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Elective for **ARTS** students : Popular Physics (III Sem.)

Elective for **OTHER SCIENCE** Students : Basics of Applied Physics (IV Sem.)

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Head,  
Department of Physics
PROPERTIES OF MATTER AND THERMAL PHYSICS

Objective : To acquire the knowledge about the physical and thermal properties of materials

Unit 1 VISCOSITY AND SURFACE TENSION (15 hrs)
Streamed line motion – turbulent motion – coefficient of viscosity and its dimension – Rate of flow of liquid in a capillary tube – Poiseuill’s formula – Explained to determine viscosity by variable pressure head. Definition and dimension of surface tension – Excess of pressure over curved surfaces – Variation of surface tension with temperature – Jaegar’s experiment

Unit 2 ELASTICITY (15 hrs)

Unit 3 GASEOUS STATE (15 hrs)

Unit 4 KINETIC THEORY I (15 hrs)

Unit 5 KINETIC THEORY II (15 hrs)
TEXT BOOKS:


REFERENCES:

Objective: To give the basic concepts in differential calculus, trigonometry and algebra.

Course Outline:

Unit 1: Successive differentiation – Leibnitz’s theorem (15 hours)
Unit 2: Curvature – radius of curvature – centre of curvature – radius of curvatures in polar coordinates – evolutes (15 hours)
Unit 3: Trigonometry – expansions – hyperbolic functions – logarithm of complex numbers. (15 hours)
Unit 4: Theory of equations – formations of equations - relation between the roots and the co-efficients – sum of the powers of the roots - Reciprocal equations – transformation of equations (15 hours)
Unit 5: Groups – subgroups – cyclic groups – order of a group – order of an element (15 hours)

Book for Study:

Books for Reference:
ALLIED PHYSICS PAPER-I:
(for Maths and Chemistry students)

MECHANICS, PROPERTIES OF MATTER AND THERMAL PHYSICS

Objective: To understand the physical and thermal properties of materials

Unit 1 Gravitation (12 hrs)

Unit 2 Elasticity (13 hrs)

Unit 3 Heat (10 hrs)

Unit 4 Thermodynamics (10 hrs)

TEXT BOOKS:

REFERENCES:
Objective: To grasp the principle behind the electrical components and simple electrical instruments

Unit 1 Electricity: (12 hrs)

Unit 2 Electromagnetism (20 hrs)
Lorentz force - Biot – Savart’s Law - Magnetic induction at a point due to a straight conductor carrying current – Magnetic induction at any point on the axis of a solenoid – Force on a current carrying conductor in a magnetic field – Force experienced by an electron moving in a magnetic field – Torque on a current loop in a uniform magnetic field – Moving coil Ballistic galvanometer – Current and voltage sensitiveness of a moving coil galvanometer - Measurement of charge sensitiveness (Figure of merit of BG) – Comparison of two capacitances using B.G. – Ampere’s circuital Law.
Hysteresis – Experiment to draw M.H. curve (Horizontal method) – Energy dispersion in cycle – Importance of Hysteresis curve – Choice of magnetic material

Unit 3 Electromagnetic Induction (11 hours)

Unit 4 Transient & Alternating Currents (18 hours)
Unit 5 AC Bridges & Maxwell’s Equations  (14 hours)
AC Bridges – General Principle –Anderson’s Bridge Desauty’s Bridge– wein’s Bridge

TEXT BOOKS:

REFERENCES:
Arul Anandar College (Autonomous), Karumathur
Department of Physics - B.Sc. (Physics) Syllabus – 2015 - 16 onwards

Class : I year    Part : III Core
Semester : I & II   Total hours : 90 (45 per sem.)
Code : 15PPYP12    Credit : 3

PHYSICS LAB – I

Objective : To apply the physics principles in the following experiments and measure different physical properties

Any 14 of the following list of experiments:
1. Young’s Modulus - Uniform bending – Pin & Microscope
2. Young’s Modulus - Uniform bending – Optic lever & Telescope.
3. Young’s Modulus - Non-Uniform bending – Pin & Microscope
5. Young’s Modulus - Cantilever
6. Torsion Pendulum - Rigidity Modulus and M.I of the disc
7. Compound Pendulum – Acceleration due to gravity
8. Specific heat capacity of liquid - Method of Cooling
9. Thermal conductivity – Lee’s disc method
10. Spectrometer -μ of solid prism
11. Spectrometer -μ of hollow prism
12. Spectrometer - Dispersive power of a prism
13. Sonometer - Frequency of the tuning fork
14. Potentiometer – Calibration of Low range voltmeter
15. Potentiometer – Calibration of Ammeter
16. Dipole Moment of a magnet - Tan C method
17. Comparison of dipole moments – Tan A ,Tan B simultaneous method
18. Potentiometer – Resistance and Specific resistance
19. Moving coil Galvanometer – Current and voltage sensitiveness
20. Thermo emf - Moving Coil Galvanometer
Objective: To introduce the basic concepts in integral calculus, vector calculus, and methods to solve differential equations

