Shift keying- Digital communication - Advantages of digital communication - Modem classification - Modes of modem operation – Modem interconnection - Modem interfacing.

Text Books

Unit 1 and Unit 3

1. V. Vijayendran, Introduction to Integrated Electronics: Digital and Analog, Third Reprint, S.Viswanathan (Printers &Publishers), PVT., Ltd, 2007.
2. J. Millman and C.Halkias , Integrated Electronics, New Delhi, Tata McGraw Hill, 2001.

Unit 2

1. D. Roy Choudhury.D and ShailB.Jain, Linear Integrated Circuits, 4th edition, New AgeInternational (P) Ltd, Chennai,2010.
2. George Kennedy, Electronic Communication systems, 3rd Edition, McGraw Hill, London 1987.

Unit-4

1. Dr.Rajendra Prasad, Electronic Measurements and Instrumentation, Khanna Publications.
2. S.Ramabhadran, Electronic Measurements and Instrumentation Khanna Publications.

Unit-5

1. Pallab Bhattacharya, Semiconductor Optoelectronic devices, Second Edition, Pearson Education, New Delhi, 2001.
2. D. Roy Choudhuryand ShailB.Jain, Linear Integrated Circuits, 4th edition, New Age International (P) Ltd, Chennai,2010.

Books for Reference

1. C. Sarkar , D.C.Darkar, Optoelectronics and Fibre Optics communication, New Delhi, New Age International Publishers, 2006.
2. M.S.Tyagi, Introduction to Semiconductor Devices, Wiley, New York.
3. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Third Edition, Prentice Hall India, New Delhi,1997.

4. R.F. Coughlin and F.F, Driscol, Op-Amp and linear integrated circuits, Prentice Hall of India, New Delhi, 1996.
5. Louis E. Fresnel, Communication Electronics : principles and Applications, TMH Pub. Co., Ltd, 2002.
6. Wayne Tomasi, Electronic communication Systems, Fifth Edition, New Delhi, Pearson education, Inc, 2011.
7. Donald P Leach, Albert Paul Malvino and GoutamSaha, Digital Principles and Applications, Sixth Edition, Tata McGraw-Hill publishing company Ltd, New Delhi, 2008.
8. Allen Mottershead, Electronic devices and circuits, Prentice Hall India, New Delhi, 2000.

E-Materials

1. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_ECE_EDC%20NOTES.pdf
2. https://www.researchgate.net/publication/275408225_Electronic_Devices_and_Circuits
3. https://www.researchgate.net/publication/312190335_Fundamentals_of_Electronic_Devices_Circuits_from_A_to_Z
4. http://engineering.nyu.edu/gk12/amps-cbri/pdf/Basic%20Electronics.pdf
5. http://www.ece.mtu.edu/faculty/ljbohman/onlinetext/elapp200.pdf
6. https://en.wikipedia.org/wiki/Transducer
7. https://www.youtube.com/watch?v=PTENYoZF9fA
8. https://www.youtube.com/watch?v=VMBGtCS2EGg
9. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_analog_pulse_modulation.htm
10. https://www.elprocus.com/pulse-amplitude-modulation/

Course Outcomes

1. After studying unit-I, the students will be able to:
   understand the characteristics and significance of logic families
   Identify different types of logic families
   describe fundamental and applied aspects of optoelectronic device physics and its applications to the design and operation of laser diodes, light-emitting diodes, and photo detectors

2. After studying unit-II, the students will be able to:
   understand the significance of Op-amps and their importance
   understand various linear/non-linear applications
   to solve simultaneous equations and second order differential equations

3. After studying unit-III, the students will be able to:
   understand about the 555 timer and applications
   explain the working of multivibrators using IC 555
   Illustrate the function of application of PLL and its applications

4. After studying unit-IV, the students will be able to*:*
   Know the principle and working of transducers
   explaindifferent types of transducers

5. After studying unit-V, the students will be able to:

able to compare different modulation schemes with their advantages, disadvantages and applications.

Use modulation and demodulation techniques in analog and digital communications

able to understand the concept of MODEM and MODEM interfacing

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CORE ELECTIVEPAPER- 1
(to choose 1 out of 3)

Name of the course/subject:M.Sc Physics Semester: I
Name of the Paper:B. Fiber Optic Communication Credits: 3
Hours of teaching: 4 Paper type: Core Elective
……

Course objectives

1. To understand the concept of electromagnetic waves and formulate the Maxwell's equations.
2. To acquire the basic knowledge about optical fiber and waveguides
3. To study the different types of optical fiber and it characteristics
4. To teach the fabrication and connection of optical fibers
5. To learn the nonlinear effects in fiber and solitons

UNIT-1: Linear, nonlinear waves and Maxwell's equations

Simple pendulum – small and large oscillations – Duffing oscillator – Linear and nonlinear medium - Maxwell's equations – Electromagnetic waves phase and group velocity, modes in a planar and cylindrical wave guides – polarization - dielectric susceptibility – first and higher order susceptibilities.

UNIT -2: Optical fiber waveguides and sources

Ray theory transmission: Total internal reflection, acceptance angle, numerical aperture and skew rays –- evanescent field and Goos-Haechen shift – step index and graded index fibers – single and multi-mode fibers.

Sources:LED - Lasers – mode locked Lasers - modulation capability- transient response - semiconductor losses - diode structure and threshold conditions – modulation – temperature effects – source linearity and reliability – Photo detectors – PIN Photo detector – avalanche photodiode.

UNIT -3: Transmission characteristics of optical fibers

Attenuation – material absorption losses in silica fibers – linear and nonlinear scattering losses – fiber bend loss – mid-infrared and far-infrared transmission – intramodal and intermodal dispersion – overall fiber dispersion in multimode and single-mode fibers – modal birefringence.

UNIT-4: Fabrication and connection of optical fibers

Glass fibers - Preparation of optical fibers – Liquid-phase (melting) and Vapour-phase deposition techniques – characteristics of single-mode, multimode, plastic-clad and all-plastic fibers - Stability of the Fiber Transmission Characteristics: Micro bending and hydrogen

absorption – fiber alignment and joint loss – fiber splices – Fiber connectors: cylindrical ferrule expanded beam connectors - Fiber couplers: Three and four port couplers - star couplers.

UNIT-5: Nonlinear effects in fiber and solitons in optical fiber communication

Refractive index – frequency and intensity dependent refractive index – group velocity dispersion – self-phase modulation - Kerr effect – chirping - stimulated Raman scattering – stimulated Brillouin scattering – self-steepening – self-focusing – self-defocusing – concept of solitons – formation of solitons – kdV equation - Nonlinear Schrödinger equation for solitons – soliton switching – soliton laser- advantages of soliton based communication.

Text Books

Unit 1 to Unit 5

1. AjoyGhatak and K. Thyagarajan, Introduction to fiber optics, 6th Edition, Cambridge University press, 2006.
2. John M. Senior, Optical fiber communications: Principles and practice, 2nd edition , PHI.
3. Govind P. Agrawal, Fiber-Optic communication systems, John Wiley, 2003.
4. Waves called Solitons: concepts and experiments, Springer Verlag, 1992.
5. Gerd Keiser, Optical fiber communications,5th edition, McGra-Hill Education Pvt. Ltd., New Delhi, 2013.

Reference Books

1. B.B. Laud,Lasers and Non-Linear optics, New Age International, New Delhi.
2. Akira Hasegawa and Yujiodama, Solitons in optical communications, oxford Press, 1995.
3. Robert W Boyd, Nonlinear fiber optics, 2nd Edition, Elsevier, 2006.

E-Materials

1. http://www.fibersystems.com/pdf/whitepapers/Basics-of-Fiber-Optics.pdf
2. https://en.wikipedia.org/wiki/Maxwell%27s_equations
3. https://optiwave.com/optibpm-manuals/bpm-introduction-to-optical-waveguides
4. http://optic1999.tripod.com/chapter3.htm
5. https://www.quora.com/What-are-the-different-methods-of-optical-fibre-fabrication-techniques
6. http://what-when-how.com/fiber-optics/nonlinear-effects-in-optical-fibers-part-1
7. https://en.wikipedia.org/wiki/Soliton_(optics)
8. https://www.youtube.com/watch?v=635Ip6NWnfk
9. https://arxiv.org/ftp/arxiv/papers/1111/1111.5226.pdf
10. https://www.youtube.com/watch?v=QB1ns1WdzYI

Course Outcomes

1. After studied unit-1, the student will be able to explain basics and electromagnetic wave and can derive the Maxwell's equations.
2. After studied unit-2, the student will be able to describe waveguides and sources
3. After studied unit-3, the student will be able to demonstrate the different characteristic of optical fibers
4. After studied unit-4, the student will be able to design the fabrication and connection of optical fibers.
5. After studied unit-5, the student will be able to understand nonlinear effects in fibers and solitons and applications.

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CORE ELECTIVEPAPER -1
(to choose 1 out of 3)

Name of the course/subject:M.Sc Physics **Semester: I**
Name of the Paper:C. Electronics Communication System **Credits: 3**
Hours of teaching: 4 **Paper type: Core Elective**

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Course Objectives

1. To Understand the Signal coding Techniques
2. To learn the coding and Error Techniques of different control system
3. Students can get the depth Knowledge of Satellite Communication system like GEO, MEO etc.
4. To teach the basics concept of Cellular communication System
5. To acquire the basic knowledge of Local area networks communication system

UNIT-1: Signal Encoding Techniques

Antennas: types-Propagation modes – line of sight transmission- fading in the mobile environment – signal encoding techniques: criteria- ASK – FSK – BFSK – MFSK – PSK – BPSK – QPSK –multilevel PSK – AM modulation – Angle modulation – PCM – delta and adaptive delta modulation.

UNIT-2: Coding and Error Control

Error detection – Parity check – cycle redundancy check – block error correction codes – hamming code – cyclic codes – BCH code – reed – Solomon codes – block interleaving – convolution codes – decoding – turbo coding – automatic repeat request – flow control – error control.

UNIT-3: Satellite Communication

Satellite parameters and configurations – Satellite orbits – GEO – MEO – LEO – frequency bands – transmission impairments – Satellite foot print – atmospheric attenuation – satellite network – configuration – capacity allocation – multiplexing : FDM and TDM.

UNIT-4:Cellular wireless networks

Principles of cellular networks : Organization – frequency reuse – operation – mobile radio propagation effects – hand-off – power control – traffic engineering – first generation analog – AMPS – second generation – TDMA – mobile wireless TDMA design consideration – CDMA – mobile wireless CDMA design considerations – Soft handoff –IS 95 – Third generation systems – wireless local loop.

UNIT-5: Wireless LANS

Overview: Wireless LAN applications, requirements and technology – Infrared LANS – spread spectrum LANS – narrow band microwave LANS – IEEE 802 architecture – IEEE 802.11 architecture.

Text Books

Unit 1to Unit 5

1. William Schweber, Electronic Communication Systems, Complete Course Pearson Pub, 2011.
2. George Kennedy, Electronic Communication Systems, 3 rd Edition, Tata McGrawHill Edition, New Delhi, 2008.

Reference books

1. William Stallings, Wireless communications and Networks, Pearson education, Asia, 2002.
2. Robert J. Schoen beck, Electronic communications, modulation and transmission PHI, 1999.
3. P. Gnanasivam, Telecommunication switching and networks, PHI, 2004.

E-Materials

1. https://www.youtube.com/watch?v=mSrdM0vUNRw
2. https://en.wikipedia.org/wiki/Antenna_types
3. https://en.wikipedia.org/wiki/Error_detection_and_correction
4. https://www.youtube.com/watch?v=9ftH_6uCEhU
5. https://www.youtube.com/watch?v=Samc3ce6Fsw
6. http://www.swiftutors.com/types-of-satellite-orbits.html
7. https://electronics.howstuffworks.com/cell-phone7.htm
8. https://www.youtube.com/watch?v=oYRMYSIVj1o&vl=pt-BR
9. https://www.youtube.com/watch?v=r6yDbRCIS78
10. https://en.wikipedia.org/wiki/Wireless_LAN

Course outcomes

1. After studied unit-1, the student will be able to know the principle of antenna and its types.
2. After studied unit-2, the student will be able to explain error detection, parity check etc.
3. After studied unit-3, the student will be able to understanding the satellite the principle of GEO,MEO and LEO.
4. After studied unit-4, the student will be able to learn the cellular networks like TDMA.
5. After studied unit-5, the student will be able to know the wireless LAN applications and its types.

OPEN ELECTIVEPAPER-1
(to choose 1 out of 3)

Name of the course/subject:M.Sc Physics **Semester: I**
Name of the Paper:A. Energy Physics **Credits: 3**
Hours of teaching: 3 **Paper type: Open Elective**
……

Course objectives
1. Ability to know the power potential of the sun and its utility.
2. Understanding the experimental procedure of collecting solar energy.
3. Knowing various types of storage methods involving.
4. Knowing the other alternative sources for energy production.
5. Applying knowledge to fabricate solar cells for energy storage purpose.
6. Knowing other forms of energy which are existing in the nature.

UNIT-1: Solar - Thermal Conversion

An overview of thermal application and solar radiation – energy alternatives – devices for thermal collection and storage – thermal applications – Water heating – Space heating – Power generation – instruments for measuring solar radiation and sun shine

UNIT-2: Performance of Flat-Plate Collectors

Performance analysis - -Transmissivity of the cover system based on reflection - Refraction - Absorption - Transimissivity for diffuse radiation - Transmissivity - Absorptive product

UNIT-3: Concentrating Collectors and Energy Storage

General characteristics - Definitions - Methods of classifications – Thermal energy storage - Sensible heat storage - Liquids - Solids - Latent heat storage - Thermal chemical storage

UNIT-4: Photo Conversion

Photovoltaic conversion - Single crystal silicon cell - Principle and working insular cells - Conversion efficiency - Single crystal silicon – Polycrystalline and amorphous silicon - Cadmium sulphide - Cadmium telluride – copper Indium di-selenide

UNIT-5: Other Forms of Energy

Wind energy - Recent developments - Energy from biomass - Direct methods - Indirect methods ~ Wave energy – Vegetation for fuel - Bio-diesel – Plants for Bio-diesel- Physical and chemical properties of Bio-diesel .

Text Book

1. P. Sukhatme, Solar energy (Second edition), Tata McGraw-Hill Publishing Co. Ltd. (New Delhi)

Reference Book

1. G.D.Rai, Solar Energy Utilization, Khanna publishers (New Delhi)

E-Materials

1. https://www.nrel.gov/docs/legosti/old/1846.pdf
2. https://www.e-education.psu.edu/eme811/node/730
3. https://www.newport.com/n/photovoltaic-energy-conversion
4. https://www.youtube.com/watch?v=qOyc3p0OmSg
5. http://www.iraj.in/journal/journal_file/journal_pdf/2-129-143080175869-74.pdf
6. https://www.youtube.com/watch?v=wvl0QAQCJyc
7. https://www.youtube.com/watch?v=BL34OwuUrBU
8. https://www.youtube.com/watch?v=oos7fETc2OE
9. https://en.wikipedia.org/wiki/Biomass
10. https://physicsworld.com/a/biomass-energy-green-or-dirty/

Course Outcomes

1. After studied unit-1, the student will be able to explain thermal conversion
2. After studied unit-2, the student will be able to describe performance of flat-plate collectors
3. After studied unit-3, the student will be able to design the thermal energy storage devices
4. After studied unit-4, the student will be able to understand the principles of photovoltaic conversion
5. After studied unit-5, the student will be able to know other forms of renewable energy sources.

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OPEN ELECTIVE PAPER-1
(to choose 1 out of 3)

Name of the course/subject:M.Sc Physics **Semester: I**
Name of the Paper:B. Basic Physics **Credits: 3**
Hours of teaching: 3 **Paper type: Open Elective**

……

Course objectives

1. Students can learn the importance of measurements and its units
2. To study the basic concepts of heat and different scales of temperatures
3. To learn the basics of charges and know about Ohm's law
4. To understand the different types of wave motion and its properties
5. To teach the importance of light energy and propagation of light

UNIT-1: Fundamentals of Physics

Need of measurement and unit-definition of unit , requirements of standard unit, systems of units-CGS,MKS and SI, fundamental and derived quantities and their units - Least count and range of instrument, least count of vernier caliper, micrometer screw gauge-Definition of accuracy, precision and error, estimation of errors - absolute error, relative error and percentage error, rules and identification of significant figures.

UNIT2: Thermal Physics

Heat-unit of heat-Different scales of temperatures, thermal expansions, Calorimetry – specificheat, latent heat, triple point, transmission of heat, heat conductivity, Black body, Stefan Boltzmann Law, Wien's Displacement Law,

UNIT-3: Electricity

Concept of charge, Coulomb's inverse square law, Electric field, intensity, potential and potential difference.-Electric current, Ohm's law, laws of series and parallel combination of resistance -D.C. circuits, Kirchhoff's law, heating effect & chemical effect of current

UNIT-4: Waves

Definition of wave motion, amplitude, period, frequency, and wavelength, relation between velocity, frequency and wavelength, longitudinal and transverse wave, principle of superposition of waves, definition of stationary wave , node and antinode, definition of resonance with examples, Formula for velocity of sound in air-Factors affecting the velocity of sound-Doppler effect

UNIT-5: Light

Reflection, Refraction and total internal reflection of light and their applications-Mirrors-Lenses-Aberration in Lenses-spherical aberration-Prism-dispersion-dispersive power of a prism-refractive index of a prism- Optical instruments – microscopes, telescopes, binoculars, Defects of Human Eye.

Text Book

Unit-1 to Unit-5

1. N Subramaniam&BrijLal, Principles of Physics, BrijlalSubramaniam, S.ChandCo.,Ltd, New Delhi,2001.
2. Plus one and Plus two Physics Books–TN State Board.
3. Plus one and Plus Two Physics Books-NCERT/CBSE.

