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

The Course of Study and the Scheme of Examination

Sl. No.	Study Components		ins. hrs / week	Credit	Title of the Paper	Maximum Marks		
	Course Title					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
4	Core-Practical	Paper-1	4	0	General Practical	0	0	0
5	Core-Practical	Paper-2	4	0	Electronics Practical	0	0	0
Internal Elective for same major students (Choose any one)								
6	**@ Core Elective**	**Paper-1**	4	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)								
7	**@ Open Elective**	**Paper-1**	3	3	A.Energy Physics B.Basic Physics C. Communication Physics	25	75	100
			30	**18**		**125**	**375**	**500**
SEMESTER II						**CIA**	**Uni. Exam**	**Total**
8	Core-Theory	Paper-4	5	4	Mathematical Physics - II	25	75	100
9	Core-Theory	Paper-5	5	4	Electro Magnetic Theory	25	75	100
10	Core-Theory	Paper-6	4	4	Quantum Mechanics - II	25	75	100
11	Core-Practical	Paper-1	4	4	General Practical	25	75	100
12	Core-Practical	Paper-2	4	4	Electronics Practical	25	75	100
Internal Elective for same major students (Choose any one)								
13	**Core Elective**	**Paper-2**	3	3	A.Nanoscience B.Electronics Instrumentation C. Non- linear optics	25	75	100
External Elective for other major students (Inter/multi disciplinary papers)								
14	**Open Elective**	**Paper-2**	3	3	A.Spectroscopy and Lasers B. Physics for Competitive Exams C. Analog and Digital Electronics	25	75	100
15	***Field Study**		-	2		100	-	100
16	**Compulsory Paper**		2	2	**Human Rights & Duties**	25	75	100
			30	**30**		**300**	**600**	**900**

*** 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 registered 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

ANNAMALAI UNIVERSITY
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.

ANNAMALAI UNIVERSITY

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

Cmmutation 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/

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.

ANNAMALAI UNIVERSITY
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
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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.

ANNAMALAI UNIVERSITY,

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.

ANNAMALAI UNIVERSITY

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**
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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.

ANNAMALAI UNIVERSITY

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**

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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.

ANNAMALAI UNIVERSITY

Communication Physics

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 features
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.

ANNAMALAI UNIVERSITY,
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.

ANNAMALAI UNIVERSITY

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.

ANNAMALAI UNIVERSITY

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.

ANNAMALAI UNIVERSITY

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

ANNAMALAI UNIVERSITY

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.

ANNAMALAI UNIVERSITY
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).

E-Materials

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.

ANNAMALAI UNIVERSITY

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.

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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.

ANNAMALAI UNIVERSITY

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

.

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
3. 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.

ANNAMALAI UNIVERSITY

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.

ANNAMALAI UNIVERSITY

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

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