Course Outline:

Unit 1: Reduction formulae – Beta and Gamma functions – Fourier series (15 hours)
Unit 2: Vector calculus – differentiation of vectors – directional derivatives – gradient, divergence and curl and their simple properties – directional derivatives – solenoidal and irrotational fields (15 hours)
Unit 3: Vector integration – line, surface and volume integrals – Green’s, Stoke’s and Gauss theorems (Statements only) and their simple applications (15 hours)
Unit 4: Exact differential equations – equations of first order but of higher degree – solvable for p, y and x – Clairaut’s equations (15 hours)
Unit 5: Laplace transforms – solving differential equations using Laplace transforms (15 hours)

Text Books:


Reference Books:

ALLIED PHYSICS PAPER-II :
(for Maths and Chemistry students)
OPTICS, ELECTRICITY, MODERN PHYSICS AND ELECTRONICS

Objective: To understand the basics of light, electricity, modern physics and electronics

Unit 1 Interference (12 hrs)

Unit 2 (10 hrs)

Unit 3 (10 hrs)

Unit 4 (13 hrs)
Junction Diodes – Forward and Reverse Bias – Diode Characteristics – LED and Zener – Bridge Rectifier with Filter Circuit (π-section only)– Transistor – CE mode characteristics
De Morgan’s Theorem – Proof with Truth Table – OR, AND, NOT, NOR, NAND and XOR Gates – NAND and NOR Gates as Universal Building Blocks.

TEXT BOOKS:
REFERENCES:
3. Murugeshan, R., Electricity and Electronics
Objective: To apply the physics principles in the following experiments and measure different physical properties

Any 14 of the following list of experiments:
1. Young’s Modulus - Uniform bending – Pin & Microscope
2. Young’s Modulus - Uniform bending – Optic lever & Telescope.
3. Young’s Modulus - Non-Uniform bending – Pin & Microscope
5. Torsion Pendulum - Rigidity Modulus and M.I of the disc
6. Compound Pendulum – Acceleration due to gravity
7. Comparison of Viscosities of two Liquids – Burette method
9. Thermal conductivity – Lee’s disc method
10. Air Wedge – Thickness of thin wire
11. Spectrometer – Grating – Normal Incidence method
12. Ballistic Galvanometer - Current & voltage sensitiveness
13. Series resonance circuit - Resonant frequency , Self-inductance (L) ,Q-factor & Band width
14. Bridge Rectifier with filter – Determination of voltage regulation factor
15. Zener diode – V-I Characteristics- Voltage regulation
16. Transistor Characteristics –CE mode
17. Single stage amplifier _ CE mode – construction & measurement of Voltage gain
18. Hartley Oscillator – frequency of Oscillations
19. Logic Gates _ AND,OR , NOT , NAND , NOR Gates using IC’s
20. Demorgan’s theorem – Verification using IC’s
BASIC ELECTRONICS

Objective: To understand the basics of electronics and electronic devices.

Unit 1 Network Analysis (15 hours)

Unit 2 Solid State Devices (18 hours)

Unit 3 Transistors (18 hours)

Unit 4 Amplifiers and Oscillators (19 hours)
Amplifiers – Common Emitter Type – Voltage Gain – Frequency Response of Amplifiers: Low, Mid and High Frequency responses - Common Base and Common Collector Amplifiers (Basics only) – Push Pull Amplifier.

Unit 5 Opto Electronics and Operational Amplifiers (20 hours)

TEXT BOOKS:
1. Theraja. B.L., 1998, Basic Electronics, S.Chand and Co. New Delhi. [Unit I – Ch.4 (relevant titles),
   Unit II – Ch.14,15,17 (relevant titles),
   Unit III – Ch.18,26,27 (relevant titles),
   Unit IV – Ch.22, 28,29 (relevant titles),
   Unit V – Ch.16, 31 (relevant titles)]
REFERENCES:
ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF CHEMISTRY

ALLIED CHEMISTRY [For First Year Maths and II Year Physics]
(For students admitted from the academic year 2012-2013 onwards)

Class : I year
Semester : I / III
Code : 12CMA114

Objectives
To enable the student to understand
- Concept of Chemical bonding
- Basic Industrial chemical processes used in fuels and in the synthesis of petrol
- Stereoisomerism in Organic Chemistry and the relation between the structure of molecules and their colour
- Rates of chemical reactions, order and its determination and the application of Le Chatelier’s principle in equilibrium processes

Unit I
Chemical Bonding
   Molecular orbitals. MO configuration of H₂, N₂, O₂, F₂. Bond order.
2. Diborane: Preparation and properties, structure, preparation and uses of NaHB₄, Borazole

Unit II
Industrial Chemistry
Synthetic petrol.