Reference Books

1. N Subramaniam&BrijLal, Heat and Thermodynamics, S.ChandCo.,Ltd, New Delhi,2001.
2. D Jayaraman and K Ilangovan, Thermal Physics, Ananda Book Depot, Chennai, 2018.
3. K Ilangovan, Properties of Matter and Sound, Ananda Book Depot, Chennai, 2018.
4. R Murugeshan, Electricity and Magnetism, S Chand & Co., Ltd.,New Delhi, 2006.
5. N SubramanyamBrijLal, A Text Book of Sound, Vikas Publishing House Pvt. Ltd., New Delhi, 2016.
6. N Subramanyam&BrijLal, Waves and Oscillations, Vikas Publishing House Pvt. Ltd., New Delhi, 2016.
7. J Jayachitra and M Gunasekaran, Properties of Matter and Acoustics, KRU Publications, Chennai, 2007.
8. N Subramanyam&BrijLal and MN Avadhanulu, A Text Book of Optics, S.Chand& Co. Ltd,New Delhi, 2010.
9. The Feynman Lectures on Physics, Vols. I, II and III, by R P Feynman, RB Leighton and M Sands, Narosa, New Delhi, 1998.
10. Fundamentals of Physics, 6th Edition by D Halliday, R Resnick and J Walker, Wiley NY 2001.

E-Materials

1. https://www.quora.com/What-are-fundamental-units-and-derived-units
2. http://tnschools.gov.in/textbooks
3. https://ncertbooks.ncert.gov.in/login
4. https://en.wikipedia.org/wiki/Heat
5. https://learn.sparkfun.com/tutorials/voltage-current-resistance-and-ohms-law/all
6. http://agni.phys.iit.edu/~vpa/wavesosci.html
7. https://en.wikipedia.org/wiki/Light
8. https://www.youtube.com/watch?v=dzR7rcO2-fI
9. https://www.youtube.com/watch?v=GXwZ3LMb-ik
10. https://www.youtube.com/watch?v=32q5x-81H5Q
11. https://www.youtube.com/watch?v=sBb5WUw2_2I

Course outcomes

1. After studied unit-1, the student will be able to know the fundamental quantities and its units and also they can derive the derived quantities and its units
2. After studied unit-2, the student will be able to learn about heat and its measurements.
3. After studied unit-3, the student will be able to distinguish between positive and negative charges and they can Ohm's law
4. After studied unit-4, the student will be able to study the basics of sound and its properties and also they formulate the expression for velocity of sound
5. After studied unit-5, the student will be able to understand the basic phenomenon of light and learn about the optical instruments like telescope, microscope etc.

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OPEN ELECTIVE PAPER-1
(to choose 1 out of 3)

Name of the course/subject:M.Sc Physics **Semester: I**
Name of the Paper:C. Communication Physics **Credits: 3**
Hours of teaching: 3 **Paper type: Open Elective**

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Course objectives

1. From the course students can study the principles of radio transmission and reception.
2. To learn the basic principle of fiber optics and its application for communication system
3. To teach the introduction on radar system and its application
4. To know the history of satellites and its feaures
5. To study the concept of cellular phones and to understand the Wi-Fi network system.

UNIT -1: Radio transmission and Reception

Transmitter: Modulation - types of modulation-amplitude modulation -modulation factor-sideband frequencies in AM wave-limitations of amplitude modulation - frequency modulation-comparison of FM and AMDemodulation-Essentials in demodulation.Receivers: A.M. radio receivers -Types of A.M. radio receivers – Stages ofsuperhetrodyne radio receiver-Advantages of superhetrodyne circuit –FMreceiver-Difference between FM and AM receivers.

UNIT-2: Fiber optic Communication

Introduction -Basic principle of fiber optics – Advantages – Constructionof optical fiber-Acceptance angle and Numerical aperture –Classification ofoptical fibers based on the refractive index profile – Classification of opticalfibers based on the number of modes of propagation – Losses in opticalfibers – Attenuation – Fiber optic communication – Advantages.

UNIT-3: Radar Communication

Introduction -Basic radar system -Radar range –Antenna scanning – Pulsedradar system – A Scope- Plan position indicator-Search radar- Trackingradar- Moving target indicator-Doppler effect-MTI Principle- CW DopplerRadar- Frequency modulator CW Radar.

Unit-4: Satellite Communication

Introduction – history of satellites – satellite communication system –satellite orbits Basic components of satellite communication system-constructional features of satellites-Commonly used frequency in satellite-communication- Multiple access – communication package – antenna- power-source – satellite foot points- satellite communication in India.

UNIT -5: Mobile Communication

Introduction-The concept of cell –Basic cellular mobile radio system-Thecellphone-Facsimile-Important features of Fax machine-Application ofFacsimile – VSAT (very small aperture terminals) – Modem – IPTV (internet protocol television) –Wi-Fi-4G (Basic ideas only).

Text Books

Unit 1

1. V.K.Metha, Principles of Electronics, S. Chand & Company Ltd., 2013

Unit 2 to Unit 5

1. Anokh Singh and Chopra A.K., Principles of communicationEngineering, S.Chand& Company Pvt. Ltd., 2013.

Reference Books:

1. I. PoornimaThangam, Satellite communication, Charulatha Publications,2012.
2. Dennis Roddy and John Coolen, Electronic Communication, PHI, 1990.
3. William C.Y. lee, Cellular telecommunication (second edition), TataMcgraw Hill, 1991.

E-Materials

1. https://en.wikipedia.org/wiki/Radio
2. https://www.britannica.com/technology/radio-technology
3. https://en.wikipedia.org/wiki/Fiber-optic_communication
4. https://en.wikipedia.org/wiki/Radar
5. http://archive.mu.ac.in/myweb_test/Satelight%20Comm..pdf
6. https://www.youtube.com/watch?v=q8U_mne2fO0
7. https://www.youtube.com/watch?v=-ap00IUJm7k&list=PLFW6lRTa1g83YaqmM9r2MAAiJVY93bOP7
8. https://www.youtube.com/watch?v=bXcY5Kjz8Hw
9. https://www.youtube.com/watch?v=dt4Ce8gQPns&list=PLAnjLC20C-XQnoowCtt-67WmyxoQPu2Fi
10. https://www.youtube.com/watch?v=f2wlHL1Sok8&list=PLuv3GM6-gsE3ypUYh43pPuZsXxJVG1e7F

Course outcomes

1. After studied unit-1, the student will be able to understand the different types of modulation will be used in radio transmission and reception.
2. After studied unit-2, the student will be able to know the basics of fiber optics and its types
3. After studied unit-3, the student will be able to learn the principle of radar communication

4. After studied unit-4, the student will be able to describe the satellites and its importance,
5. After studied unit-5, the student will be able to demonstrate the different types of mobile phones and updating the knowledge about Wi-Fi and fourth generation of communication system.

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CORE PAPER-4

Name of the course/subject: M.Sc Physics **Semester: II**
Name of the Paper: Mathematical Physics-II **Credits:4**
Hours of teaching: 5 **Paper type: Core**

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Course objectives

1. To teach the basics of complex variables and formulate the different theorems
2. To provide the knowledge on partial differential equations and to get the solutions of two and three dimensional heat flow
3. To expose an idea about Fourier and Laplace's integral Transforms
4. To describe the basics of group theory and different representation of a group
5. To explain the different probability distributions and theory of errors

UNIT-1: Complex Variables

Functions of a complex variable – Analytic function-The necessary and sufficient conditions-Cauchy-Riemann Differential equations- Cauchy-Riemann equations in polar form-Lapalce equation-Line integral of a complex function-Basic properties of the complex line integrals-Cauchy's integral theorem with proof-Cauchy's Integral formula with proof-and formula -Derivatives of an analytic function-Taylor and Laurent's series with proof-Cauchy Residue theorem expansions-Residues and their evaluation- Residue theorem -Evaluation of definite integrals.

UNIT-2: Partial differential equations

Introduction-Laplace's equations – solutions of Laplace's Equations in Cartesian coordinates-Two dimensional cylindrical coordinates-spherical polar coordinates-Diffusion equation (Fourier equation of heat flow) – solutions of two and three dimensional heat flow –The equation of motion for the vibrating string-D' Alembert's solution.

UNIT-3: Fourierand Laplace's Integral Transforms

Fourier's Transform-Infinite Fourier Sine and Cosine Transforms-Properties of Fourier's Theorem- Finite Fourier sine and cosine transforms- Simple applications of Fourier Transforms-Laplace transforms- Properties of Laplace Transforms-Convolution or Faltung Theorem-Evaluation of Inverse Laplace Transforms by Convolution Theorem-Evaluation of Laplace Transform by using Differential Equations-with constant and variable coefficients.

UNIT-4: Group Theory

Concept of a group-Examples of group-Abelian group-Cyclic group-Group multiplication table-Subgroups-Group of order two and three-Conjugate elements and classes-Isomorphism and homomorphism-Symmetry operations and symmetry elements-Group multiplication table for water molecule-Molecular points groups-Matrix representation of symmetry operations- Reducible and irreducible representations –The Great Orthogonally theorem with explanation (no proof)- Character Table for C_{2v} and C_{3v}Point groups-Infrared and Raman activity for CH_3Cl molecule-The three dimensional rotation group SO(3)-The special unitary groups SU(2) and SU(3).

UNIT-5: Probability

Definition of probability-A priori probability- A posterior probability-Repeated trials-Sample space-random variables-The expectation-The Laplace De Moivre Limits Theorem-Theoretical Distributions-Binomial distribution-The constants or first four moments, mode

and moment generating function of Binomial distribution-Poisson's distribution- The constants or first four moments, mode and moment generating function of Poisson's distribution-Normal distribution- Standard form of the normal curve-Properties of the normal curve-Moment generating function of normal distribution.

Text Books

Unit -1 to Unit -3

1. Satyaprakash, Mathematical Physics with Classical Mechanics Sultan Chand & sons, New Delhi, 2016.

Unit-4

1. Satyaprakash, Mathematical Physics with Classical Mechanics Sultan Chand & sons, New Delhi, 2016
2. Aruldhas G, Molecular Structure and Spectroscopy, Prentice-Hall of India PVT Ltd, New Delhi, 2005.
3. P.K. Chattopadhyay, Mathematical Physics, New Age International Publishers, New Delhi, 2016.

Unit-5

1. B.S. Rajput, Mathematical Physics, PragatiPrakashan, Meerut, 2009
2. Satyaprakash, Mathematical Physics with Classical Mechanics Sultan Chand & sons, New Delhi, 2016.

Reference Books

1. H.K. Dass, Dr. Rama Verma, Mathematical Physics, New Delhi, 2014.
2. B.D. Gupta, Mathematical Physics, Vikas publishing house 3rd Edition, New Delhi, 2006.

E-Materials

1. https://en.wikipedia.org/wiki/Analytic_function
2. https://en.wikipedia.org/wiki/Cauchy%E2%80%93Riemann_equations
3. https://dlmf.nist.gov/1.14
4. https://www.youtube.com/watch?v=qnmUzjnY35M
5. https://www.youtube.com/watch?v=ey9rAu6-uEY
6. http://www.bhojvirtualuniversity.com/slm/mscche1p4.pdf
7. https://www.youtube.com/watch?v=oBPQsOrhbuc&t=2s
8. https://www.youtube.com/watch?v=82Ad1orN-NA&list=PLDp9Jik5WjRtVUYHjx_Q0KohHqqDVKhcX
9. https://www.youtube.com/watch?v=WWv0RUxDfbs
10. https://en.wikipedia.org/wiki/Binomial_distribution

Course outcomes

1. After studied unit-1, the student will be able to learn analytic functions, derive an equation forCauchy-Riemann Differential equations in different forms about Taylor, Laurent's series and Cauchy Residue theorem
2. After studied unit-2, the student will be able to obtain the solution for Laplace's Equations in Cartesian coordinates and also fortwo and three dimensional heat flow
3. After studied unit-3, the student will be able to study the Fourier and Laplace's Integral Transforms in detail
4. After studied unit-4, the student will be able to describe group theory and construct the character table for different point groups
5. After studied unit-5, the student will be able to acquire theory of probability and different theoretical distributions.

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CORE PAPER-5

Name of the course/subject: M.Sc Physics Semester: II
Name of the Paper: Electro Magnetic Theory Credits:5
Hours of teaching: 4 Paper type: Core
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Course Objectives

1. To provide a clear and logical presentation of Electrostatics and electrodynamics.
2. To introduce the Maxwell's equations applicable in electromagnetism.
3. To make the students understand the source of production and propagation of electromagnetic waves.

UNIT-1: Electrostatics

System of charges: Charge distribution-charge densities-Electric field-Electrostatic potential-multipole expansion-Gauss' law-integral and differential forms.- Laplace and Poisson equations-Solution of Laplace's equation in cartesion and spherical coordinates- Conducting sphere in a uniform electric field. Dielectric polarization: Polarization and displacement vectors-molecular polarazibility and electrical susceptibility-dielectric sphere in a uniform field-Electrostatic energy

UNIT-2: Magnetostatics

Biot-Savart Law –integral and differential forms-Application to a long wire carrying steady current- Ampere's circuital law –integral and differential forms-Application to a long wire wire and a solenoid carrying current. Magnetic vector potential-charecteristics-application to a distant current loop-Magnetic scalar potential- characteristics- application to a circular coil carrying current-Magnetostatic energy.

UNIT-3:Maxwell's equations and Applications:

Faraday's laws of Induction - Maxwell's displacement current – continuity equation for current density –Maxwell's equations -differential and integral forms- significance of Maxwell;s equations-Maxwell's equations in free space, linear isotropic media and in conducting medium- Gauge invariance - Coulomb and Lorentz gauges –inhomogeneous wave equations-Lorentz force- Lorentz force interms of magnetic scalar and vector potentials- Energy and momentum of the field - Poynting's theorem - Conservation laws for a system of charges and electromagnetic fields.

UNIT-4: Electromagnetic fields and Radiation from localized sources:

Retarded potentials- oscillating electric dipole: magnetic vector and scalar potentials-electric and magnetic fields-power radiated and radiation resistance-Radiation from a small current element-Radiation from a linear antenna- Radiation from a centre fed half wave linear antenna- Antenna array.

UNIT-5: EM Wave propagation

Plane wave equation and solution- Wave propagation in free space, isotropic dielectric and in a conducting medium-skin depth-Reflection and refraction at a plane interface:kinematic and dynamic properties-Fresnel's formulae-propagation between two perfectly conducting planes –propagation in a rectangular wave guide.

Text Books

Unit 1 to Unit 5

1. SatyaPrakash, Electromagnetic theory and Electrodynamics, Meerut, KedarNath Ram,2010.
2. David.J.Griffiths, Introduction to Electrodynamics, New Delhi, Addison Wesley, 2012.
3. Uma Mukherji, , Electromagnetic field Theory and Wave Propagation, New Delhi,Narosa publishing House, New Delhi, 2006.

Reference Books

1. Agarwal G.C, Agarwal G. C., Chopra K. K., Electromagnetic Theory, K Nath& Co.,2010.
2. Edward C.Jordan, Keith G. Balmain, Electromagnetic waves and Radiating systems,Prentice Hall of India, 2005.
3. Reitz John R., Foundations of Electromagnetic Theory, , Pearson Education India, New Delhi, 2009.
4. Puri S.P, Classical Electrodynamics, , Tata McGraw-Hill publishing company Limited,New Delhi, 1997.
5. Prasad K.D Antenna and Wave Propagation, ,Sathyaprakashan, New Delhi, 1993.
6. Meenakumari, R.,Subasri R., Electromagnetic fields, second edition, , New Age
7. International Publishers, New Delhi, 2008.
8. J.D.Jackson, Classical Electrodynamics, 3rd Edition, Wiley Eastern Ltd, New Delhi, 1998.

E-Materials

1. https://www.slideshare.net/abhishekchoksi56/poissons-and-laplaces-equation
2. https://www.youtube.com/watch?v=m9CExTmve_A
3. https://www.youtube.com/watch?v=Nwnj1JSvfnk
4. https://en.wikipedia.org/wiki/Magnetic_potential
5. https://en.wikipedia.org/wiki/Displacement_current
6. https://www.youtube.com/watch?v=eJJrzekmuiA
7. https://www.youtube.com/watch?v=0J_v2kD4Tcs
8. https://en.wikipedia.org/wiki/Retarded_potential
9. https://en.wikipedia.org/wiki/Electromagnetic_wave_equation
10. https://www.youtube.com/watch?v=siaFxvdokmM

Course outcomes

1. After studying Unit-1, the students will be able to
   have a depth knowledge of electrostaticsand
   clearly understand dielectric polarization.
2. After studying Unit-2, the students will be able to
   know the fundamental laws to find the magnetic field of a source.
   have depth knowledge of magnetic potential.

apply the magnetic scalar and vector potentials to find the magnetic field due to localized source.

3. After studying Unit-3, the students will be able to
   use Maxwell's equations for a system of charge and electromagnetic field.
   Obtain homogeneous equations for a charged system.
   Students will be able to understand clearly Gauge transformation and gauge invariance.
4. After studying Unit-4, the students will be able to
   Understand about the oscillating dipole.
   Know how the power radiated from a linear antenna.
   Understand clearly antenna arrays.
5. After studying Unit-5, the students will be able to
   Know the propagation of electromagnetic waves in free space, dielectric medium andConductingmedium.
   Have a depth knowledge of kinematic and dynamic properties of electromagnetic waves.
   Understand the wave propagation principle in the case of wave guide.

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CORE PAPER-6

Name of the course/subject: M.Sc Physics **Semester: II**
Name of the Paper: Quantum Mechanics-II **Credits:4**
Hours of teaching: 4 **Paper type: Core**

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Course Objectives

1. The primary objective is to teach the students various approximation methods in quantum mechanics.
2. The important topic of quantum scattering is also dealt with. Relativistic quantum theory like Klein-Gordon equation and Dirac equation is also covered

UNIT-1: Approximation Methods for Stationary Systems

Time-independent perturbation theory, (a) non- degenerate and (b) degenerate – Variational method and its applications – WKB method and its applications

UNIT-2: Approximation Methods for time-dependent perturbations

Time dependent perturbation theory – Transition to a continuum of final states, Fermi's GoldenRule – Application to constant and harmonic perturbations – Sudden and adiabatic approximations

UNIT-3: Scattering

Wave packet description of scattering – Formal treatment of scattering by Green's function method – Born approximation and applications – Partial wave analysis – Optical theorem

UNIT-4: Relativistic Quantum Mechanics

Klein – Gordon and Dirac equations – Properties ofDirac matrices – Plane wave solutions of Dirac equation – Spin and magnetic moment of theelectron – Non-relativistic reduction of the Dirac equation

UNIT-5: Dirac Equation

Covaiant form of Dirac equation – Second quantization of Klein-Gorden field – Creation and annihilation operators – Properties of gamma Matrices – Traces – Relativistic invariance of Dirac equation – Probability density – current four vector – Bilinear Covariant.