Unit III

Unit IV
Colour and constitution: chromophore, auxochrome, bathochromic shift, hypsochromic shift, hyperchromic effect, hypochromic effect.
Dyes: Classification of dyes. Azo, phthalein and triphenylmethane dyes- Preparation of methyl orange, phenolphthalein and Bismarck brown.

Unit V:
Kinetics and equilibrium
Rate, order, molecularity, pseudo first order, determination of order. Measurement of reaction rate. Effect of temperature on the rate – Arrhenius equation. Energy of activation.

Text Book
Course material provided by the Department
POPULAR PHYSICS – (elective for arts students)

Objective: To understand the nature of light and sound, sources of energy, communications, physics of the body and astrophysics.

Unit 1 Light And Sound (9 hours)

Unit 2 Energy Physics (9 hours)
- Introduction – Different forms of energy – Conventional and non-conventional energy sources – Solar energy - Wind energy – Tidal energy – Nuclear energies – Hydrogen energy – Applications

Unit 3 Communications (9 hours)

Unit 4 Astrophysics (9 hours)

Unit 5 Medical Physics (9 hours)

TEXT BOOKS:
1. Lecture notes
REFERENCES:
1. Krishnamurthy, S., et al., Ancillary Physics, Optics and Sound (Unit – I).
3. Rai, G.D., 2005, Non-conventional sources of Energy- 4th Ed., Khanna Publishers, New Delhi. (Unit II - Ch.1 – 1.1, 1.4.1, 1.4.2, relevant topics in 1.4.3, 1.5)
4. Alexis Leon and Mathews Leon, Fundamentals of Information Technology, UBS Publishers distributors Ltd. (Unit II - relevant topics in Ch.19)
6. John R. Cameron and James G. Skofronick, 1978, Medical Physics, John Willy & Sons (Unit V – relevant topics in 8.4, 14.4, 12.1, 15.8, 15.9, 17.1, X-ray, MRI, ECG, CT scan, Bloodless surgery – 16.2, 17.6, 9.4, 16.6, 4.6).
Objective: To study the basic physics behind the stars

Unit I: On the way to the stars - The Pauli principle – bosons – fermions – wave function – probability density – degeneracy pressure.


Unit III: Bohr radius and energy of the first orbit of hydrogen and deuteron - Something about stars: The forces at work – A bird’s eye view – the virial theorem

Unit IV: Classical gas – electrons want space – small hot star – smallest size possible at Tmax – when no star – smallest planet possible.

Unit V: Some further thoughts – Chandrasekar and his limit – white dwarf – neutron star.

Book for study:

1. Why are things the way they are? – G. Venkataraman, Universities Press
2. Introduction to Astronomy – Nicholes A. Panindes, Addison Wesley.
MECHANICS

Objective: To study the dynamics of rigid bodies and understand their physical properties

Unit 1 Projectile Motion (10 Hours)
Forces on a projectile – Displacement as a combination of vertical and horizontal displacements-Distance of focus from the point of projection (Definition only)- Results pertaining to the motion of a projectile-Maximum horizontal range for a given velocity-Two trajectories with a given speed and range, Projectile projected on an inclined plane

Unit 2 Impulse and Impact (12 Hours)

Unit 3 Dynamics of Rigid Bodies (13 Hours)

Unit 4 Two dimensional motion of a rigid body (10 Hours)
Motion of a rigid body rotating about a fixed axis – Compound pendulum – Reaction of the axis of the rigid body revolving about it, Equation of motion for two dimensional motion– Motion of a uniform circular disc rolling down an inclined plane – motion of a system having a heavy pulley

TEXT BOOKS:
   Unit2: 14.1-14.5
   Unit3: 17.1, 17.1.1, 18.1, 18.1.1, 18.2.1
   Unit4: 18

REFERENCES:
Arul Anandar College (Autonomous), Karumathur
Department of Physics - B.Sc. (Physics) Syllabus – 2015 - 16 onwards

Class : II year Part : III Core-5
Semester : IV Total hours : 45
Code : 12PYC243 Credit : 3

CLASSICAL AND RELATIVISTIC MECHANICS

Objective: (i) To understand the mechanics of systems of particles and their equations of motion.
(ii) To study the concept of relativity.

Unit 1 Mechanics of a System of Particles (10 hours)
External and Internal force, Centre of Mass – Conservation of Linear momentum –
Conservation of Angular momentum – Conservation of Energy (K.E., P.E.) - Conservation theorem – (Example Box Train)

Unit 2 Lagrangian Formulation (10 hours)
Lagrangian Equations from D’Alembert’s Principle. (Derivation) – Examples (Simple Pendulum, Atwood’s Machine, Compound Pendulum, Motion under central force), Lagrangian Equations in presence of Non-Conservative.