Text Books

Unit 1 to Unit 5

1. P. M. Mathews and K. Venkatesan, 1976, A Text book of Quantum Mechanics, Tata McGraw-Hill, New Delhi.
2. L. I. Schiff, 1968, Quantum Mechanics, 3rd Edition, International Student Edition, MacGraw-Hill Kogakusha, Tokyo.
3. E. Merzbacher, 1970, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York.

4. V. K. Thankappan, 1985, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi.
5. J.D. Bjorken and S.D. Drell, 1964, Relativistic Quantum Mechanics, MacGraw-Hill New York.
6. V. Devanathan, 2005, Quantum Mechanics, Narosa Publishing House, New Delhi.
7. S.L. Gupta and I.D.Gupta - Quantum Mechanics.

Reference Books

1. P. A. M. Dirac, 1973, The Principles of Quantum Mechanics, Oxford University Press, London.
2. L. D. Landau and E. M. Lifshitz, 1958 Quantum Mechanics, Pergomon Press,London.
3. S. N. Biswas, 1999, Quantum Mechanics, Books and Allied, Kolkata.
4. G. Aruldhas, 2002, Quantum Mechanics, Prentice-Hall of India, New Delhi.
5. J. S. Bell, Gottfried and M.Veltman, 2001, The Foundations of Quantum Mechanics, World Scientific.
6. V. Devanathan, 1999, Angular Momentum Techniques inQuantum Mechanics, Kluwer Academic Publishers, Dordrecht.
7. Lewis H. Ryder, Quantum Field Theory ,2nd Ed., Cambridge University. Press,1996
8. J.D. Bjorken and S.D. Drell, Relativistic Quantum Fields, Vol. II (McGraw-Hill,1978
9. J.D. Bjorken and S.D. Drell, Relativistic Quantum Fields, Vol.IMcGraw-Hill,1964.

E-Materials

1. http://www.freebookcentre.net/physics-books-download/Lecture-Notes-on-Quantum-Physics.html
2. http://www.freebookcentre.net/physics-books-download/Lecture-Notes-Quantum-Physics.html
3. http://www.freebookcentre.net/physics-books-download/Quantum-Physics-by-Prof.-Graeme-Ackland.html
4. https://web.phys.ksu.edu/vqm/AVQM%20Website/AVQMweb.htm
5. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/
6. http://www.eas.asu.edu/~vasilesk/EEE434.html
7. http://minty.caltech.edu/Ph125a/
8. http://walet.phy.umist.ac.uk/QM/LectureNotes/
9. http://www.physics.usu.edu/torre/Classical_Field_Theory/Lectures/02_KG.pdf
10. https://www.youtube.com/watch?v=oKqvj4Qv9Ts

Course Outcomes

1. Understand the concept of perturbation theory to solve problems in quantum mechanics.
2. Acquire the knowledge of variation methods and able to solve harmonic perturbation step by step using mathematical methods.

3. Formulates ideas on born approximation transformation and concepts of scattering theory.
4. Understand the Dirac matrices and gained knowledge about spin and magnetic movement of electron.
5. Able to understand the creation and annihilation operator and gain the knowledge about anti particle.

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CORE ELECTIVEPAPER -2
(Choose 1 out of 3)

Name of the course/subject: M.Sc Physics **Semester: II**
Name of the Paper: A. Nanoscience **Credits:3**

Hours of teaching: 4 **Paper type: Core Elective**

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Course objectives

1. The course gives the some fundamental concepts of nanomaterials and its properties
2. Students can learn the synthesis of nanostructure materials by different methods
3. To expose an idea about quantum dots and growth of the quantum dots
4. To demonstrate the different tools for the characterization of synthesized materials
5. To study the important applications of nanomaterials and nanocomposites.

UNIT-1: Fundamentals of Nanoscale Science

Introduction - nano and nature - background to nanotechnology -scientific revolutions opportunities at the nanoscale - time and lengthscale in structures - surfaces and dimensional space - evolution ofband structures and Fermi surfaces - electronic structure ofnanocrystals - bulk to nano transition - size and shapes -dimensionality and size dependent phenomena- Energy landscapes basic intermolecular forces –interdynamicaspects of intermolecular forces.

UNIT-2: Classification of nanoparticles and its properties

Metal Nanoparticles: Size control of metal nanoparticles,Structural, Surface, electronic and optical properties.

Semiconductor Nanoparticles: solid state phase transformation,Excitons, Quantum confinement effect, Semiconductor quantum dots(SQDs), Correlation of properties with size, Quantum Well, QuantumWires, Super lattices band and Band offsets, Quantum dot lasers.
Magnetic nanomaterials: Fundamentals of magnetic materials, Dia,Para, Ferro, Ferric, and Superpara magnetic materials, NanostructuredMagnetism.

Semiconductor Nanocomposites: Types of Nanocomposites(Metal oxides, ceramic and Glass), Core - Shell nanoparticles – Typesof systems - properties of nanocomposites.
Carbon Nanostructures: Introduction, Fullerenes, C60, CNT,mechanical, optical and properties.

Unit 3: Synthesis of Nanomaterials

Physical methods: Thermal evaporation, Spray pyrolysis,Molecular beam epitaxy (MBE), Physical vapour deposition (PVD),Microwave heating, Electric arc deposition, Ion implantation.

Chemical methods: Chemical and co - precipitation, Solfundamentals - sol - gel synthesis of metal oxides, Micro emulsions orreverse micelles, Solvothermal, Sonochemical synthesis,Electrochemical synthesis, Photochemical synthesis, Langmuir -blodgett (LB) technique, Chemical vapour deposition (CVD)

Unit 4: Characterization Techniques

Powder X - Ray Diffraction, Scanning electron microscope(SEM), Transmission electron microscope (TEM), Scanningtunnelling microscope (STM), Atomic force microscope (AFM),Scanning probe microscopy (SPM), UV - Visible absorption,Impedance measurement, V - I characteristics, Vibrating sample magnetometer (VSM)-Brunauer - Emmett - Teller (BET) Surface Area Analysis,Energy dispersive X - ray (EDX), X - ray photoelectron spectroscopy(XPS) and Photoluminescence.

Unit 5: Applications of Nanomaterials and Nanocomposites

Nanophotonics and Devices: ID, 2D, 3D Photonic crystals,Couplers, Waveguides, Photonic crystal fibres, Optical data storagesystems and Quantum computing

Medical applications: Imaging of cancer cells, Biological tags andTargeted nano drug delivery system.

Nanosensors: Sensors based on physical properties -Electrochemical sensors, Sensors for aerospace, defence andBiosensors.

Energy: Solar cells, LEDs and Photovoltaic device applications.

Photocatalytic applications: Air purification, Water purificationsand Volatile organic pollution degradation.

Carbon nanotubes: Field emission, Fuel cells and Display devices.

Text Books

Unit 1 to Unit 5

1. B. Viswanathan, Structure and Properties of Solid State Materials, 2nd Edition, Alpha Science International,2006.
2. T.Pradeep, Nano - The Essentials, Tata McGraw -Hillpublishing company limited,2007.

Reference Books

1. Pulickel M. Ajayan, Linda S. Schadler, Paul V. Braun, Nanocomposite Science and Technology, John Wiley &Sons, 2006.
2. Günter,Schmid, Nanoparticles: From Theory to Application, 2nd Edition, John Wiley & Sons, 2011.
3. SulabhaK.Kulkarni, Nanotechnology: Principles And Practices, Capital publishing company,2007.
4. B. Viswanathan, Nanomaterials, Narosa PublishingHouse Pvt. Ltd., New Delhi, 2009.
5. A. K. Bandyopadhyay, Nano Materials, 2nd Edition, NewAge International Publishers Ltd., New Delhi, 2007.
6. Charles P.Poole, Frank J. Owens,Introduction to nanotechnology, John Wiley & Sons publication,2003.

E-Materials

1. https://www.ncsl.org/print/standcomm/sctech/Roberto0806.pdf
2. https://education.mrsec.wisc.edu/what-is-nanotechnology-defining-nanotechnology/
3. https://en.wikipedia.org/wiki/Quantum_dot
4. https://www.youtube.com/watch?v=AGfOQJPjGEE
5. https://www.youtube.com/watch?v=0JW6WcbcFFY
6. https://nptel.ac.in/content/storage2/courses/117104022/Lectures/Lec8.pdf
7. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/113106064/lec12.pdf
8. https://www.youtube.com/watch?v=mC0rYNlMz9Q
9. https://www.youtube.com/watch?v=RnUGSDW-Tfk
10. https://en.wikipedia.org/wiki/Nanophotonics

Course Outcomes

1. After studied unit-1, the student will be able to understand the nanoscale and nanomaterial.
2. After studied unit-2, the student will be able to learn how to synthesis the nanostructured materials
3. After studied unit-3, the student will be able to distinguish between nanoparticles and quantum dots
4. After studied unit-4, the student will be able to describe the different tools will be used for characterization of the nanomaterial.
5. After studied unit-5, the student will be able explain the different applications of nanotechnology

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CORE ELECTIVE PAPER -2
(to choose 1 out of 3)

Name of the course/subject: M.Sc Physics **Semester: II**
Name of the Paper: B. Electronics Instrumentation **Credits:3**

Hours of teaching: 4 **Paper type: Core Elective**

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Course Objectives

1. Students can learn the principle and classification of transducers
2. To know the principle, block diagram and working of some digital instruments
3. To study the working and applications of analytical instrumentation techniques
4. To teach the some basics of bio-medical instruments
5. To acquire the knowledge about internal and external peripheral devices

UNIT-1 : Transducers

Classification of Transducers - Principle, construction and working of Thermistor - LVDT, Electrical strain gauges and capacitive transducers, Photoelectric transducer, Piezoelectric transducer – Photovoltaic transducer, Photo emissive transducer**,** Measurement of non-electrical quantities - Strain, Displacement, temperature, Pressure, Magnetic fields, vibration, optical and particle detectors.

UNIT-2: Digital Instrumentation

Principle, block diagram and working of Digital frequency counter, digital multimeter, digital pH meter, digital conductivity meter and digital storage oscilloscope. Introduction to digital LCR meters, Working of LCR, introduction to virtual instrumentation, Supervisory control and data acquisition (SCADA), data acquisition system.

UNIT-3: Analytical Instrumentation

Principle, block diagram, description, working and applications of Photoelectron Spectroscopy (XPS) ,Auger Electron Spectroscopy, Atomic Absorption Spectroscopy, Secondary Ion Mass spectroscopy (SIMS),Carbon Hydrogen Nitrogen Sulphur analyzer (CHNS). Flame emission spectrometer and ICP -Basic concepts of Gas and Liquid Chromatography.

UNIT-4: Bio-Medical Instrumentation

Physiological transducers to measure blood pressure, body temperature - Sources of Bioelectric potentials - resting potential, action potential, bio-potential electrodes - Principle, block diagram and operation of ECG ,EEG and EMG recorders**.** Principle-block diagram and operation of CT Scanner –MRI Machine.

UNIT-5: Computer Peripherals

Introduction to Internal and external peripherals- Printers - Printer mechanism – Classification - Dot matrix, Ink jet and laser printers - Basic concepts of key board and mouse. Mass data storage - Hard Disk - Optical disk (CD) – DVD –Blueraydisc **,**Flash memory – I/O Interfaces-Universal Serial Bus (USB).Communications(COM),Serial ports.

Text Books

Unit 1 to Unit 5

1. Dr.Rajendra Prasad, Electronic Measurements and Instrumentation, Khanna Publications.
2. S.Ramabhadran, Electronic Measurements and Instrumentation Khanna Publications.
3. Leslie Cromwell fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements 2 nd Edition, Prentice –Hall of India Private Ltd, New Delhi, 2010.
4. D. Kealey and P.J. Haines, Analytical chemistry, Viva Publications, New Delhi, 2002.
5. R.LakshmiRekha., C.Ravikumar, Biomedical Instrumentation and Medical electronics, Lakshmi Publications, Chennai,2009.

Reference Books

1. S.M. Dhir, Electronics and Instrumentation, Khanna Publishers, Khandpur.
2. Albert D.Heltrick, William D. Cooper, Modern Electronics Instrumentation and measurement Techniques, PHI, New Delhi.
3. Douglas A.Skoog, F.James Holler, Timothy A.Nieman, Principles of Instrumental Analysis, Harcourt College publishers,5th edition, 2001
4. A.J.Bouwens, Digital Instrumentation, , McGraw Hill international, New Delhi, 2002
5. W.D.Cooperand A.D.Helfrick, Electronic Instrumentation and Measurement Techniques,1st edition , Dorling KinderslyPvt. Ltd . India, 2009

E-Materials

1. https://en.wikipedia.org/wiki/Transducer
2. https://www.youtube.com/watch?v=AZdCXJx4xSA
3. https://www.youtube.com/watch?v=CJ6YWBuHoes
4. https://en.wikipedia.org/wiki/Multimeter
5. https://en.wikipedia.org/wiki/X-ray_photoelectron_spectroscopy
6. https://www.youtube.com/watch?v=XpDqJfybma4
7. https://www.youtube.com/watch?v=xIZQRjkwV9Q
8. https://en.wikipedia.org/wiki/Electrocardiography
9. https://en.wikipedia.org/wiki/USB
10. https://www.digitaltrends.com/computing/usb-c-vs-usb-a/

Course Outcomes

1. After studied unit-1, the student will be able to know the principle, working and types of transducers.
2. After studied unit-2, the student will be able to demonstrate the principle, function of different digital instruments like digital multimeter.
3. After studied unit-3, the student will be able to explain the working and applications of Photoelectron Spectroscopy (XPS) ,Auger Electron Spectroscopy, Atomic Absorption Spectroscopy.
4. After studied unit-4, the student will be able to describe the operation of ECG,EEG and EMG biomedical instrumentations.
5. After studied unit-5, the student will be able to know the classification of printers, function of hard disk, CD and DVD.

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CORE ELECTIVE PAPER-2
(to choose 1 out of 3)

Name of the course/subject: M.Sc Physics **Semester: II**
Name of the Paper: C: Non-linear optics **Credits:3**
Hours of teaching: 4 **Paper type: Core Elective**
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Course objectives

1. To study the basics of Lasers and its types
2. To acquire the knowledge on introduction to non-linear optics and its generation
3. To teach the multiphonon processes and hence to study the optical Kerr effect
4. To expose the basic information on non-linear optical materials
5. To know about the fundamentals of fiber optics and different types of fibers

UNIT-1: Lasers

Gas lasers – He-Ne, Ar+ ion lasers – Solid state lasers – Ruby – Nd:YAG, Ti sapphire - Organic dye laser – Rhodamine – Semiconductor lasers – Diode laser, p-n-junctionlaser and GaAs laser.

UNIT-2: Basics of Nonlinear Optics

Wave propagation in an anisotropic crystal – Polarization response of materials to light-– Harmonic generation – Second harmonic generation – Sum and difference frequency-generation– Phase matching – Third harmonic generation – Terahertz –Bistability-Self-focusing.

UNIT-3:Multiphoton Processes

Two photon process – Theory and experiment – Three photon process – Parametricgeneration of light – Oscillator – Amplifier – Stimulated Raman scattering – Intensitydependent refractive index -- Optical Kerr effect -- Foucault effect – Photorefractive,electronic and optic effects.

UNIT-4: Nonlinear Optical Materials

Basic requirements – Inorganics – Borates – Organics – Urea, Nitroaniline –Semiorganics – Thoreau complex – Laser induced surface damage threshold.

UNIT-5: Fiber Optics

Step -Graded index fibers – Wave propagation – Fiber modes – Single and multimodefibers-Numerical aperture – Dispersion – Fiber bandwidth- Fiber losses -Scattering,absorption, bending, leaky mode and mode coupling losses-Attenuationcoefficient -Material absorption.

Text Books

Unit 1 to Unit 5

1. K.R. Nambiar, *Lasers: Principles, Types and Applications* (New Age Inter-national Publishers Ltd, New Delhi, 2014).
2. B.B. Laud, *Lasers and Nonlinear Optics*, 3rd Edn. (New Age, New Delhi, 2011).
3. R.W. Boyd, *Nonlinear Optics*, 2nd Edn. (Academic Press, New York, 2003).
4. G.P. Agarwal, *Fiber-Optics Communication Systems*, 3rd Edn. (John Wiley,

Singapore, 2003).

Reference Books

1. W.T. Silvast, *Laser Fundamentals* (Cambridge University Press, Cambridge, 2003).
2. D.L. Mills, *Nonlinear Optics – Basic Concepts* (Springer, Berlin, 1998).

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1. https://en.wikipedia.org/wiki/Laser
2. https://en.wikipedia.org/wiki/Helium%E2%80%93neon_laser
3. https://www.physics-and-radio-electronics.com/physics/laser/ndyaglaser.html
4. https://en.wikipedia.org/wiki/Nonlinear_optics
5. https://www.youtube.com/watch?v=3WevI1A2Bdk
6. https://shodhganga.inflibnet.ac.in/bitstream/10603/35888/1/chapter1.pdf
7. https://www.photonics.com/Articles/Fiber_Optics_Understanding_the_Basics/a25151
8. http://www.infocobuild.com/education/audio-video-courses/physics/IntroToNonlinearOptics-IIT-Kharagpur/lecture-12.html
9. https://www.slideshare.net/krishslide/nonlinear-optical-materials
10. https://en.wikipedia.org/wiki/Graded-index_fiber

Course Outcomes

1. After studied unit-1, the student will be able to understand the laser and its types
2. After studied unit-2, the student will be able to know the fundamentals of non-linear optics.
3. After studied unit-3, the student will be able to study the multiphonon process in nonlinear optics.
4. After studied unit-4, the student will be able to learn the basic requirements for nonlinear optical materials like borates, organics etc.
5. After studied unit-5, the student will be able explain the principle, construction and working of fiber modes.

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OPEN ELECTIVE PAPER-2
(to choose 1 out of 3)

Name of the course/subject: M.Sc Physics **Semester: II**
Name of the Paper: A. Spectroscopy and Lasers **Credits:3**
Hours of teaching: 3 **Paper type: Open Elective**

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Course Objectives

1. The aim of the course is to give some fundamentals of spectroscopy and lasers.
2. To provide good knowledge on microwave spectroscopy and its applications.
3. To teach the different regions of Infrared spectroscopy and its theory.
4. Students can acquire facts about Raman spectroscopy and its applications.
5. To learn the basics of lasers, its types and applications.