Unit 3 HAMILTONIAN FORMULATION (9 hours)
Hamiltonian Function H and conservation of energy(Jacobi’s Integral) – Physical significance, Hamilton’s Equations (Derivation) – Examples in Hamiltonian Dynamics (Harmonic oscillator, motion of a particle in central force field, Compound Pendulum, Two Dimensional Harmonic Oscillator – In Cartesian coordinates only)

Unit 4 Relativistic Mechanics I (8 hours)

Unit 5 Relativistic Mechanics II (8 hours)

TEXT BOOKS:
1. J.C. Upadhyaya July 2005, Classical Mechanics, Published by Himalya Publishing House, Mumbai
   Unit1:1.7.1, 1.7.2, 1.7.3, 1.7.5, 1.7.8- (a, b, c), 2.3, 2.4, 2.5, 2.6
   Unit2: 2.7, (Example 2, 3, 5, 8), 2.9, 2.14(2 only)
   Unit3: 3.4, 3.5, 3.7(1, 2, 4, 5(a))
   (Unit IV & V – Ch.1).

REFERENCES:
Arul Anandar College (Autonomous), Karumathur
Department of Physics - B.Sc. (Physics) Syllabus – 2015 - 16 onwards

Class : II year       Total hours : 90
Semester : III & IV   Credit : 6
Code : Hours/Week : 3

PHYSICS LAB – II

Objective : To apply the physics principles of electricity, optics, electronics and magnetism in the following experiments and measure different physical properties

Any 14 of the following list of experiments:
1. Field along the axis of the coil – Vibration magnetometer
2. Determination of M and BH – Tan A and Tan B
3. Potentiometer – Calibration of high range voltmeter
4. B.G. – Current and voltage sensitiveness
5. B.G. – Charge sensitiveness
6. B.G – Thermo emf
7. Spectrometer – i-d curve
8. Spectrometer – i-i’ curve
10. Spectrometer – grating – oblique incidence method
11. Spectrometer – Cauchy’s constant
12. Newton’s rings – radius of curvature
13. Bridge rectifier – with pi filter
14. Field along the axis of the coil – deflection magnetometer
15. Zener diode – V-I characteristics, Voltage regulation
16. Single stage RC coupled amplifier – CE mode
17. Hartley oscillator
18. Voltage doubler and tripler
19. Transistor static characteristics – CE mode
ALLIED CHEMISTRY
[For First Year Maths and II Year Physics]
(For students admitted from the academic year 2012-2013 onwards under the New CBCS)

Class: I year
Part: III Allied
Semester: II & IV
total hours: 45
Code: 12CMA223
Credit: 3

ALLIED CHEMISTRY –II

Objectives
To enable the student to understand
- Principle behind metallurgical processes
- Structure and bonding in coordination compounds
- Preparation and reactions of amino acids and carbohydrates
- Principles of chemical energetics, relation between heat and work and the concept of free energy
- Electrolytic conductance and electrochemical cells

Unit I
Metals - General methods of extraction of metals. Types of ores. Methods of ore dressing.
Reduction methods, electrical methods, types of refining Van Arkel and Zone refining.

Unit II
Coordination chemistry - Nomenclature. Werner theory. Chelation- examples. Haemoglobin
Chlorophyll - functions. EDTA and its applications in analysis.

Unit III
Amino Acids: Classification, preparation and properties of glycine and alanine. Isoelectric
point and zwitter ion. Peptide bond.
Classification of proteins by physical properties and by biological functions.
Carbohydrates: classification, preparation and properties of glucose and fructose. Conversion
of glucose to fructose and vice versa.

Unit IV
Energetics- Definition of first law thermodynamics. Types of systems. Reversible,
energy. Need for the second law. Entropy and its significance. Free energy change in a
chemical reaction. Spontaneous processes – Criteria of spontaneity of chemical reaction.

Unit V
Conductometric titrations. Salt hydrolysis. Buffer solutions and buffer action. Galvanic
cells, e.m.f. standard electrode potentials, reference electrodes. Electrochemical series and its
applications.

Text Book
Course material provided by the Department
Arul Anandar College (Autonomous), Karumathur

Department of Physics 2015 - 16 onwards

Class : I year Part : III Allied
Semester : I & II Total hours : 60 (30 per sem.)
Code : Credit : 3

PHYSICS LAB
I Maths (aided and SF), II Chemistry 2012-13 onwards

Objective : To apply the physics principles in the following experiments and measure different physical properties

Any 14 of the following list of experiments:
1. Young’s Modulus - Uniform bending – Pin & Microscope
2. Young’s Modulus - Uniform bending – Optic lever & Telescope.
3. Young’s Modulus - Non-Uniform bending – Pin & Microscope
5. Torsion Pendulum - Rigidity Modulus and M.I of the disc
6. Compound Pendulum – Acceleration due to gravity
7. Comparison of Viscosities of two Liquids – Burette method
9. Thermal conductivity – Lee’s disc method
10. Air Wedge – Thickness of thin wire
11. Spectrometer – Grating – Normal Incidence method
12. Ballistic Galvanometer - Current & voltage sensitiveness
13. Series resonance circuit - Resonant frequency , Self-inductance (L) ,Q-factor & Band width
14. Bridge Rectifier with filter – Determination of voltage regulation factor
15. Zener diode – V-I Characteristics- Voltage regulation
16. Transistor Characteristics –CE mode
17. Single stage amplifier _ CE mode – construction & measurement of Voltage gain
18. Hartley Oscillator – frequency of Oscillations
19. Logic Gates _ AND,OR , NOT , NAND , NOR Gates using IC’s
20. Demorgan’s theorem – Verification using IC’s
Basics of Applied Physics (For other science students)

Objective: To understand the basic concepts and applications of Electricity, Lasers, Communications, Spectroscopy, Medical Physics and Astrophysics.