UNIT 1: Microwave Spectroscopy

Classification of molecules-Interaction of radiation with rotating molecule-Rotational spectra of rigid diatomic molecules-Non-rigid rotor-Linear ployatomic molecules-Symmetric and asymmetric top molecules-Design of microwave spectrometer-Applications

UNIT 2: Infrared Spectroscopy

Introduction on Infrared spectroscopy-Vibration energy of a diatomic molecule-Morse curve and the energy of a diatomic molecule-Vibrating diatomic molecule-Vibrations of polyatomic molecules-Normal modes of molecular vibrations-Normal modes of CO_2 and H_2O molecules-Dipole moment change in CO_2 molecule-FTIR spectroscopy-Principle-Instrumentation and applications.

UNIT-3:Raman spectroscopy:

Introduction on Raman effect-Differences between Raman and Infrared Spectra-Classical and quantum mechanical picture of Raman effect-Characteristic parameters of Raman lines-Rotational Raman spectra- Vibrational Raman Spectra- Structure determination using IR and Raman Spectroscopy for CO_2 and H_2O-Laser Raman spectrometer-Principle-instrumentation-Applications of Raman spectroscopy.

UNIT-4: Laser

Basic Principle of Laser – Einstein Coefficients – Condition for light amplification – Population Inversion – Threshold Condition – Line Shape Function – Optical Resonators – Three level and four level systems.

UNIT-5: Laser Types and Applications

Solid State Lasers- Ruby and Nd-YAG Laser-Gas Lasers – He-Ne and CO_2 lasers-Application of laser in industry -cutting and welding-drilling – Surface Hardening-Medical applications.

Text Books

Unit-1 to Unit-3

1. G. Aruldhas Molecular and Structure and Spectroscopy:, PHI PVT, Ltd, New Delhi, 2007

2. H. Kaur, Spectroscopy, PragatiPrakashan, Meerut, 2017.

Unit-4 and Unit-5

1. K. Thyagarajan and AjoyGhatak, Laser Theory and Applications, Cambridge University Press, 1999.

Reference Books

1. Colin Banwell,Elaine M. McCash,Fundamentals of Molecular Spectroscopy:, TMH publishers, 2013.
2. D.N. Satyanarayana, Vibrational Spectroscopy and Applications, New Age International Publications, New Delhi, 2004.
3. G.R.Chatwal and S.K.Anand, Spectroscoy (Atomic & Molecular), Himalaya Publishing House, 2016
4. M.N.Avadhanulu, An Introduction to Laser: Theory and Applications, S.Chand and Co., New Delhi, 2001.
5. P.K. Palanisamy, Physics for Engineering, Scitech Publishing Pvt. Ltd., Chennai.

E-Materials

1. https://en.wikipedia.org/wiki/Microwave_spectroscopy
2. https://www.youtube.com/watch?v=3-8nAn0Mo6w
3. https://en.wikipedia.org/wiki/Vibrational_spectroscopy_of_linear_molecules
4. https://www.youtube.com/watch?v=58wqjy-ALLg
5. https://en.wikipedia.org/wiki/Raman_spectroscopy
6. https://www.youtube.com/watch?v=Y7GbNd8mMHg
7. https://en.wikipedia.org/wiki/Spectroscopy
8. https://www.youtube.com/watch?v=ADpmJppu83Q
9. https://www.slideshare.net/jaydipkanpariya1/ndyag-laser-working-and-construction
10. https://www.youtube.com/watch?v=XI18Is5Lp9I

Course Outcomes

1. After studied unit-1, the student will be able to learn more about microwave spectroscopy and its applications.

2. After studied unit-2, the student will be able to know the fundamentals of vibrational spectroscopy and can assign normal modes of vibrations for different type of molecules.
3. After studied unit-3, the student will be able to distinguish the classical and quantum theory of Raman spectroscopy and it will be applied for structural confirmation of a molecule.
4. After studied unit-4, the student will be able to derive the expression for Einstein Coefficients for Stimulated emission of Radiation and learn about three level and four level systems.

5. After studied unit-5, the student will be able describe the different types of Laser and know the condition for population inversion and can study the Laser applications.

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OPEN ELECTIVE PAPER-2
(to choose 1 out of 3)

Name of the course/subject: M.Sc Physics **Semester: II**
Name of the Paper: B. Physics for competitive Exams **Credits:3**
Hours of teaching: 3Paper type: Open Elective
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Course Outcomes

1. Understand the principle of mechanics and properties of matter.
2. Analyze, understand and solve the problems in thermodynamics.
3. To study the basics of magnetic field and related phenomenon
4. Understand principles physical optics and lasers
5. To expose an idea about modern physics and electronics

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UNIT -1: General mechanics and Properties of matter

Scalars and Vectors(Concepts), Newton's Equations of Motion, impulse, Principle ofconservation of Linear momentum- Direct Collision between two smooth spheres- Circular motion-Relation between linear velocity and angular velocity-Centripetal force- banking of Curved roads- Newton's Lawof Gravitation- Variation ofacceleration due to gravity with altitude and depth-Kepler's Laws-Escape velocity- Elasticity-Introduction-Bending of Beams-Cantilever-Viscosity-Poiseuille's method- SurfaceTension-Drop weight method

UNIT-2: Thermodynamics

Boyle's Law, Charle's Law-Ideal gas equation-First law of thermodynamics-Second law of thermodynamics-Carnot Engine- thermodynamic scale of temperature concepts of entropy – temperature entropy diagram – entropy of perfect gas.

UNIT-3: Magnetism

Magnetic field-magnetic intensity-magnetic lines of force-magnetic flux-Biot-Savart's law-straight conductor, circular coil, solenoid carrying current-Lenz's law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

UNIT-4: Optics and Laser

Interference- Theory of thin films – Air wedge – Determination of diameter of a thin wire by air wedge –Diffraction-Fresnel and Fraunhofer Diffraction- Polarization-Double refraction-Optical Activity - Specific Rotatory Power.

Laser: Properties of laser- spontaneous and stimulated emission- population inversion, optical pumping- construction and working of Ruby Laser- applications of lasers.

UNIT-V: Modern physics and Electronics

Bohr's theory-Hydrogen spectrum, Nuclear Physics, Binding Energy, X-rays, Alpha,Beta and Gamma rays, Einstein's photo electric effect-Mass-Energyrelation- Semi-conductors-PN Junction Diodes-Half wave rectifier-Zener diode-Voltage regulator-LED-Transistors-NPN-PNP-Modes of Transistors-CE Characteristics of a transistor-Single stageAmplifier.

Text Books

Unit-1

1. R Murugeshn, Mechanics and Mathematical Methods,S Chand Pvt Ltd, New Delhi 2016.
2. R Murugeshn, Properties of Matter,S Chand Pvt Ltd, New Delhi 2016.
3. K Ilangovan, Properties of Matter and Sound, Ananda Book Depot, Chennai, 2018.
4. N Subramaniam&BrijLal, Properties of Matter, S.ChandCo.,Ltd, New Delhi,2001

Unit-2

1. N Subramaniam&BrijLal, Heat and Thermodynamics, S.ChandCo.,Ltd, New Delhi,2001

Unit-3

1. R Murugeshan, Electricity and Magnetism, S Chand & Co., Ltd.,New Delhi, 2006

Unit-4

1. N Subramanyam&BrijLal and MN Avadhanulu, A Text Book of Optics, S.Chand& Co. Ltd,New Delhi, 2010.
2. Laser theory and applications by K. Thyagarajan and AjoyGhatak, Cambridge University Press, 1999.

Unit-5

1. R Murugeshan and KiruthigaSivaprasath, Modern Physics, S Chand & Co., Ltd.,New Delhi, 2016
2. V.K. Mehta and Rohit Mehta, Principles of Electronics, S Chand & Co., Ltd.,New Delhi, 2014

Reference Books:

1. J Jayachitra and M Gunasekaran, Properties of Matter and Acoustics, KRU Publications, Chennai, 2007.
2. D Jayaraman and K Ilangovan, Thermal Physics, Ananda Book Depot, Chennai, 2018
3. R Murugeshan, Optics & Spectroscopy, S Chand & Co., Ltd.,New Delhi, 2006
4. An Introduction to Laser : Theory and Applications by M. N. Avadhanulu, S.Chand and Co., New Delhi 2001.
5. M.ArulThalapathi, Basic & Applied Electronics, Comptek Publishers, Chennai,2010

E-materials:

1. https://en.wikipedia.org/wiki/Equations_of_motion
2. https://www.youtube.com/watch?v=xViRvJxTu6k
3. https://en.wikipedia.org/wiki/Elasticity_(physics)
4. https://www.youtube.com/watch?v=PoG14wRRQmM
5. https://en.wikipedia.org/wiki/First_law_of_thermodynamics
6. https://www.khanacademy.org/science/biology/energy-and-enzymes/the-laws-of-thermodynamics/v/first-law-of-thermodynamics-introduction
7. https://byjus.com/physics/biot-savart-law/
8. https://en.wikipedia.org/wiki/Biot%E2%80%93Savart_law
9. https://en.wikipedia.org/wiki/Wave_interference

10. https://www.youtube.com/watch?v=CAe3lkYNKt8
11. https://en.wikipedia.org/wiki/X-ray
12. https://byjus.com/physics/x-ray/
13. https://www.electrical4u.com/theory-of-semiconductor/
14. https://en.wikipedia.org/wiki/Semiconductor

Course Outcomes

1. After studied unit-1, the student will be able to understand the concept of mechanics and to study the different properties of matter
2. After studied unit-2, the student will be able to learn about First and second law of thermodynamics and also provided basics of entropy
3. After studied unit-3, the student will be able to study the magnetism and magnetic materials
4. After studied unit-4, the student will be able to explain the phenomenon of interference, diffraction and polarization and also to describe the fundamentals of laser
5. After studied unit-5, the student will be able to demonstrate the atomic structure using Bohr's theory and also derive Einstein's Mass-Energy relation. Also they acquired knowledge on fundamentals of semiconductors.

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OPEN ELECTIVE PAPER-2
(to choose 1 out of 3)

Name of the course/subject: M.Sc Physics Semester: II
Name of the Paper: C. Analog and Digital Electronics Credits:3 Hours of teaching: 3Paper type: Open Elective

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Course Objectives

1. The course gives the basics of semiconductors and it will be used to learn different type of semiconductors and can understand the concept of PN junction.
2. Rectifiers and amplifiers will be explained to know how it works
3. The basics of operational amplifiers are introduced
4. The various number systems are introduced and to understand the different codes
5. To give an insight to the students about fundamental logic gates

UNIT-1: Basics of Semiconductors

Classification of solids in terms of forbidden energy gap-Fermi level-Intrinsic and extrinsic semiconductors-N-Type and P-Type semiconductors-Forward and Reverse Bias-PN junction-PN junction Diode and Zener Diode-V-I Characteristics-Zener Diode as a Voltage regulator.

UNIT-2: Rectifiers and Amplifiers

Half-wave, Full-wave and bridge rectifier –Transistor-NPN and PNP transistors- Three modes of transistors-CE characteristics of a Transistor-Single stage amplifier-frequency response curve-Feedback amplifier.

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UNIT-3: Operational Amplifier Fundamentals

OPAMP –Symbol and Terminals -Parameter-Inverting and Non-inverting amplifier – gain - Virtual ground -Offset voltage- offset current-CMRR.

Mathematical operations-OPAMP – Sign and Scale changer -adder, subtractor and voltage follower.

UNIT-4 :Number systems

Number systems – decimal, binary, octal and hexadecimal system – Conversion from one number system to another. Codes – BCD code – Excess 3 code, Gray code –- Binary arithmetic –Binary addition – subtraction – unsigned binary numbers – sign magnitude numbers – 1's and 2's complement.

UNIT-5: Logic gates

Basic Logic gates- AND, OR using diodes- NOT gate using transistor-NAND, NOR and EXOR gates- NAND & NOR as universal gates- De Morgan's theorems and their circuit implications -Half adder- Halfsubtractor.

Text Books

Unit-1 and Unit-2

1. V.K. Mehta and Rohit Mehta, Principles of Electronics, S Chand & Co., Ltd.,New Delhi, 2014.

Unit-3 to Unit-5

1. V Vijayendiran, Introduction to Integrated Electronics, Ananda Book Depot, Chennai, 2007.

Reference Books

1. Malvino and Leech, Digital Principles and Applications, 4th Edition, Tata McGraw Hill, New Delhi, 2000.

2. Millman and Halkias, Integrated Electronics, International Edition, McGraw Hill, New Delhi, 1972.

3. M Arul Thalapapathi, Fundamentals of Digital Computers, Comptek publishers, Chennai, 1995.

E-Materials

1. https://en.wikipedia.org/wiki/Semiconductor
2. https://www.youtube.com/watch?v=CjAVfW_6juw
3. https://en.wikipedia.org/wiki/Amplifier
4. https://www.youtube.com/watch?v=WZD9RZoMhVE
5. https://en.wikipedia.org/wiki/Operational_amplifier
6. https://www.youtube.com/watch?v=XmCuCf6GZLY
7. https://www.tutorialspoint.com/digital_circuits/digital_circuits_number_systems.htm
8. https://www.elprocus.com/basic-logic-gates-with-truth-tables/
9. https://www.youtube.com/watch?v=aWp8ILQgudI
10. https://www.electrical4u.com/universal-gate-nand-nor-gate-as-universal-gate/

Course Outcomes

1. After studied unit-1, the student will be able to understand basics of semiconductors and able to distinguish between N-Type and P-Type semicondutors.
2. After studied unit-2, the student will be able to design rectifier circuits using diodes and amplifier circuits using transistors.
3. After studied unit-3, the student will be able to perform the various mathematical operations using OP-AMP.
4. After studied unit-4, the student will be able to understand the different number systems and to know how to convert one number to another number system.
5. After studied unit-5, the student will be able to demonstrate the basic logic gates AND,OR and NOT gates using diodes and transistor and also explain the Universal logic gates using NAND and NOR gates.

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CORE PRACTICAL-1

Name of the course/subject: M.Sc Physics Semester: I& II
Name of the Paper: General Practical Credits:4
Hours of teaching: 4 Paper type: Core Practical

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(Any 12 out of the given 20)

1. Young's modulus -Cornu's method - forming elliptical fringes.
2. Young's modulus Cornu's method – forming hyperbolic fringes.
3. Spectrometer-Determination of Cauchy's constants
4. Spectrometer - Polarizability of liquids.
5. Spectrometer - Charge of an electron.
6. Spectrometer- Biprism - Wavelength of monochromatic source - Refractive Index of a liquid
7. Co-efficient of linear expansion - Air wedge method.
8. Hydrogen spectrum - Rydberg's constant.
9. Solar spectrum - Hartmann's Interpolation formula
10. Viscosity of liquid - Meyer's disc.
11. Determination of Stefan's constant.
12. Determination of solar constant using Lee's Disc.
13. Thermistor-Band gap energy.
14. Electrical resistance of a metal / alloy as a function of temperature by four probe method.
15. Determination of dielectric constant of solid samples
16. Determination of dielectric constant at high frequency by Lecher wire.
17. Specific charge of an electron -Thomson's method / Magnetron method.
18. B-H loop using Anchor ring.
19. Permittivity of a liquid using RFO.
20. Measurement of Numerical aperture and attenuation characteristics of the optical fibre for variable lengths.

Text Books

1. C.C. Ouseph, U.J. Rao, V. Vijayendran, Practical Physics and Electronics, Ananda Book Depot, Chennai, 2018
2. M.N.Srinivasan, S. Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, Sultan Chand & Sons, New Delhi, 2015

Reference Books

1. Samir Kumar Ghosh, A Textbook of Advanced Practical Physics, NCBA, Kolkatta, 2000
2. D. Chattopadyay, P.C.Rakshit, An Advanced Course in Practical Physics,NCBA, Kolkatta, 2011

CORE PRACTICAL-2

Name of the course/subject: M.Sc Physics Semester: I & II
Name of the Paper: Electronics Practical Credits:4
Hours of teaching:4 Paper type: Core Practical

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(Any 12out of the given 20)

1. Construction of dual regulated power supply.
2. V-I characteristics of solar cell.
3. OP-AMP-Active 2nd order filter circuits:Low pass, High pass and Band pass filters.
4. OP-AMP- Design of Phase-shift Oscillator-Study of attenuation characteristics
5. OP-AMP- Design of Wien Bridge Oscillator-Study of attenuation characteristics.

6. OP-AMP - Solving simultaneous equations.
7. OP-AMP - Design of square wave, saw tooth wave, and Triangular wave generators.
8. OP-AMP- Design of Schmitt Trigger and construction of Monostablemultivibrator.
9. OP-AMP- Instrumentation amplifier
10. OP-AMP- Design of Pulse with modulator
11. Arithmetic operations (Adder/ Subtractor) Using IC 7483.
12. Study of (i) Multiplexer using IC 74150 for the generation of Boolean functions and(ii) Demultiplexer using IC 74154
13. Study the function of Decoder and Encoder.
14. IC 7490 -as modulus counters and display using IC-7447
15. Up-down counters - Design of modulus counters.
16. IC 7476 - 4 bit Shift Register - Ring counter and Johnson counters.
17. IC 555 –Astablemultivibrator and Voltage Controlled Oscillator.
18. IC 555 –Monostablemultivibrator and Frequency Divider.
19. IC 555 - Schmitt Trigger and Hysteresis.
20. IC 555-Temperature co-efficient of resistance
21. A/D converter using comparator LM 339.
22. Study of A/D converters-4 bit simultaneous A/D converter and successive approximation A/D converter using ADC IC 0801/IC 0804.

Text Books

1. C.C. Ouseph, U.J. Rao, V. Vijayendran, Practical Physics and Electronics, Ananda Book Depot, Chennai, 2018
2. M.N.Srinivasan, S. Balasubramanian, R.Ranganathan, A Text Book of Practical Physics, Sultan Chand & Sons, New Delhi, 2015

Reference Books

1. Samir Kumar Ghosh, A Textbook of Advanced Practical Physics, NCBA, Kolkatta, 2000
2. D. Chattopadyay, P.C.Rakshit, An Advanced Course in Practical Physics,NCBA, Kolkatta, 2011

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SEMESTER: III

PAPER-7

CONDENSED MATTER PHYSICS

Course Objectives

1. To understand the basic crystal structures, bonding of solids and the lattice energycalculations.
2. To study the lattice dynamics and phonon momentum.
3. To explain the free electron gas in three dimensions and electronic heat capacity.

4. To understand basics concept of magnetism and its applications.
5. To study the properties of superconducting materials and its applications.

Unit-1: Crystal Physics

Types of lattices - Miller indices – symmetry elements and allowed rotations - simple crystal structures – Atomic packing factor - Crystal diffraction - Bragg's law –Scattered wave amplitude - Reciprocal lattice (sc, bcc, fcc) – Diffraction conditions - Laue equations – Brillouin Zone - Structure factor - Atomic form factor - Inert gas crystals.

UNIT-2: Lattice Dynamics

Monoatomic lattices - Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Einstein's model and Debye's model of specific heat.

UNIT-3: Band theory of metals and Semiconductors

Free electron gas in three dimensions - Electronic heat capacity - Wiedmann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penny model - Semiconductors - Intrinsic carrier concentration – Temperature dependence - Mobility - Impurity conductivity – Impurity states - Hall effect.

UNIT-4: Magnetism

Diamagnetism - quantum theory of Paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - ferromagnetic domains - Bloch Wall - Spin waves - Quantization - Magnons - thermal excitation of magnons

UNIT-5: Super conductors and its applications

Experimental facts: Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - Entropy and heat capacity - Isotope effect - Energy gap - Type I and Type II superconductors. Theoretical explanation: Thermodynamics of super conducting transition - London equation - BCS Theory - Coherence length –- Cooper pairs - Single particle Tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature super conductors - SQUIDS.

Text Books

Unit 1 to Unit 5

1. S.O. Pillai, Solid State Physics, New Age International, New Delhi, 2016.

Reference Books

1. C. Kittel, Introduction to Solid State Physics, 7th Edition, Wiley, New York, 1996.
2. M. Ali Omar, Elementary Solid State Physics-Principles and Applications, Addison-Wesley, London, 1974.
3. K.Ilangovan, Solid State Physics, S. Viswanathan (Printers&Publishers) Pvt.Ltd.,Chennai,2007.
4. N.W. Aschroft, N.D. Mermin, Solid State Physics, Rhinehart and Winton, New York.
5. J.S. Blakemore, Solid State Physics, 2nd Edition, W.B. Saunder, Philadelphia, 1974.
6. A.J. Dekker, Solid State Physics, Macmillan India, New Delhi.
7. H.M. Rosenburg, The Solid State, 3rd Edition, Oxford University Press, Oxford, 1993.
8. S.L. Altmann, Band Theory of Metals, Pergamon, Oxford.
9. M.A. Wahab, Solid State Physics, Structure and Properties of Materials, Narosa, New
10. Delhi, 1999.
11. J.M. Ziman, Principles of the Theory of Solids, Cambridge University Press, London, 1971.

E-Materials

1. https://web.iit.edu/sites/web/files/departments/academic-affairs/academic-resource-center/pdfs/Miller_Indices.pdf
2. https://www.youtube.com/watch?v=LcoUFX3_A1s
3. https://www.youtube.com/watch?v=-MTYPNfVw5Y
4. https://en.wikipedia.org/wiki/Brillouin_zone
5. http://yclept.ucdavis.edu/course/215b.W17/Kronig-Penney_Rapp-3.pdf
6. https://www.youtube.com/watch?v=6EdotZPaCIA
7. https://www.youtube.com/watch?v=IMbGqcb8aN4
8. https://en.wikipedia.org/wiki/Hund%27s_rules
9. https://en.wikipedia.org/wiki/Meissner_effect
10. https://www.youtube.com/watch?v=NVeAmKUbXvA

Course Outcomes

1. After studied unit-1, the student will be able to know the types of lattices and crystal structures.
2. After studied unit-2, the student will be able to explain lattice dynamics like Einstein's model and Debye's model of specific heat.
3. After studied unit-3, the student will be able to studyBand theory of metals and semiconductors and also able to explain Kronig-Penny model.
4. After studied unit-4, the student will be able to understand the quantum theory of paramagnetism and ferromagnetism.

5. After studied unit-5, the student will be able to basics of superconductors and its applications. Also able to differentiate Type I and Type II superconductors.

PAPER-8

NUCLEAR PHYSICS

Course Objectives

1. To teach the basic properties of nuclear properties like energy levels, angular momentum, parity and isopin.
2. To study the alpha, beta, gamma decay and nuclear reactions.
3. To acquire the knowledge on different nuclear models
4. To know the principle and working of nuclear detectors.

5. To learn the classification of elementary particles and its properties.

UNIT-1: Nuclear Properties

Nuclear energy levels - Nuclear angular momentum, parity, isospin – Nuclear magnetic dipole moment – Nuclear electric quadropole moment - Ground state of deuteron – Magnetic dipole moment of deuteron – Proton-neutron scattering at low energies – Scattering length, phase shift – Nature and properties of nuclear forces – Spin dependence – Charge symmetry – Charge independence – Repulsion at short distances – Exchange forces – Meson theory.

UNIT-2:Decay and Reactions

Alpha decay: Energy relations - Q values –Spectrum and selection rules - Gamow's theory.
Beta decay: Energy relations - Q values – Spectrum - Pauli's neutrino hypothesis – Electron capture -Fermi's theory of beta decay – Selection rules .
Gamma decay- Kinematics of Gamma decay – Spectrum – Internal conversion – Selection rules
Nuclear Reactions -Types and conservation laws – Q-equation -Threshold energy -General solution of the Q equations – Cross section of nuclear reactions –Scattering and reaction cross section - Compound nucleus model -Breit Wigner single level formula-Ghosal's experiment

UNIT-3: Nuclear Models

Liquid drop model: Semi empirical mass formula – Applications of LDM - Mass parabola – Q-values (Alpha, Beta and Fission) – Energetics of fission – Fissility parameter - Bohr-Wheeler's theory Shell model:Evidences in favour of shell model - Shell model potential – Square well, Harmonic Oscillator, Woods-Saxon – Spin – Orbit coupling – Nuclear Ground state configuration and spin parity – Nuclear moment – Nuclear isomerism – Predictions and failures of the shell model Collective model: Vibrational model – Rotational model – Quadrupole moment – Fermi gas model

UNIT-4: Detectors and applications

Detectors: General Properties- Energy proportionality – Pulse shape – Energy resolution – Detection efficiency – Time resolution - Ionization Chamber – Geiger-Muller counter – Scintillation detectors – Semiconductor detectors Accelerators –Linear Accelerator – Cyclotron – Large Hadron Collider.
Applications – Neutron activation analysis – Rutherford backscattering spectrometry – Accelerator mass spectroscopy

UNIT-5: Elementary Particles

Nucleons, leptons, mesons, baryons, hyperons, hadrons, strange particles -Classification of fundamental forces and elementary particles – Basicconservation laws-Additional conservation laws: Baryonic, leptonic,strangeness and isospin charges/quantum numbers – Gell-mann--Nishijimaformula - Invariance under charge conjugation (C), parity (P) and time

reversal (T) -CPT theorem -Parity non-conservation in weak interactions – CPviolation – Eight-fold way and supermultiplets – SU(3) symmetry andquark model-Gell – Mann Okubo mass formula for octet and decaplet-Ideas of Standard model and Higgs particle.

Text Books

1. K. S. Krane, Introductory Nuclear Physics, John-Wiley, New York, (1987).
2. S. B. Patel, Nuclear Physics: An Introduction, Wiley-Eastern, New Delhi, (1991).
3. B. L. Cohen, Concepts of Nuclear Physics, Tata McGraw Hill, New Delhi, (1988).
4. M.L Pandya and R.P.S Yadav, Elements of Nuclear Physics, KedarNath Ram, Meerat (1994).

Reference Books

1. H. S. Hans, Nuclear Physics: Experimental and Theoretical, New Age International Publishers, New Delhi, (2001).
1. D. C. Cheng and G. K. O'Neill, Elementary Particle Physics: An Introduction, Addison-Wesley, (1979).

E-Materials

1. https://www.youtube.com/watch?v=Jf6MSWoZRmc
2. http://www.scholarpedia.org/article/Nuclear_Forces
3. https://en.wikipedia.org/wiki/Alpha_decay
4. https://www.youtube.com/watch?v=CwExbnOzc4o
5. https://www.youtube.com/watch?v=nqSs7vrF9DY
6. http://hyperphysics.phy-astr.gsu.edu/hbase/Nuclear/liqdrop.html
7. https://en.wikipedia.org/wiki/Geiger_counter
8. https://www.youtube.com/watch?v=jxY6RC52Cf0
9. https://www.youtube.com/watch?v=fivOAjr_suA
10. https://en.wikipedia.org/wiki/Gell-Mann%E2%80%93Nishijima_formula

Course Outcomes

1. After studied unit-1, the student will be able to understand the concept of nuclear energy levels, nuclear angular momentum, parity and isospin. Also able to explain nature and properties of nuclear forces.
2. After studied unit-2, the student will be able to describe Gamow's theory, Fermi's theory of beta decay and kinematics of gamma decay. Also able to derive the Breit Wigner single level formula.
3. After studied unit-3, the student will be able to differentiate different nuclear models.
4. After studied unit-4, the student will be able to know the principle and working of G.M. counter, scintillation detectors and particle accelerators.

5. After studied unit-5, the student will be able to obtain Gell-mann--Nishijimaformula and Gell – Mann Okubo mass formula. Also able to explain the classification of elementary particles.

PAPER-9

MICROPROCESSORS & MICROCONTROLLERS

Course Objectives

1. To learn interrupts of 8085, Timing diagram and assembly language programming.
2. To understand the principle of interfacing with peripheral devices
3. To acquire new knowledge on fundamentals of microcontroller 8051.
4. To study the Interrupts and instructions set of 8051and hence to acquire the knowledge on Programming.
5. To expose PUSH and POP, Jump and Call instructions and some interfacing devices.

Unit-1:Instructions & ALP

8085- Instructions- Data transfer, Arithmetic, Logical, Branch and I/O and Machine Control Instructions-Timing Diagram for Memory Read/Write Cycle-Timing diagram for MOV/MVI instructions-Delay Calculations-Time delay using a single register-Two register-Register pair.

Assembly language programs -8-bit Addition with Carry-Multibyte addition-8-bit Subtraction with Borrow-Multibyte subtraction-BCD subtraction-16-bit Multiplication-BCD Multiplication-8-bit Division-BCD division-Square and Square root-Largest and smallest numbers in a data set – Ascending order and descending order –Binary to ASCII-ASCII to Binary-BCD to ASCII and ASCII to BCD-Debugging a program.

Unit-2: Peripheral Devices and Interface (8085)

Data transfer schemes -- Synchronous and asynchronous data transfer-Interfacing memory and devices- I/O and Memory mapped I/O – Pin function, working and interfacing of Programmable peripheral interface (8255)-Programmable keyboard / display interface (8279)-Interfacing Seven segment display interface-Block diagram and interfacing of analogto digital converter (ADC) and Digital to analog converter (DAC)- Steppermotor with clockwise and anti-clockwise rotation-Traffic control.

Unit-3: Basic of Microcontroller 8051

8051 Micro-controller hardware: 8051 oscillator and clock - Program counter and data pointer - A and B CPU register - Flags and PSW - Internal memory - Internal RAM - Stack and stack pointer - Special function registers - Internal ROM-Input / output pin, ports and circuits - External memory.

Counter and Timer: Counter / Timer interrupts - Timing - Timer modes of operation – Counting-Serial data input / Output: Serial data interrupt - Data transmission - Data reception - serial data transmission modes.

UNIT-4: Interrupts & Instructions

Interrupts: Timer flag interrupt - Serial port interrupt - External interrupt - reset - Interrupt control - Interrupt priority - Interrupt destination - Software generated interrupts.

Introduction - Addressing modes - Byte level logic operations - Bit level logic operations - Rotate and swap operations - Simple program.

Arithmetic Operations: Introduction - Flags - Incrementing and Decrementing - Addition - Subtraction - Multiplication and Division - Simple Program.

Unit-5: Instructions & Interfacing

Introduction - External data move - code memory read only data move - PUSH and POP - Opcodes - Data exchange - Simple Programs.

Jump and Call instructions: Introduction - Jump and call program range - Jumps - Calls and subroutine - Interrupt and returns - more detail on interrupts - Simple programs.

Keyboard interfacing - Display interface - 7 segment and LED display - D/A conversion - A/D conversion - Stepper motor Interface.

Text Books

Unit-1 to Unit-2

1. V.Vijayendran, Fundamentals of Microprocessor 8085 - Architecture, programming and interfacing, S.Viswanathan (Printers & Publishers) Pvt, Ltd, Chennai, 2008.
2. A. NagoorKani, 8085 Microprocessor and its Applications, Tata McGraw –Hill Education Private Ltd, New Delhi,2013.

Unit-3 to Unit-5

1. Kenneth Ayala, The 8051Microcontroller,Cengage Learning India, New Delhi, 2013.

Reference Books

1. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.

2. B. Ram, Fundamentals of Microprocessors and Microcomputers, DhanpatRai publications, New Delhi.

3. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi , 2007.

4. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.

5. Muhammed Ali Mazidi, Janice Gillespie Mazidi and Rolin D McKinlay,The 8051 Microcontroller and Embedded Systems, Pearson Education , 2013.
6. P.S. Manoharan, Microprocessors and Microcontroller, Charulatha Publications.

E-Materials

1. https://en.wikipedia.org/wiki/Intel_8085
2. https://www.youtube.com/watch?v=fS7FFOaC_iQ
3. https://www.youtube.com/watch?v=tC4WvbM3hZA
4. http://www.uomisan.edu.iq/eng/ar/admin/pdf/90949589293.pdf
5. https://www.pantechsolutions.net/how-to-interface-stepper-motor-with-8085-lab-trainer-kit
6. http://www.8085projects.info/Stepper-Motor-control-Program70.html
7. https://www.youtube.com/watch?v=shJAszu34xY
8. https://www.elprocus.com/8051-microcontroller-architecture-and-applications/
9. https://www.youtube.com/watch?v=iXSXIJn_Xwc
10. https://www.electronicshub.org/stepper-motor-control-using-8051-microcontroller/
11. https://circuitdigest.com/microcontroller-projects/stepper-motor-interfacing-with-8051

Course Outcomes

1. After studied unit-1, the student will be able to know various interrupts, timing diagram for memory read/write cycle and able to write assembly language programs.
2. After studied unit-2, the student will be able to describe the different interfacing devices and can demonstrate the interfacing of DAC/ADC and stepper motor with 8085.
3. After studied unit-3, the student will be able to understand the hardware of 8051, memories, Counter and Timer.
4. After studied unit-4, the student will be able to explain the interrupts, addressing modes and arithmetic operations.
5. After studied unit-5, the student will be able todescribe PUSH-POP, jump and call instructions and able to know how to interface the peripheral devices with 8051.

CORE ELECTIVE
PAPER -3

(to choose 1 out of 3)

A. RESEARCH METHODOLOGY

Course Objectives

1. To teach the basics of research philosophies and research approaches.
2. To know how to do the review of literature.
3. To expose the importance of internet in research.
4. To learn how to write a thesis or paper.
5. To understand the different numerical methods.

UNIT-1: Basics of Research

Understanding Research Philosophies and Approaches -Meaning, Objectives and Motivation in research - Types of research - Research Approaches - Research Process - Validity and Reliability in research.

Research Design -Features of a good design - Types of Research Design - Basic principles of Experimental Design-Survey Design-Classroom-Based Research. Sampling Design - Steps in Sample Design - Characteristics of a good sample design - Random Samples and Random Sampling Design.

UNIT-2: Review of literature

Survey of literature including patents - chemical nomenclature and literature primary sources-secondary sources including reviews. Treatise and monographs, literature searching, Review of work relevant to the chosen problems.

UNIT-3: Internet and Presentation

Internet and its applications-Search engines- Wikipedia-Web of Science- SCOPUS-BASE-CORE-Google Scholar-Science Hub.

Presentation: Presenting articles in Seminars, workshops, conferences and symposia.

Publication of research paper:e-journals- National, International and Electronic Journals -UGC CARE list Journals- Open access articles benefits-citations-impact factor, h-index- copy rights-Intellectual property rights and patents.

UNIT-4 : Writing methods

Writing a thesis or paper - General formation - page and chapter formation. The use of quotation - footnotes - tables and figures - referencing - appendixes - revising the paper or

thesis - editing and evaluating and the final product - proof reading -Plagiarism-the final types copy.

UNIT-5: Numerical methods

Linear Interpolation-Gregory-Newton forward and Backward Interpolation formula--Gauss forward and backward interpolation formula.
Numerical Differentiation:-Modified Euler's method-Runge-Kutta second and fourth order method for solving first order differential equations.
Numerical Integration: Trapezoidal rule-Simpson's 1/3rd rule .

Text Books

Unit 1 to Unit 4

1. J Anderson, B.H. Dursten and M. Poole , Thesis and Assignment Writing, Wiley Eastern,1977.

2. C.R.Kothari, Research Methodology: Methods and Techniques. New Delhi: New Age International (P) Publishers, 2004.

Unit 5

1. S.S. Sastry, Introductory Methods of Numerical analysis, PHI, N.Delhi

2. E. Balagurusamy, Numerical Methods,Tata McGraw Hill, New Delhi, 2013.

Reference Books

1. R.Kumar, Research Methodology: A Step-by-Step Guide for Beginners.London: Sage Publications, (2011).
2. J.H. Mathews, Numerical Methods for Mathematics, Science and Engineering Prentice-Hall of India, New Delhi, 1998.
3. P.B. Patil and U.P. Verma, Numerical Computational Methods (Narosa, New Delhi, 2013.
4. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation (New Age International, New Delhi, 1993
5. M.K.Venkataraman, Numerical methods in Science and Engineering, National Publishing Company, Chennai ,2004.