Unit 1 Heating Effects of Electric Current (9 Hours)
Joules law of heating-materials for heating elements- applications of heating effect (Incandescent lamps, electric iron, water heater, electric kettle)
Fuses (Parts, types, precautions) - Electromagnetic Induction, mutual induction-transformers-types-uses

Unit 2 Communication Physics (9 Hours)

Unit 3 Spectroscopy & Lasers (9 Hours)

Unit 4 Medical Physics (9 Hours)

Unit 5 Astrophysics (9 Hours)

Text Books:
1. Lecture notes
REFERENCES:
   (Unit I & II– relevant topics in Ch.5)  
   (Unit II – relevant topics in Ch.19)  
   (Unit III - Ch.6- Sections 6.4-6.6)  
   (Unit IV – relevant topics in 8.4, 14.4, 12.1, 15.8, 15.9, 17.1, X-ray, MRI, ECG , CT scan, Bloodless surgery – 16.2, 17.6, 9.4, 16.6, 4.6).  
   (Unit V - relevant topics in Sections 1.3, 6.2, 6.3, 7.2, 7.3, 12.1, 28.1)  
Class: II year  Part: Self-Learning Course
Semester: IV  Credit: 3
Code: 

POLYMER SCIENCE
(Self Learning Course - Offered by Department of Physics)

Objective: To study the basic physics behind the polymer compounds

Unit I: Molecular weight- Monomer – Polymer- Plastics – Rubber – Number averaged Molecular Weight- Weight averaged Molecular Weight – Determination of molecular weight of polymers by viscosity method

Unit II: Degree of Polymerization - Chain length – Glass Transition temperature

Unit III: Linear Polymers – Cross- linked Polymers

Unit IV: DSC diagram for a typical Polymer – use of DSC diagram to find glass transition temperature

Unit V: Melting temperature – Industrial Polymers – Bio polymers.

Books for Reference:

1. A Text Book of Polymer Science : Gowrikar ( Chapters 1,2,3)
2. A Text Book of Polymer Science : Billmeyer ( Chapters 1 &2 )
3. Notes compiled by the course teacher
ATOMIC PHYSICS

Objective: To grasp the principle behind
(i) the wave-particle duality and
(ii) the structure of atoms and their spectra.

UNIT I Particle Properties of Waves (15 hours)

UNIT II Wave Properties of Particles (15 hours)

UNIT III Atomic models (15 hours)

UNIT IV Magnetic Dipole Moment & Spectra (15 hours)

UNIT V Magnetic and Electric field effects (15 hours)
TEXT BOOKS:
1. Beiser Arthur, 1969, Perspectives of Modern Physics, McGraw Hill, New Delhi. (Unit I – Ch.2 & Unit II – Ch.3)

REFERENCES:
PHYSICAL OPTICS AND MOLECULAR SPECTROSCOPY

Objective:  
To understand the basics of
(i) Optical phenomena such as interference, diffraction and polarization,
(ii) Various emission spectra and their origin.

UNIT I Interference (12 hours)

UNIT II Diffraction (12 hours)

UNIT III Polarization (15 hours)

UNIT IV Introduction to Spectroscopy (16 hours)

UNIT V IR & Raman spectroscopy (20 hours)

**TEXT BOOKS:**

   (Unit 1 – Chapter 14.5-14.9, 15.5-15.8, 15.11.4, 15.12
   Unit 2 – Chapter 17.7, 17.10, 18.7
   Unit 3 - 20.5.1, 20.5.1.1, 20.5.2, 20.8.1, 20.8.2, 20.8.3, 20.5.5, 20.6, 20.6.1)
   (Unit 4 – Chapter 1.1-1.3, 1.7, Chapter 2.1-2.3,
   Unit 5 – Chapter 3.1-3.4, Chapter 4.1.1, 4.3.1)

**REFERENCES:**

QUANTUM MECHANICS

Objective: To understand the quantum nature of particles and their wave equations.

Unit I Origin of Quantum Theory (15 hours)

Unit II Operators (10 hours)

Unit III Applications of Schrödinger Equation I (10 hours)
Free States – Free Particle -Step potential – Rectangular Barrier – Square Well Potential - Bound States – Infinite Well - Particle in a Box – Degeneracy.

Unit IV Applications of Schrödinger Equation II (10 hours)
Linear Harmonic Oscillator – One Dimensional Case - Eigen Values – Significance of Zero Point Energy – Hydrogen atom (only angular part and no derivation).

Unit V Angular Momentum and spin (15 hours)
The angular momentum operators – Angular momentum commutation relations – Eigen values and Eigen functions of $L^2$ and $L_z$ – General angular momentum – Eigen values of $J^2$ and $J_z$ – Angular momentum matrices – Spin angular momentum

TEXT BOOKS:
   (Unit 1 – Chapter 1.1, 1.2, Chapter 2.8, 2.5, 2.6, 2.9, 2.7, 2.10; Unit 2 – Chapter 3.2- 3.5, 3.10 Unit 5 – Chapter 8.1-8.7)
   [Unit I – Ch.2 – 2.3, 2.8, 2.10, 2.14 – 2.19), Unit 2 – Ch.7 -7.7, 7.10-7.16, 7.21 - 7.24 Unit 3– Ch.5- 5.1, 5.2, 5.4-5.6, 5.8, Unit 4 – Ch.5- 5.9, Ch.6.5]
REFERENCES:
3. Gupta, S.L. & Kumar, V., 1997, Quantum mechanics, Jai Prakash Nath & Company, Meerut. (Unit I - Ch.1 – 1.1 – 1.5, 1.11, 1.12)
DIGITAL ELECTRONICS

Objective: To understand the basics of digital electronics, number systems, and electronic devices such as ICs and microprocessors.

Unit I Number Systems (14 hours)

Unit II Combinational Logic (10 hours)

Unit III Flip-Flops & Timers (10 hours)

Unit IV Shift registers and Counters (10 hours)

Unit V Microprocessor (16 hours)

TEXT BOOKS:
   (Unit I – Ch.5 & 2;
Unit II – Ch.3, Ch.4 – 4.1 – 4.3;  
Unit III – Ch.8, Ch.7 – 7.4-7.5;  
Unit IV - Ch.9 – 9.1-9.5, Ch.10)  
   (Unit V - Chap.3 related topics).

REFERENCES:
2. Moiris Mano, 1979, Digital logic and computer design, Prentice Hall of India New Delhi
ASTROPHYSICS

Objective: To understand the basics of astronomical tools, solar system, origin and evolution of stars and galaxies.

Unit I Tools of The Astronomer (12 hours)

Unit II The Earth & Solar System (12 hours)
The orientation of Earth in space- Seasons-Precession of the Earth-Arc and time units-Time keepers-Sidereal time- local time-Standard time. Planets-Terrestrial and Jovian planets (Planets individual description is not required in detail) - Satellites-Asteroids-Meteoroids- Comets.

Unit III Sun & The Moon (12 hours)

Unit IV Properties of Stars (12 hours)

Unit V Galaxies & Multiple Star System (12 hours)

TEXT BOOKS:
UNIT I – Ch. 4 (relevant sections)
UNIT II – Ch.6, 8 (relevant sections)
UNIT III – Ch.10 and 7(relevant sections)
UNIT IV – Ch.11 and 13(relevant sections)
UNIT V- Ch.15, 12, 14 (relevant sections)

REFERENCES:
Class: III year  Part: Self-Learning Course
Semester: V  Credit: 3

NON-DESTRUCTIVE TESTING TECHNIQUES

Objective: To study the basic ideas of testing techniques

Unit I: Basic ideas of Ultra-violet, Visible and Fourier Transform Infrared spectroscopy - Characterization and measurement techniques using UV, Visible and FTIR spectrum.

Unit II: Basic ideas of Raman effects - Characterization and measurement using Raman spectroscopic Techniques.

Unit III: Basic ideas of X-rays, diffraction and diffractrometer - Characterization and measurement techniques using diffraction techniques.

Unit IV: Basic ideas of Ultrasonics - Characterization and measurement techniques using Ultrasonic techniques.

Unit V: Basic ideas of photo acoustics - Characterization and measurement techniques using photo acoustics spectroscopic techniques.

Books for study
NUCLEAR PHYSICS

Objective: To study in detail about
(i) the nucleus and other elementary particles,
(ii) their detectors and
(iii) nuclear reactions.

Unit 1 Introduction:  (11 hours)

Unit 2 Theories of Nuclear Composition  (16 hours)

Unit 3 Detectors, Accelerators & Radio activity  (16 hours)

Unit 4 Nuclear Reactions & Neutron  (16 hours)

Unit 5 Nuclear energy & Elementary particles  (16 hours)

TEXT BOOKS:
   [Unit I & II – Ch.8,
   Unit III – relevant titles in Ch.9,10,11,
   Unit IV – relevant titles in Ch.12,
   Unit V – relevant titles in Ch.13 and 15.)

REFERENCES:
Objective: To understand the basics about the crystal structures, bonding and their physical properties.