E-Materials

1. https://en.wikipedia.org/wiki/Research_design
2. https://study.com/academy/lesson/types-of-research-design.html
3. https://www.scribbr.com/dissertation/literature-review/
4. https://www.youtube.com/watch?v=-ny_EUJXHHs
5. https://www.youtube.com/watch?v=XDfgdwMBPfc
6. https://www.colorado.edu/history/undergraduates/paper-guidelines/using-internet-research
7. https://www.ldeo.columbia.edu/~martins/sen_sem/thesis_org.html
8. https://www.wikihow.com/Write-a-Thesis-Statement
9. https://www.youtube.com/watch?v=gt3QZgMNq3s
10. https://en.wikipedia.org/wiki/Simpson%27s_rule

Course Objectives

1. After studied unit-1, the student will be able to know the basics of research theories, approaches and design.
2. After studied unit-2, the student will be able to demonstrate what do you mean by review of literature and know how to proceed the research work based on review of literature.
3. After studied unit-3, the student will be able to explain the importance of internet in the field of research.
4. After studied unit-4, the student will be able to how to write a thesis or a research paper. Also students will be able to learn how to present a research article in a seminar/conference or how to publish the article in e-journals.
5. After studied unit-5, the student will be able to formulate the Euler's method, Range Kutta method,Trapezoidal rule and Simpson's 1/3rd rule of numerical methods.

CORE ELECTIVE
PAPER -3

B. MATERIAL SCIENCE

Course Objectives

1. To understand the basic concepts of phase transition materials.
2. To learn the introduction on ceramic and polymer materials.
3. To teach biomaterials for biomedical applications.
4. To expose the knowledge on nonlinear optical materials.
5. To give an idea about energy conversion and storage materials

UNIT-1: Phase transition materials

Definition and basic concepts - solubility limit -phases - microstructure –phase equilibria – unary phase diagrams-Binary phase diagrams – Binaryisomorphous systems – Interpretation of phase diagrams-Development ofmicrostructure in isomorphous alloys -mechanical properties ofisomorphous alloys- Binary eutectic systems – Development ofmicrostructure in eutectic alloys – Equilibrium diagrams having intermediatephases or components – Eutectoid and peritectic reactions -Concurrent phase transformations -ceramics and ternary phase diagrams -The Gibbs phase rule - The iron – iron carbide phase diagrams.

UNIT-2:Ceramics and Polymers

Ceramics: Introduction -Glasses - Glass Ceramics - clay products – refractory's –abrasives-cements – advanced ceramics - ceramic phase diagrams - brittle fracture of ceramics- stress - strain behavior – mechanism of plasticdeformation – miscellaneous mechanical consideration.

Polymers - Polymerization mechanism - Polymer structures - Deformation of polymers - Behaviour of polymers,

UNIT-3: Biomaterials

Introduction to biomaterials for biomedical applications, Chemical structure and property of biomaterials, Degradation of biomaterials, Polymeric biomaterials: Introduction, preparation, hydrogel biomaterials, Bioconjugation techniques, Biomaterials for drug delivery application (small molecules, gene and protein)-Biomaterials implantation- Biomaterials for imaging and diagnosis.

UNIT-4: NLO materials

Introduction-Harmonic Generation-Second Harmonic Generation-PhaseMatching-Third Harmonic Generation-Optical Mixing-Parametric Generationof Light-Selffocusing of Light– nonlinear optical materials.

UNIT-5: Energy conversion and Storage materials

Solar cells: Organic solar cells - Polymer composites for solar cells - p-njunction - Device fabrication and characterization – Nanomaterials for solarcells - Dye-sensitized solar cells - Organic - inorganic hybrid solar cells.

Batteries -primary and secondary batteries, Lithium, Solid-state and molten solvent batteries; Lead acid batteries; Nickel Cadmium Batteries; Advanced Batteries, Super capacitors for energy storage. Role of carbon nanomaterials as electrodes in batteries and super capacitors.

Text Books

Unit 1 to Unit 5

1. G.K. Narula, K.S. Narula, and V.K. Gupta, Material Science, TMH, New Delhi, 1995.
2. Dr. M.N. Avadhanulu, Material science, S.Chand& Company, New Delhi, 2014
3. V.Ragavan, Material Science and Engineering, 4th Edition, Prentice Hall of India,New Delhi, 2003.
4. M. Arumugam, Materials Science, 3rd Edition, Anuradha Agencies, 2002.

Reference Books

1. Lawrence H. Vlack, Elements of Materials Science and Engineering, 6th Edition, Second ISE reprint, Addison-Wesley, 1998.
2. H. Iabch, H. Luth, Solid State Physics, An introduction to principles of Material Science, 2nd Edition, Springer, 2001.
3. Balasubramanian. R., Callister's,Material Science and Engineering,Wiley, India, 2010.
4. A.J. Dekker, Solid State Physics, McMillan Co., 1981.

E-Materials

1. https://www.tf.uni-kiel.de/matwis/amat/iss/kap_6/illustr/s6_1_1.html
2. https://www.youtube.com/watch?v=3EFu2t94Mrw
3. https://www.youtube.com/watch?v=vnVPwf2T4Eo
4. https://en.wikipedia.org/wiki/Glass-ceramic
5. https://en.wikipedia.org/wiki/Biomaterial
6. https://nptel.ac.in/courses/113104009/
7. https://www.slideshare.net/krishslide/nonlinear-optical-materials
8. https://shodhganga.inflibnet.ac.in/bitstream/10603/36565/4/chapter%201.pdf
9. https://en.wikipedia.org/wiki/Dye-sensitized_solar_cell
10. https://www.youtube.com/watch?v=17SsOKEN5dE

Course Outcomes

1. After studied unit-1, the student will be able to know the concepts of phase diagrams and phase transformations.
2. After studied unit-2, the student will be able to explain the property of ceramic materials and also able to learn polymerization mechanism.

3. After studied unit-3, the student will be able to explain the chemical structure and property of biomaterials.
4. After studied unit-4, the student will be able to understand the properties NLO materials and its harmonic generation.
5. After studied unit-5, the student will be able to design the energy conversion and storage materials.

CORE ELECTIVE
PAPER -3

C. NUMERICAL METHODS & C PROGRAMMING

Course Objectives

1. To learn the fundamentals of numerical differential and integration
2. The course gives the principles of scientific research
3. Students can study the basics of C programming
4. To acquire knowledge on operator, arrays and strings
5. To teach how to write the simple programs using C language

UNIT-1: Numerical methods

Solutions of equations - Simple iterative methods - Newton - Raphson method - Numerical Integration - Simpson's 3/8 rule - RungeKutta method II order - Solution of Simultaneous equation.

UNIT-2: Principles of Scientific Research

Identification of the problem - Literature survey - Reference collection - Familiarity with ideas and concept of investigation – Use of Internet in research - Drawing Inferences from data – Qualitative and Quantitative analysis - Results – Presentation in a Seminar - Synopsis writing - Art of writing a Research paper and Thesis - Power point presentation

UNIT-3: Programming in C

Introduction –Importance of C language - Basic structure of C Programming - Character set - constants - Keywords - Identifiers - Variables - declaration of variables - Assigning values to variables - defining symbolic constants – Types of Operators - Arithmetic, relational, logical, assignment, increment, decrement conditional and special type conversion in Expressions.

UNIT-4: Operators, Arrays and Strings

Arrays:Introduction - one, two and multi-dimensional arrays - Initializing two dimensional arrays - Declaring and Initialising string variables - Reading and Writing Strings on the screen – Arithmetic operations on strings.

UNIT-5: Simple Programs

Multiplication programs - Return values and their types - Calling Functions - Categories of functions - Matrix multiplication - Diagonalisation and inversion - Solution to simultaneous equations - differential and integral equations.

Text Books

Unit 1

1. S.S. Sastry, Introductory Methods of Numerical analysis, PHI, N.Delhi
2. E. Balagurusamy, Numerical methods, Tata McGraw-Hill, Delhi

Unit 2

1. J. Anderson B.H. Burston and M. Poole, Thesis and Assignment writing, Wiley, UK,1977
2. Rajammal.P. Devadas, Hand book of Methodology of Research, RMM Vidyalaya Press. 1976

Unit 3- Unit 5

1. E. Balagurusamy, Programming in ANSI C, 4th Edition TMH, New Delhi, 2009
2. V. Rajaraman, 1993, Computer Oriented Numerical Methods, 3rd Edition, PHI, New Delhi.

Reference Books

1. V. Rajaraman, Programming in C, PHI, New Delhi.
2. C.R. Kothari, Research methodology : Methods and Techniques, New Age International Publishers
3. S.D. Conte and C.de Boor, Elementary Numerical analysis-an algorithmic approach, 3rd Edition, McGraw Hill,1981
4. B.F. Gerald, and P.O. Wheatley, Applied Numerical analysis, 5th Edition, Addison-Wesley, M.A,1994

E-Materials

1. https://nptel.ac.in/courses/122102009/
2. httphttps://www.scribbr.com/dissertation/literature-review/s://math.dartmouth.edu/~m3cod/klbookLectures/406unit/trap.pdf
3. https://uscupstate.libguides.com/c.php?g=627058&p=4389968
4. https://www.geeksforgeeks.org/c-language-set-1-introduction/
5. https://www.youtube.com/watch?v=KJgsSFOSQv0
6. https://www.youtube.com/watch?v=aMpsKnf6DrQ
7. https://www.studytonight.com/c/programs/
8. https://www.youtube.com/watch?v=Yzfl3rtF0SM
9. https://learnenglish.britishcouncil.org/writing-purpose/literature-surveys-structure-1
10. https://www.tutorialspoint.com/cprogramming/c_arrays.htm

Course Outcomes

1. After studied unit-1, the student will be able to get the solutions using different numerical methods.
2. After studied unit-2, the student will be able to explain the fundamentals of research and know how to write a thesis or paper.
3. After studied unit-3, the student will be able to understand the basic structure of C programming.
4. After studied unit-4, the student will be able to learn the one, two and multidimensional arrays and also know the reading and writing strings.
5. After studied unit-5, the student will be able to write different programs after learning the structure of C programming.

OPEN ELECTIVE
PAPER -3
(to choose 1 out of 3)

A. ELECTRICAL AND ELECTRONICS APPLIANCES

Course Objectives

1. The course gives the some fundamental knowledge of electrical and electronics technology
2. To identify the discrete components will be used in electrical circuits
3. To know basics of household electrical connections
4. To expose the principle and design of electrical appliances used in our day-today life
5. To teach basics of semiconductors and related electronics circuits
6. To give the fundamentals and working design of consumer electronics appliances

UNIT-1: Basics of Electrical Technology I

Resistance and its types – capacitance and its types – Colour codes-inductance and its units – Transformers – Electrical Charge – Current – Electrical Potential-Ohm's law – Galvanometer, Ammeter, Voltmeter and Multimeter -Analog and Digital - Electrical Energy - Power – Watt – kWh – Consumption and electrical power.

UNIT-2: Basics of Electrical Technology II

AC-Single phase and three phase connections - House wiring – Star and delta connection – overloading-Earthing-short circuiting-Fuses-Colour code for insulation wires- Transformers

UNIT-3: Electrical Appliances

Electric iron Box-Electric Fan-Construction and Working of Ceiling and Table fans-Water Heater –Types-Function -Wet Grinder-Mixer Grinder-Principle and Design

UNIT-4: Basics of Electronics

Semiconductors-Junction diode-Zener diode-LED- Transistor-configurations – diode half wave and full wave rectifier -Regulated power supply using Zener diode-Transistor amplifier

UNIT-5: Electronics Appliances

Scientific Calculators, Personal computer-Lap Top-Smart Phones- Laser Printer-Color TV-OLED-QLED TV-Refrigerator-Washing Machine – Function – Types – Semi and Fully Automatic-Top and Front loading-washing technique-Air Conditioner, Microwave Oven-Principle and Design

Text Books

Unit-1 to Unit-4

1. B L Theraja , A text book in Electrical Technology,S. Chand & Co., New Delhi, 2013
2. V K Metha , Principles of Electronics by, S. Chand & Co., 2001.
3. R.S Sedha, A Text Book of Digital Electronics, S.Chand&CO.Ltd., New Delhi,2010
4. Performance and design of AC machines – M G Say ElBSEdn.

Unit-5

1. S.P Bali, Consumer Electronics, Pearson, 2004

Reference Books

1. Bagde and Singh, Elements of Electronics, S. Chand & Co., New Delhi, 2000.
2. Gulati, Monochrome and Colour TV,New Age International (P) limited, Publishers, New Delhi, 2005
3. Mitchel Schultz, Grob'sBasic Electronics,McGraw Hill NY ,2010.

E-Materials

1. https://www.allaboutcircuits.com/textbook/reference/chpt-2/resistor-color-codes/
2. https://www.youtube.com/watch?v=SjlnW5g9np4
3. https://circuitglobe.com/difference-between-single-phase-and-three-phase.html
4. https://www.youtube.com/watch?v=r_DGW3OrPVg
5. https://www.youtube.com/watch?v=NNkoAJkXUAw
6. https://www.slideshare.net/ideseditor/533-28626238
7. https://en.wikipedia.org/wiki/Semiconductor
8. https://www.youtube.com/watch?v=CjAVfW_6juw
9. https://www.youtube.com/watch?v=7HiNABH1kYE
10. https://mrwashingmachine.in/working-principle-of-washing-machine/

Course Outcomes

1. After studied unit-1, the student will be able to identify the given discrete components like resistors using color coding method.
2. After studied unit-2, the student will be able to understand the theory of household electrical connections.
3. After studied unit-3, the student will be able to know the principle and working of some household electrical appliances.
4. After studied unit-4, the student will be able to acquire knowledge about theory of semiconductors.
5. After studied unit-5, the student will be able to know the principle and working of some household electronics appliances.

OPEN ELECTIVE
PAPER -3

B. PHYSICS OF MATERIALS

Course Objectives

1. To teach the basics of bonding in crystals
2. Students can learn the diffraction of X-Rays by crystals
3. To expose the classical and quantum free electron theory of metals
4. To discuss the theory of different energy bands in solids
5. To explain the introduction and properties of superconductors

Unit-1: Crystals

Basic concepts-Symmetry elements-Bravais Lattice-Miller Indices-Basic definitions of crystal structure-BCC and Cesium chloride structure-Bonding in solids: Types of bonds in crystals - Ionic, Covalent, Metallic, Molecular andHydrogen bonds.

UNIT-2: Diffraction of X-Rays by crystals

X-ray diffraction: Derivation of Bragg's law - Bragg spectrometer –Determination of interatomic distance-Determination of interplanar distance-Interpretation of X-ray diffraction pattern - Laue's, Rotating crystal and Powder methods.

UNIT-3: Conductors

Classical free electron theory- Expression for electrical conductivity-Verification of Ohm's law-Thermal conductivity- Expression for thermal conductivity-Wiedmann-Franz law and Lorentz number- Quantum free electron theory of metals

UNIT-4: Semiconductors

Energy bands in solids: Classification of solids on the basis of energy band theory - Semiconductors- n type and ptype semiconductors - Fermi level in intrinsic semiconductorElectrical conductivity-Determination of band gap-Hall effect-Determination of Hall coefficient

UNIT-5: Superconductors

Introduction-Properties of superconductors-Meissner effect-Types of Superconductors-Type I and Type II-BCS theory of superconductivity-Cooper pair-Josephson Effect-Applications.

Text Book

Unit 1 to Unit 5

K. Ilangovan, Solid State Physics, S. Viswanathan, Printers & Publishers Private Ltd, Chennai, 2007

Reference Books

1. S.O. Pillai, Solid State Physics, New Age International Publishers, 2015.
2. C. Kittel, Introduction to Solid State Physics ,Wiley Eastern Limited,2005.
3. Saxena, Gupta &Saxena, Fundamentals of Solid State Physics, PragatiPrakashan, Meerut, 2015.

E-Materials

1. https://en.wikipedia.org/wiki/Crystal_structure
2. https://byjus.com/chemistry/crystal-structure/
3. https://en.wikipedia.org/wiki/Bragg%27s_law
4. https://www.youtube.com/watch?v=8Gma_FfCl2A
5. https://www.youtube.com/watch?v=vMZOYpOUGZ8
6. http://en2k6.blogspot.com/2008/02/free-electron-theory.html
7. https://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1
8. https://www.youtube.com/watch?v=_AwjbHzwWLo
9. https://www.youtube.com/watch?v=Vqx21iqQ7cI
10. https://en.wikipedia.org/wiki/Meissner_effect

Course Outcomes

1. After studied unit-1, the student will be able to learn the basics of crystal structure and various types of bond exists in the crystals
2. After studied unit-2, the student will be able to know the statement of Bragg's law and to study the Diffraction of X-ray by different methods
3. After studied unit-3, the student will be able to understand the classical and quantum theory of free electrons in metals
4. After studied unit-4, the student will be able to distinguish between intrinsic and extrinsic semiconductor and can determine the Hall coefficient of a material
5. After studied unit-5, the student will be able to describe the properties of superconductors and hence the students can distinguish Type I and Type II superconductors

OPEN ELECTIVE
PAPER - 3

C. GEOPHYSICS

Course Objectives

The aim of the course is to understand physical properties of Earth through Physics principles

1. To learn the different concepts related to the earth
2. Study of earth with geophysical and geochemical methods
3. To give an introduction about seismology
4. To study the properties of earth with reference to magnetic field
5. To inculcate knowledge on radioactivity of earth and its thermal properties

Unit 1: Physics of the Earth

Introduction to Geophysics- Earth as a member of the solarsystem-Atmosphere-Ionosphere-Asthenosphere-Lithosphere-Hydrosphere and Biosphere-Meteorology-Oceanography andHydrology.

Unit 2: Geophysical and Geochemical methods

Geophysical methods: Geo referencing using Arc GIS software-Electrical methods-Qualitative interpretation of VerticalElectrical Sounding curves –Preparing pseudo cross section forelectrical resistivity data and interpretation
Geochemical methods: Introduction-Principles of groundwaterchemistry-Sources of contamination- Ground water qualityanalysis.

Unit 3: Introduction to Seismology

The earth's interior and crust as revealed by earthquakes-Rayleigh waves and Love waves-Elastic rebound theory-Continental drift-Earthquake magnitude and intensity-Horizontal seismograph and seismograph equation-Tsunami-Causes andImpacts-Tsunami warning systems.

Unit 4: Geomagnetism and Gravity

Historical introduction –The physical origin of magnetism-Causes of the main field-Dynamo theory of earth's magnetism-Gravitational potential-Laplace's equation and Poisson'sequation-Absolute and relative measurements of gravity-Worden gravimeter.