Unit 1 Elements of Crystallography (20 hours)

Unit 2 Thermal Properties of Solids (12 hours)

Unit 3 Electron theory of metals (15 hours)

Unit 4 Magnetic properties (15 hours)

Unit 5 Superconductivity (13 hours)

TEXT BOOKS:
   (Unit I – Chap.1 Secs.1.1 – 1.4, Chap 2- Secs 2.1 – 2.6.
   Unit III – Chap.6 Secs. 6.1 – 6.5, 6.9 – 6.10
   Unit IV – Chap.8 Secs. 8.1 – 8.8 (8.7.1. excluded)
   Unit V – Chap.10 Secs. 10.1 – 10.5.1, 10.10 – 10.12
   Unit II– Chap.16 Secs.16.10 – 16.12

REFERENCES:
THERMODYNAMICS AND STATISTICAL MECHANICS

Objective: To study the basic laws of thermodynamics, transfer of heat and statistics of gas molecules.

Unit 1 Transmission of Heat (12 hours)

Unit 2 Thermodynamics I (12 hours)

Unit 3 Thermodynamics II (12 hours)
Entropy and the second Law of Thermodynamics – Entropy Changes of a Closed system During Irreversible Process – Entropy – Change in Entropy in a Reversible Process (Carnot’s Cycle) - Change in Entropy in an Irreversible Processes - Third Law of Thermodynamics – Temperature Entropy Diagram (T-S) – Entropy of Perfect Gas – Maxwell’s Thermodynamical Relations – Thermodynamic Potentials (Definition only)– First Order Phase transition and Second Order Phase transition (Definition only)

Unit 4 Classical Statistics (12 hours)

Unit 5 Quantum Statistics (12 hours)

TEXT BOOKS:
   (Unit – I: Ch.8.1, 8.2, 8.8, 8.30, 8.35, 8.37, 8.38, 3.5, 3.6,
   Unit – II: Ch.8.42- 8.44, 8.48, 6.8, 6.25,
REFERENCES:
Objective: To understand the basics of nanomaterials, their characteristics, technology to prepare, and applications.

Unit I: Basics of Nanomaterials

Unit II: Quantum wells, Quantum wires and Quantum Dots

Unit III: Carbon Nanotubes

Unit IV: Bio nanotechnology
Unit V: Nanoelectronics and Applications Bio nanotechnology


Book for Study

1. Basic Nanophysics, Sr. Gerardin Jayam(Editor), Department of Physics, Holy Cross College, Nagercoil(2010)

Books for reference

Objective: To apply the physics principles of electricity, optics and magnetism in the following experiments and measure different physical properties

Any 14 of the following list of experiments:
1. Air wedge – thickness of a wire
2. Bi-prism – wavelength using optic bench
3. Hydrogen spectrum – Rydberg constant
4. Hartmann’s formula - spectrometer
5. Small angle prism - - spectrometer
6. i for d, d for i - - spectrometer
7. Owen’s bridge – self inductance of a coil
8. Rayleigh’s bridge– self inductance of a coil
9. Desauty’s bridge – self inductance of a coil
10. Potentiometer – emf of a thermocouple
11. Impedance and power factor – LR circuit
12. Galvanometer – conversion of ammeter
13. Galvanometer – conversion of voltmeter
14. B.G. – comparison of emf of two cells
15. B.G. – comparison of capacitances
16. B.G. – absolute capacitance
17. B.G. – mutual inductance
18. B.G. – M1/M2
19. B.G. – High resistance by leakage
20. LCR – series resonance circuit
21. LCR – Parallel resonance circuit
22. Planck’s constant – h – determination using photocell
23. Energy band gap determination
Class : III year  
Semester : V & VI
Code : 

Total hours : 60  
Credit : 4  
Hours/Week : 3

PHYSICS LAB – IV (Electronics)

___________________________________________________________________________________

Objective : To apply the physics principles of electronics in the following experiments  
and measure different physical properties

Any 14 of the following list of experiments:
1. Single stage amplifier with feedback 
2. Two stage amplifier with feedback 
3. Two stage amplifier without feedback 
4. Clippers and clampers using diode and CRO 
5. Colpitt’s oscillator 
6. Monostable multivibrator using transistor 
7. Schmitt trigger – IC 555 
8. Astable multivibrator using transistor 
9. Opamp – IC 741 - characteristics 
10. Opamp – IC 741 – differentiator and integrator 
11. Opamp – IC 741 – adder and subtractor 
12. Logic gates using discrete components 
13. Logic gates using ICs 
14. Logic gates – using IC universal gates 
15. Logic gates – ICs – Demorgan’s theorem 
16. Logic gates - ICs – Boolean expressions 
17. XOR and XNOR – Using ICs 
18. Half adder and full adder 
19. R-S, J-K and D flip-flops 
20. Mod 5 and Mod 10 counters 
21. Ring counters 
22. Shift registers 
23. Microprocessor – 8085 – perform addition, subtraction 
24. Microprocessor – 8085 – perform 1’s and 2’s complement subtraction 
25. Microprocessor – 8085 – perform multiplication and division
BASIC ELECTRIC PRINCIPLES AND APPLICATIONS

Objective: To grasp the physics principle behind the electrical appliances.