Unit 5: Geochronology and Geothermal physics

Radioactivity of the earth-Radioactive dating of rocks andminerals-Geological time scale-The age of the earth-Flow of heat to the surface of the earth –Sources of heat withinthe earth-Process and heat transport and internal temperature ofearth.

Text Books

1. Cook,A.H , Physics of the Earth and Planets, McMillanPress,London,1973.
2. Arthur W.Hounslow, Water quality data -Analysis and,Interpretation, Lewis publishers, Washington D.C.1995
3. G.P.Mahapatra,. Physical Geology,CBSPublishers,New Delhi,1994.

Reference Books

1. Garland, Introduction to Geophysics 11 edition, WBSaunder Company, London, 1979.
2. William Lowrie, Fundamentals of Geophysics, 11Edition, Cambridge press,UK.
3. Nils-Axel Morne, Geochronology-Methods and casestudies, INTECH publications .
4. John Raferty, Geochronology –Dating and Precambriantime –The beginning of the world as we know it,Britannica Educational publishers, New York-2011.
5. Don L.Anderson, Theory of the Earth, Blackwellscientific Publications-UK, 1979

E-Materials

1. https://en.wikipedia.org/wiki/Earth_science
2. https://en.wikipedia.org/wiki/Earth
3. https://www.youtube.com/watch?v=JGXi_9A__Vc
4. https://www.youtube.com/watch?v=-ZFmAAHBfOU
5. https://mangomap.com/gis-software
6. https://en.wikipedia.org/wiki/Earthquake
7. https://www.youtube.com/watch?v=GQQCvsxHtJo
8. https://www.youtube.com/watch?v=fQt6UaR8Fcw
9. https://en.wikipedia.org/wiki/Gravimeter
10. https://www.radioactivity.eu.com/site/pages/Earth_Heat.htm
11. https://www.youtube.com/watch?v=46MN_okpKbQ

Course Outcomes

1. After studied unit-1, the student will be able to explain about solar system and atmosphere, ionosphere etc.
2. After studied unit-2, the student will be able to demonstrate geo referencing using GIS software and to test the contamination of ground water using geochemical method.
3. After studied unit-3, the student will be able to describe about earthquakes and natural disaster Tsunami and its impacts
4. After studied unit-4, the student will be able to learn about the earth in the presence of magnetic field and gravity
5. After studied unit-5, the student will be able to know the radioactivity of the earth, can calculate the radioactive dating of rocks and minerals and thermal properties of the earth.

SEMESTER IV

PAPER - 10

SPECTROSCOPY

Course Objectives

1. To give an idea about rotational spectra of different molecules using rotational spectroscopy
2. To study the vibrational spectroscopy of diatomic and polyatomic molecules using Infrared spectroscopy
3. To acquire knowledge on Raman spectroscopy and its applications.
4. To expose the concept of Ultra Violet spectroscopy and its applications
5. Students can learn the theory and applications of NMR ,ESR, AAS and Mössbauerspectroscopy.

UNIT-1: Rotational (Microwave) Spectroscopy

Classification of molecules-Interaction of radiation with rotating molecule- Rotational spectra of Rigid –Isotope effect in rotational spectra- Intensity of rotational lines-Non-rigid rotator-Linear polyatomicmolecules- Symmetric and asymmetric top molecules-Stark effect-QuadrupoleHyperfine Interaction-Microwave spectrometer Instrumentation-Applications..

UNIT-2: Infrared spectroscopy

Introduction- Vibrational energy of a diatomic molecule-Vibrating diatomic molecule-Diatomic vibrating rotator-Vibrations of polyatomic molecules-Normal modes of molecular vibrations- Normal mode vibrations of CO_2 and H_2O molecules-Dipole moment change in CO_2 molecule-Hydrogen bonding-Interpretation of vibrational spectra-Instrumentation of IR spectrometer-FTIR spectroscopy-Principle, Instrumentation, sample handling techniques and applications-ATR Technique.

UNIT-3: Raman Spectroscopy

Classical theory of Raman Scattering - Quantum theory of Raman effect-Rotational, Vibrational Raman spectra of molecules; Structure determination using IR and Raman spectroscopy-Instrumentation of Raman spectrometer-Coherent anti-Stokes Raman Spectroscopy - Surfaces for SERS study – Enhancement mechanism – Instrumentation and sampling techniques - FT Raman Spectroscopy: Principle, Instrumentation, sample handling techniques and applications.

UNIT-4: UV Spectroscopy

Energy levels-Molecular orbitals-Theory of UV (electronic) spectra-Franck Condon Principle -transition Probability, measurement of spectrum – Types of transition in Organic molecules -

Types of absorption bands – transition in metal complexes – Selection rules Chromophore concept – Applications of UV Spectroscopy.

UNIT-V: NMR, ESR, AAS and MössbauerSpectroscopy

Magnetic properties of nuclei-Resonance Condition-NMR instrumentation-Relaxation Process--Bloch equations - Chemical shifts –NMR Imaging.

Introduction-Principle of ESR - ESR spectrometer-Hyperfine Structure- ESR spectrum of Hydrogen.

Atomic Absorption Spectroscopy (AAS): Principle of AAS-single beam Spectrophotometer - Applications of AAS.

Mössbauer Effect - Recoillness emission and absorption - Mossbauer spectrum -Experimental methods - Mossbauer spectrometer-Applications.

Text Books

Unit 1 to Unit 3 and Unit 5

1. G. Aruldas, 2001, Molecular Structure and Spectroscopy, Prentice - Hall of India Pvt.Ltd., New Delhi.

Unit 4

1. H. Kaur, Spectroscopy, PragatiPrakashan, Meerut, 2017.

Reference Books

1. Colin Banwell, Elaine M. McCash,Fundamentals of Molecular Spectroscopy:, TMH publishers, 2013.
2. D.N. Satyanarayana, Vibrational Spectroscopy and Applications, New Age International Publications, New Delhi, 2004.
3. G.R.Chatwal and S.K.Anand, Spectroscoy (Atomic & Molecular), Himalaya Publishing House, 2016

E-Materials

1. https://en.wikipedia.org/wiki/Microwave_spectroscopy
2. https://www.youtube.com/watch?v=3-8nAn0Mo6w
3. https://en.wikipedia.org/wiki/Vibrational_spectroscopy_of_linear_molecules
4. https://www.youtube.com/watch?v=58wqjy-ALLg
5. https://en.wikipedia.org/wiki/Attenuated_total_reflectance
6. https://www.youtube.com/watch?v=q0evGXCK-sY
7. https://www.youtube.com/watch?v=paZS5gv3P8g
8. https://en.wikipedia.org/wiki/Raman_spectroscopy
9. https://nptel.ac.in/content/storage2/courses/115101003/downloads/module3/lecture30.pdf
10. httpshttps://www.youtube.com/watch?v=-76hr_97m10://en.wikipedia.org/wiki/Franck%E2%80%93Condon_principle
11. https://nptel.ac.in/courses/104108078/

12. https://www.vanderbilt.edu/AnS/Chemistry/Rizzo/chem220a/Ch13slides.pdf
13. https://en.wikipedia.org/wiki/Electron_paramagnetic_resonance

Course Outcomes

1. After studied unit-1, the student will be able to study the rotational spectra of diatomic and polyatomic molecules using rotational/ microwave spectroscopy.
2. After studied unit-2, the student will be able to distinguish between the rigid rotator and non-rigid rotator and students can calculate normal modes of vibrations for H_2O and N_2O molecules.
3. After studied unit-3, the student will be able to derive the expression for classical and quantum theory of Raman effect and also to study the molecular structure of water and CO_2 molecules.
4. After studied unit-4, the student will be able to understand the qualitative idea of UV-spectroscopy and also to learn the electronic spectra of poly atomic molecules.
5. After studied unit-5, the student will be able to know qualitatively the principle, theory, instrumentation and applications of NMR, ESR, AAS and Mössbauer spectroscopy.

CORE ELECTIVE
PAPER -4
(to choose 1 out of 3)

A. CRYSTAL GROWTH AND THIN FILMS

Course Objectives

1. To introduce theories of crystal growth.
2. To teach the various mechanisms of crystal growth.
3. To study the crystal symmetry and crystal structures.
4. To know the basics of thin film deposition techniques.
5. To learn the different characterization techniques.

UNIT-1: Theories of Crystal Growth

Introduction to crystal growth – Solubility – Saturation – Supersaturation – Induction Time - nucleation – Metastable Zone width – Gibbs - Thomson equation - kinetic theory of nucleation – Classical Nucleation Theory - homogeneous and heterogeneous nucleation – different shapes of nuclei – spherical, cap, cylindrical and orthorhombic – Temkins model – BCF theory.

UNIT -2: Crystal growth Techniques

Crystal Growth Mechanisms – Solid phase – Liquid Phase and Gas Phase crystal growth - Bridgman technique - Czochralski method – Skull Melting process - Verneuil technique - zone melting – Floating Zone method - gel growth – solution growth methods – low and high temperature solution growth methods – HTSG Flux growth – vapour growth - epitaxial growth techniques - LPE – MOCVD – MBE – Deposition Techniques – PVD – CVD-Sputtering – Ion Implantation – Gel growth – Hydrothermal Growth

UNIT-3: Crystal symmetry and Structures

Symmetry operations, elements - translational symmetries - point groups - space groups - equivalent positions – close packed structures - voids - important crystal structures – Pauling's rules - defects in crystals – Amorphous - polymorphism and twinning.

UNIT-4: Thin Film deposition Techniques

Thin Films – Basic of Thin films and Nanostructures - Role of thin films in Devices - Sol-gel synthesis - Spin coating – Chemical Bath Deposition – Electro Deposition - Chemical Bath Deposition - Physical Methods – Resistive Heating - Electron Beam Gun - Laser Gun-Spray pyrolysis- Evaporation and Flash Evaporations - Sputtering - Reactive Sputtering, Radio-Frequency Sputtering - ion implantation - Cathodic arc deposition - Pulsed laser deposition – Molecular beam epitaxy - Introduction to Vacuum Technology - Deposition Techniques - Films and artificial superstructures.

UNIT-5:Characterization Techniques

X – Ray Diffraction (XRD) – Powder and single crystal – Laue pattern – Spectrometry - UV-Vis-NIR Spectrometer - IR spectroscopy - Fourier transform Infrared analysis (FT-IR) – Elemental analysis – NMR: Nuclear Magnetic Resonance – ESR: Electron Spin Resonsnce – EPR: Electron Paramagnetic Resonance - Elemental dispersive X-ray analysis (EDAX) - Scanning Electron Microscopy (SEM) – Transmission Electron Microscopy (TEM) – Atomic Force Microscopy (AFM) – Luminescence Studies – Thermo Luminescence – Photo Luminescence — Etching Studies (Chemical) – Micro hardness tests – Vickers – Brinells - Micro hardness – TGA-DTA studies - Dielectric studies – Harmonic generation tests – SHG-higher generation tests.

Text Books

Unit 1 to Unit 3

1. H.E.Buckley. Crystal growth. John Wiely& sons, New York,1981.
2. P.Ramasamy and P.Santhanaraghavan. Crystal growth processes and methods. KRU Publications, 2000.

Unit 4

1. A.Goswami, Thin Film Fundamentals, New Age International (P) Limited, New Delhi ,1996.

Reference Books

1. J.C. Brice, Crystal Growth Processes, John Wiley and Sons, New York (1986)
2. S.O.Pillai, Solid State Physics, New Age International Publishers, 2016.
3. D.Elwell and H.J.Scheel. Crystal growth from high temperature solution. Academic Press, New York,1995.
4. R.A.Laudise. The growth of single crystals. Prentice Hall, Englewood,1970.
5. L.V.Azaroff. Elements of X-ray crystallography. Techbooks, 1992.
6. J.A.K.Tareen and T.R.N.Kutty. A Basic course in Crystallography. University Press, 2001.
7. C.Hammond. The Basics of Crystallography and Diffraction, IUCr-Oxford University Press, 2009.
8. H.H. Willard, L.L. Meritt, J.A. Dean, F.A. Sette, Instrumental Methods of
9. Analysis ,CBS Publishers, New Delhi, 1986.
10. S. Zhang, L. Li and A. Kumar, Materials Characterization Techniques (CRC Press, BotaRacon, 2009.
11. J.C. Brice, Crystal Growth Process (John Wiley, New York, 1986).
12. M. Ohring, Materials Science of Thin Films (Academic Press, Boston, 2002) 2nd edition.
13. E. N. Kaufmann, Characterization of Materials, Volume-I,John Wiley, New Jersey,2012.

E-Materials

1. http://14.139.186.108/jspui/bitstream/123456789/16020/1/Chapter%20I%20to%20XI.pdf
2. https://www.youtube.com/watch?v=G76H7A6_iyo
3. https://www.slideshare.net/SHASHISHAW1/crystal-growth-techniques
4. https://shodhganga.inflibnet.ac.in/bitstream/10603/364/9/09_chapter%202.pdf
5. https://www.slideshare.net/AvinashAvi110/crystal-stmmetry
6. https://slideplayer.com/slide/4199534/
7. https://www.youtube.com/watch?v=ZBf46mqRGf0
8. https://shodhganga.inflibnet.ac.in/bitstream/10603/136917/10/10_chapter%203.pdf
9. https://en.wikipedia.org/wiki/Transmission_electron_microscopy
10. https://www.youtube.com/watch?v=BbBK4T5Yr3M

Course Outcomes

1. After studied unit-1, the student will be able to learn the different theories of crystal growth and able to formulate Gibbs - Thomson equation.
2. After studied unit-2, the student will be able to demonstrate the Bridgman technique, Czochralskimethod ,Skull Melting process etc. of crystal growth.
3. After studied unit-3, the student will be able to understand the symmetry operations, elements, point groups, space groups and defects in crystals.
4. After studied unit-4, the student will be able to explain the basics of thin film deposition techniques like, spin coating, chemical bath deposition, spray pyrolysis etc.
5. After studied unit-5, the student will be able to know the principle, working and applications of different characterization techniques.

CORE ELECTIVE
PAPER -4

B. MEDICAL PHYSICS

Course Objectives

This paper provides a broad knowledge on the

1. Interaction of Non-Ionizing Radiation
2. Applications of Laser in Medicine
3. Ultrasound in tissues and their use in medicine.
4. Medical Ultrasound Applications
5. Radio frequency and Microwaves

UNIT-1: Review of non-ionising Radiation Physics in Medicine

Different sources of Non Ionising radiation-their physical; properties-first law of photochemistry- Law of reciprocity- - Electrical Impedance and Biological Impedance - Principle and theory of thermography – applications.

UNIT-2: Tissue Optics

Various types of optical radiations - UV, visible and IR sources - Lasers: Theory and mechanism-Laser Surgical Systems-Measurement of fluence from optical sources - Optical properties of tissues – theory and experimental techniques-interaction of laser radiation with tissues –photothermal -photochemical – photoablation – electromechanical effect.

UNIT-3: Mediphotonics

Lasers in dermatology, oncology and cell biology - Application of ultrafast pulsed lasers in medicine and biology-Lasers in blood flow measurement - Fiber optics in medicine - microscopy in medicine - birefringence - Fluorescence microscope - confocal microscope - Hazards of lasers and their safety measures.

UNIT-4: Medical Ultrasound

Production, properties and propagation of ultrasonic waves- Bioacoustics – Acoustical characteristics of human body- Ultrasonic Dosimetry - Destructive and nondestructive tests - Cavitation - Piezo electric receivers, thermoelectric probe – Lithotropy - High power ultrasound in theraphy

UNIT-5: Radio Frequency and Microwaves

Production and properties - interaction mechanism of RF and microwaves with biological systems: Thermal and non-thermal effects on whole body, lens and cardiovascular systems – tissue characterization and Hyperthermia and other applications-Biomagnetism - Effects - applications.

Text Books
Unit-1

1. S. S Martellucci and A. N. Chester, Laser Photobiology and Photomedicine, Plenum Press, New York, 1985.

Unit-2

1. Markolf H. Neimz, Laser-Tissue Interactions, Springer Verlag, Germany, 1996.

Unit-3 to Unit-5

1. S. S Martellucci and A. N. Chester, Laser Photobiology and Photomedicine, Plenum Press, New York, 1985.

.**Reference Books**

1. J. R. Greening, Medical Physics, North Holland Publishing Co., New York, 1999.
2. R. Pratesi and C. A. Sacchi, Lasers in Photomedicine and Photobiology, Springer Verlag,West Germany, 1980.
3. Harry Moseley, Hospital Physicists' Association, Non-ionising radiation: microwaves,
4. ultraviolet, and laser radiation, A. Hilger, in collaboration with the Hospital Physicists,Association, 1988

E-Materials

1. https://www.youtube.com/watch?v=9TCK1Sa0_Vc
2. https://en.wikipedia.org/wiki/Thermography
3. https://en.wikipedia.org/wiki/Laser_surgery
4. https://www.indiamart.com/proddetail/co2-laser-surgical-system-3595170512.html
5. https://ilchiro.org/laser-safety-for-clinical-applications/
6. https://en.wikipedia.org/wiki/Laser_safety
7. https://grantome.com/grant/NIH/R01-HD021687-06
8. https://www.frontiersin.org/articles/10.3389/fbioe.2020.00025/full
9. https://www.youtube.com/watch?v=CY4roB9ZTEo
10. https://en.wikipedia.org/wiki/Biomagnetism

Course Outcomes

1. After studied unit-1, the student will be able to study the different sources of non-ionizing radiations.
2. After studied unit-2, the student will be able to know the various types of optical radiations like UV,IR etc.
3. After studied unit-3, the student will be able to explain the laser and fiber optic instruments for mediphotonics.
4. After studied unit-4, the student will be able to learn the properties and propagation of ultrasonic waves and also able to know the ultrasonic dosimetry.
5. After studied unit-5, the student will be able to understand the applications of radio frequency and microwaves.

CORE ELECTIVE
PAPER -4

C. MATLAB AND PYTHON PROGRAMMING

Course Objectives

1. To give an basic concepts of MATLAB
2. To teach the BODMAS rules and mathematical operations
3. To expose the fundamentals of Python programming
4. To learn the structured types, mutability and higher-order functions
5. To conceptualize the TKinter modules

UNIT-1: Introduction on MATLAB

Introduction-Use of MATLAB-Introduction to MATLAB software-MATLAB window-Command window-workspace-Command history-Setting Directory-Working with the MATLAB user interface-Basic Commands-Assigning variables-Operations with variables-Character and string-Arrays and vectors-Column vectors-Row vectors.

UNIT-2: Mathematical Operations

BODMAS rules-Arithmetic operations-Operators and special characters-Mathematical and logical operators-Creating rows and columns matrix-Matrix operations-Transpose-Determinant-Inverse-Solving Matrix-Plots-2D plots-3D Plots.

UNIT-3: Basics of Python

The basic elements of python (Software, Development Tools, Programmingwith Python, writing a Python Program, Python Interactive Shell,Values andVariables, Expressions) - Branching Programs - Control Structures – Stringsand Input – Iteration - Functions and scoping – Specifications – Recursion- Global variables – Modules – Files - System - Functions and Parameters –simple programs.

UNIT-4:Structured Types, Mutability and Higher-order Functions

Strings, Tuples, Lists and Dictionaries - Lists and Mutability - Functions asObjects – extrapolation, de'slanders table, – Classes and Object-OrientedProgramming – programs

UNIT-5: TKinter

TKinter modules -Tkinter classes - Tkinter widgets: button, canvas, frame,listbox, messagebox -widget configuration – widget styles – events andbindings - standard dialogs – GUI programs

Text Books

Unit 1

1. Amos Gilat, MATLAb an Introduction with Applications, John Wiley & Sons, INC Publication, 2004

Unit 2 to Unit 4

1. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India 2013

Unit 5

1. Tkinter manual

Reference Books

1. MATLAB 7.0 Basics, P. Howard, spring, 2005.
2. R. NageswaraRao, "Core Python Programming", dreamtech
3. Wesley J. Chun. "Core Python Programming - Second Edition", Prentice Hall
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Pyhon", Wiley
5. Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication

E-Materials

1. https://www.tutorialspoint.com/matlab/index.htmww.mathworks.com/products/matlab.html
2. http://mayankagr.in/images/matlab_tutorial.pdf
3. https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf
4. https://www.mathworks.com/videos/introduction-to-matlab-81592.html
5. https://www.youtube.com/watch?v=_uQrJ0TkZlc
6. https://www.youtube.com/watch?v=rfscVS0vtbw
7. https://www.youtube.com/watch?v=Y8Tko2YC5hA
8. https://www.programiz.com/python-programming
9. https://www.w3schools.com/python/python_intro.asp
10. https://www.tutorialspoint.com/python/python_gui_programming.htm
11. https://likegeeks.com/python-gui-examples-tkinter-tutorial/

Course Outcomes

1. After studied unit-1, the student will be able to understand the basics of MATLAB
2. After studied unit-2, the student will be able to develop skills for writing a program using MATLAB
3. After studied unit-3, the student will be able to learn the fundamentals of Python programming
4. After studied unit-4, the student will be able to know the concepts of OOPs in Python
5. After studied unit-5, the student will be able tolearn how to develop graphical user interfaces by writing some Python GUI examples using Tkinter package.

OPEN ELECTIVE
PAPER-4
(to choose 1 out of 3)

A. NANOPHYSICS

Course Objectives

1. To know the fundamentals of nanotechnology.
2. To learn about carbon nanostructures and its properties.
3. To study the preparation of nanomaterial by different methods.
4. To analyse the synthesized nanomaterial by various characterization techniques.
5. To understand the various applications of nanotechnology.

UNIT-1: Introduction to Nano and Types of Nanomaterial

Need and origin of nano - Emergence of nanotechnology with special reference to Feynman. Size & Scales: definition of nanostructures;Top-down and bottom-up approaches – Introductory ideas of 1D, 2D and 3D nanostructured material– Quantum dots -- Quantum wire – Quantum well -- Exciton confinement in quantum dots.

UNIT-2: Carbon Nanostructures

Carbon molecules and carbon bond-C60: Discovery and structure of C60 and its crystal - Superconductivity in C60-Carbon nanotubes: Fabrication - Structure-Electrical properties – Vibrational properties -Mechanical properties – Applications(fuel cells, chemical sensors, catalysts).

UNIT-3: Fabrication of Nanomaterial

Synthesis of oxide nanoparticles by sol-gel method -Electrochemical deposition method-Electrospinning method –Lithography-Atomic layer deposition-Langmuir--Blodgett films - Zeolite cages -- Core shell structures – Organic and inorganic hybrids.

UNIT-4: Characterization of Nanomaterial

Principles, experimental set-up, procedure and utility of scanning electron microscopy (SEM), transmission electron microscopy (TEM), scanning tunneling microscope (STM) and scanning probe microscopy (SPM).

UNIT-5: Applications

Molecular electronics and nanoelectronics -Nanorobots -Biological applications of nanoparticles -Catalysis by gold nanoparticles-Band-gap engineered quantum devices-Nanomechanics - CNT emitters- Photoelectrochemical cells-Photonic crystals -Plasmon waveguides.

Text Books

Unit 1 to Unit 5

1. T.Pradeep et al., A Textbook of Nanoscience and Nanotechnology,Tata McGraw Hill, New Delhi, 2012.
2. T.Pradeep , Nano: The Essentials, Tata McGraw Hill, New Delhi, 2012.
3. R.W. Kelsall, I.W. Hamley and M. Geoghegan, Nanoscale Science and
4. Nanotechnology (John-Wiley & Sons, Chichester, 2005.
5. G. Cao, Nanostructures and Nanomaterials,Imperial College Press, London, 2004.
6. C.P. Poole and F.J. Owens, Introduction to Nanotechnology,Wiley, New Delhi, 2003.

Reference Books

1. H.S. Nalwa, Nanostructured Materials and Nanotechnology,Academic Press, San Diego, 2002.
2. M. Wilson, K. Kannangara, G. Smith, M. Simmons, B. Raguse, Nanotechnology:
3. Basic Science and Emerging Technologies,Overseas Press, New Delhi, 2005.

E-Materials

1. https://en.wikipedia.org/wiki/Nanotechnology
2. https://en.wikipedia.org/wiki/Carbon_nanotube
3. https://www.nanowerk.com/nanotechnology/introduction/introduction_to_nanotechnology_22.php
4. https://www.youtube.com/watch?v=sbuIluJhT4A
5. https://www.youtube.com/watch?v=14DqBIG96W0
6. https://www.sciencedirect.com/topics/chemistry/sol-gel-process
7. https://www.slideshare.net/RamalingamGopal/sol-gel-synthesis-of-nanoparticles
8. https://en.wikipedia.org/wiki/Scanning_electron_microscope
9. https://www.youtube.com/watch?v=kdb6dHEHCA0
10. https://interestingengineering.com/15-medical-robots-that-are-changing-the-world
11. https://en.wikipedia.org/wiki/Nanorobotics

OPEN ELECTIVE
PAPER-4

B. ASTRO PHYSICS

Course Objectives

1. To acquire the knowledge of astronomical instruments
2. To understand the basic ideas of space
3. To learn about the birth of stars, color, age etc.
4. To study the complete details of our solar system
5. To gain the knowledge on celestial measurements

UNIT -1: Astronomical Instruments

Optical telescope - reflecting telescope - types of reflecting telescope - advantages of reflecting telescopes - radio telescope - astronomical spectrographs - photographic photometry - photoelectric spectrometry- detectors and image processing.

UNIT-2: Space

Introduction – Hubble's Law – Big bang theory – Shape of Universe – Expanding universe in space – Galaxies – Types of Galaxies – Spiral, Elliptical and Irregular Galaxies – Clusters of Galaxies – Milky Way – Quasars.

UNIT -3 : Stars

Birth of Stars – Colour and Age – Life of Stars – Red giant stars – With dwarf star – Neutron Star – Black hole – Supernovae – Constellations - Zodiac.

UNIT -4: Solar system

Introduction – Sun – Structure of Sun – Nuclear reactions in sun – Sun spot and solar flares – Earth – Structure of earth – Atmosphere – Moon and its structure – Inner planets – Outer planets – Asteroids – Meteors – Meteorites - Comets.

UNIT-5 :Space distance, Units and Co-ordinates

Cislunar space -Translunar space-Inter planetary distance -Interesteller space -Inter galactic space-Light Year- Astronomical Unit-Astronomical Map. Astronomical Systems - Astronomical co-ordinates -Celestial Sphere -Celestial Equators – Celestial Poles.

Text Books

1. BaidyanathBasu, An introduction to Astrophysics, Prentice Hall of India Private limited New Delhi, 2001.
2. A.Hewish., Physics of the Universe, CSIR publication, New Delhi, 1992.

Reference Books

1. BimanBasu, Inside Stars, CSIR Publication, New Delhi, 1992.
2. BimanBasu, Cosmic Vistas, National Book Trust of India, 2002.
3. K.S. Krishnasamy, Astro Physics a Modern Perspective, New Age International ,New Delhi.
4. R. Murugesan and KiruthigaSivaprasath, Modern Physics, S.Chand&Co.Pvt.Ltd, 2016.
5. Mohan SundaraRajan, Space Today, National Book Trust of India, 2000.

E-Materials

1. http://www.phy.olemiss.edu/~perera/astr325/Lec23.pdf
2. https://en.wikipedia.org/wiki/List_of_astronomical_instruments
3. https://www.youtube.com/watch?v=O0HyEEkckR0
4. https://www.youtube.com/watch?v=5bYNIY7m03w
5. https://en.wikipedia.org/wiki/The_Big_Bang_Theory
6. https://en.wikipedia.org/wiki/Galaxy
7. https://www.youtube.com/watch?v=BcjmoEspoRI
8. https://www.youtube.com/watch?v=ZrS3Ye8p61Y
9. https://en.wikipedia.org/wiki/Star
10. https://en.wikipedia.org/wiki/Solar_System
11. https://www.youtube.com/watch?v=KsF_hdjWJjo
12. https://www.youtube.com/watch?v=1Toya19H12w
13. https://en.wikipedia.org/wiki/Celestial_sphere

Course Outcomes

1. After studied unit-1, the student will be able to know the principle and working of astronomical instruments.
2. After studied unit-2, the student will be able to explain big bang theory and galaxies
3. After studied unit-3, the student will be able to demonstrate variety of stars.
4. After studied unit-4, the student will be able to describe the complete details of solar system including comets.
5. After studied unit-5, the student will be able to the units to be used for the measurements celestial distance and coordinates.

OPEN ELECTIVE
PAPER-4

C. WEATHER FORECASTING

Course Objectives

1. To learn about the elementary idea of atmosphere, atmospheric pressure etc.
2. To study how to measure wind speed, direction, rain fall etc.
3. To teach the different weather systems and hurricanes
4. To explain the climate and environmental issues related to climate
5. To give and idea about weather forecasting

UNIT-1: Introduction to atmosphere

Elementary idea of atmosphere: physical structure andcomposition; compositional layering of the atmosphere; variation of pressure andtemperature with height; air temperature; requirements to measure air temperature;temperature sensors: types; atmospheric pressure: its measurement; cyclones andanticyclones: its characteristics.

UNIT-2: Measuring the weather

Wind; forces acting to produce wind; wind speed direction:units, its direction; measuring wind speed and direction; humidity, clouds and rainfall,radiation: absorption, emission and scattering in atmosphere; radiation laws.

UNIT-3: Weather systems

Global wind systems; air masses and fronts: classifications; jetstreams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes.

UNIT-4: Climate and Climate Change

Climate: its classification; causes of climate change;global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain,environmental issues related to climate.

UNIT-5: Basics of weather forecasting

Weather forecasting: analysis and its historicalbackground; need of measuring weather; types of weather forecasting; weatherforecasting methods; criteria of choosing weather station; basics of choosing site andexposure; satellites observations in weather forecasting; weather maps; uncertainty andpredictability; probability forecasts.

Text Books

Unit 1 to Unit 5

1. Chandrasekar, Basics of AtomsphericScience,PHI Learning Pvt Ltd, New Delhi,2010
2. Howard J Critcchfield, General Climatology, Prentice Hall of India, Pvt Ltd, New Delhi, 1975

Reference Books

1. I.C. Joshi , Aviation Meteorology, Himalayan Books, 2014
2. Stephen Burt, The weather Observers Hand book, Cambridge University Press, 2012
3. S.R. Ghadekar ,Meteorology,Agromet Publishers, Nagpur, 2001.
4. S.R. Ghadekar ,Text Book of Agrometeorology,AgrometPublishers,Nagpur, 2005
5. Charls Franklin Brooks Why the weather, Chpraman& Hall, London. 1924
6. John G. Harvey,Atmosphere and Ocean, The Artemis Press, 1995.

E-Materials

1. https://en.wikipedia.org/wiki/Atmosphere
2. https://www.youtube.com/watch?v=6LkmD6B2ncs
3. https://www.youtube.com/watch?v=jTWwnUIygc8
4. https://weatherstationguide.com/measure-wind-speed/
5. https://en.wikipedia.org/wiki/Thunderstorm
6. https://en.wikipedia.org/wiki/Cyclone
7. https://www.toppr.com/guides/science/winds-storms-and-cyclones/thunderstorms-and-cyclones/
8. https://climatekids.nasa.gov/weather-climate/
9. https://en.wikipedia.org/wiki/Climate
10. https://en.wikipedia.org/wiki/Weather_forecasting
11. https://www.skymetweather.com/15-days-rainfall-forecast-for-india/

Course Outcomes

1. After studied unit-1, the student will be able to study the atmosphere and its physical structure and also to know the variation of pressure and temperature with height
2. After studied unit-2, the student will be able to describe the measurement of wind speed, direction humidity, rainfall and can state the radiation laws
3. After studied unit-3, the student will be able to explain the global wind systems and able to know thunderstorms and cyclones
4. After studied unit-4, the student will be able to conceptualize the classification of climate, ozone depletion, acid rain and environmental hazards due to climate change
5. After studied unit-5, the student will be able to understand the analysis and historical background of weather forecasting and know the predictability, probability of forecasts

CORE PRACTICAL-3

Semester: III& IV

ADVANCED GENERAL EXPERIMENTS

List of Experiments(Any 10 Experiments only)

1. Determination of the velocity and compressibility of the given liquid using ultrasonic interferometer.
2. Determination of the wavelength of given monochromatic source and the difference in wavelength of the two spectral lines D1 and D2 of Sodium source using Michelson Interferometer.
3. Magnetic susceptibility of a paramagnetic solution using Quincke's tube Method.
4. Determination of magnetic susceptibility of liquid by Guoy method.
5. Determination of the coercivity, retentivity and saturation magnetization of the given material using hysteresis loop tracer equipment.
6. Determination of numerical aperture of an optical fiber by using He-Ne Laser.
7. Determination of diameter of the given thin wire by diffraction method usingHe-Ne-Laser.
8. Determination of focal length of a given lens using He-Ne laser.
9. Determination of diameter of the given pinhole using He-Ne laser.
10. Determination of Planck's constant.
11. To measure the ionizing radiation from the given source using GM counter experiment
12. Determination of Hall coefficient, mobility, Hall angle and number of charge carriers by using Hall setup
13. Analysis of XRD spectrum - Determination of lattice parameters of acrystal
14. Analysis of FTIR spectrum – Vibrational assignments of a given sample
15. UV-Vis spectrometer - Analysis of UV- Vis spectrum - Determination ofabsorption coefficient and band gap

CORE PRACTICAL-4

Semester: III& IV

PROGRAMMING & PROBLEM SOLVING SKILLS

List of Experiments (Any 15 out of the given 20)

I Microprocessor 8085 programs
(Choose maximum of six programs)

1. Number conversion - 8 bit and 16 bit: BCD to Binary, Binary to BCD
2. Square and square root of BCD and HEX numbers (both 8 and 16 bit).
3. Largest and smallest numbers in a data set
4. Sum of simple series
5. Interfacing (i) Op-amp 8 bit DAC R-2R network (ii) Switching an array of LEDs.
6. ADC and interfacing IC 0809 with MPU
7. Analog to digital conversion using a DAC Comparator and MPU system.
8. Interfacing a DC stepper motor to the MPU system - clockwise and anticlockwise – full Stepping and half stepping
9. Interfacing and programming IC 0800 with MPU – Unipolar and Bipolar.
10. Interfacing a HEX keyboard to the MPU system through I/O ports.

II Microcontroller 8051 Programs
(Choose maximum of 4 programs)

1. Addition, Subtraction
2. Multiplication and Division.
3. BCD to Binary conversion and binary to BCD
4. Sorting in ascending and descending order.
5. Stepper motor interface.

III Problem Solving Skills
(Solve minimum five problems and one problem from each topic)

Topics from NET-Physical Sciences-PART "A "CORE Syllabus

1. Mathematical Physics
2. Classical Mechanics
3. Electromagnetic theory
4. Quantum mechanics
5. Thermodynamics and statistical physics

CORE PAPER-COMPULSORY

Project with viva voce

Preamble

The concept of introducing the project will help the student community to learn and apply the principles of Physics and explore the new research avenues.

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 and submit a dissertation report with a minimum of 40 pages not exceeding 50 pages.

Format for Preparation of Dissertation

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

1. Cover Page and title Page
2. Declaration
3. Certificate
4. Abstract (not exceeding one page)
5. Acknowledgement (not exceeding one page)
6. Contents (12 Font size, Times new Roman with double line spacing)
7. List of Figures/ Exhibits/Charts
8. List of tables
9. Symbols and notations
10. Chapters
11. References

Distribution of marks for Dissertation : (25+75 = 100 Marks)

Internal : 25 Marks

External : 75 Marks

(a) For Organization and presentation of Thesis	- 40 marks
(b) For the novelty /Social relevance	-10 marks
(c) Presentation of work /Participation in state/	
(d) national level Seminar/publication	- 5 marks
(e) Viva voce (Preparation, Presentation of work and Response to questions)	- 20 marks

Massive Open Online Courses (MOOCs)

Students can choose any two courses which are available on SWAYAM- NPTEL

1. A Brief Course On Superconductivity
2. Electromagnetism
3. Electronic Theory Of Solids
4. Experimental Physics - II
5. Experimental Physics III
6. Fiber Optics
7. Group Theory Methods In Physics
8. Introduction To Atmospheric And Space Sciences
9. Optical Sensors
10. Physics Of Biological Systems
11. Physics Through Computational Thinking
12. Quantum Mechanics I

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