Unit I Nature of electricity and fundamental laws (12 hours)

Unit II Heating effects of electric current (14 hours)
Heating effects of electric current ,Joule’s law of heating- thermal efficiency- heating unit- materials for heating elements- applications of heating effect ( incandescent lamp, arc welding , electric heaters, room heater, soldering iron, air circulator, electric kettle, electric iron, water heater: immersion water heater, storage water heater). Fuse (classification, parts, types)-precautions for renewing a fuse.

Unit III Illumination (14 hours)
Definitions and units, laws of illumination, incandescent lamps. Different types of lamps- gas filled lamp, carbon arc lamp, gas discharge lamp, sodium vapour lamp, mercury vapour lamp, fluorescent tube; used of choke and starter,. Neon- light tubes and neon lamps- solar cells.

Unit IV Transformer (10 hours)

Unit V Generation and transmission of electricity (10 hours)
Generation of Thermal power, hydro power, nuclear power and non – conventional power, transmission of power.

TEXT BOOKS:
UNIT I – Ch.3, 4 (relevant sections)
UNIT II – Ch.5 (relevant sections)
UNIT III – Ch. 20(relevant sections)
UNIT IV- Ch.14 (relevant sections)
UNIT V- Ch 24 (relevant sections)
3. G.D RAI, Non- conventional energy sources.
UNIT V- Ch 1 (relevant sections)

REFERENCES:
1. M.L Anwani , Basic electrical engineering-Dhamp at Rai& co (p)LTD.
2. B.L .THERAJA, A.K THERAJA, Electrical technology, S.Chand & Company Ltd, New Delhi.
MEDICAL PHYSICS

Objective: To understand the basics about the biological systems in our body, their behaviour, and the ethical issues in medical science.

Unit 1 Introduction (12 hours)

Unit 2 Physics of CVS (12 hours)

Unit 3 Physics of Eye and Vision (12 hours)
Light in Medicine – Physics of Eyes and Vision – Electricity within the Body – Applications of Electricity and Magnetism in Medicine.

Unit 4 Nuclear Medicine (12 hours)

Unit 5 Ethical Issues (12 hours)
Ethical Issues in the Progress of Medical Science – Informed consent – Animal testing – Ethical principles of Humans used in medical research trials – Human cloning – HIV/AIDS and ethics – Euthanasia – Brain death – Organ donation - SARS.

TEXT BOOKS:
1. John R. Cameron and James G. Skofronick, 1978, Medical Physics, John Willy & Sons. (Unit I- Ch.1,2,3,4, Unit II-Ch.5,6,8,13, Unit III – Ch.14,15,9,11, Unit IV-Ch.17,18,16).
2. Tharien, A.K., Ethical issues in the progress of medical science, Voluntary Health Association of India (VHAI), New Delhi (Unit V - all).
PHOTONICS
(Self-Learning Course - Offered by Department of Physics)

Objective: To study the basics of photonics and non-linear optics


Unit II: Types of optical fibers – attenuation – applications – fiber optic communication systems – advantages.


Unit IV: Non-linear polarization – second harmonic generation – phase mixing

Unit V: Sum and difference frequency generation – parametric oscillation – simulated Raman scattering.

Books for study

2. Kattack & Thiyagarajan
UG PHYSICS COURSE

QUESTION PAPER PATTERN (2015-16 onwards)

For all major, allied papers and for core electives (Mechanics, Digital Electronics, Basic electric principles and applications)

Section A: 8 x 3 = 24
Short answer type
8 questions to be answered out of 10

Section B: 4 x 14 = 56
Detailed answer type
Open choice only
4 questions to be answered out of 6
No problems to be asked

Section C: 2 x 10 = 20
2 Problems to be solved out of 4

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Total = 100
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QUESTION PAPER PATTERN

ELECTIVE FOR ARTS STUDENTS – VYA 5012

POPULAR PHYSICS/BASICS OF APPLIED PHYSICS

The aim of the course is to give awareness about the physics related phenomena
*To arts students (History, Philosophy and Economics)
*To other science students (Maths, Chemistry, RDS)

(No numerical problems / derivations to be asked under any section)

SECTION –A (Answer ALL questions) (10 x 1=10)
(Multiple choice type/Fill in the blanks/True of False/One word)

SECTION-B (Answer any FIVE questions out of EIGHT) (5 x 6 =30)
Answer in one paragraph

SECTION-C (Answer any FIVE questions out of EIGHT) (5 x 12=60)
Answer within one page (200 words)

Total= 100Marks
Arul Anandar College (Autonomous), Karumathur
Department of Physics
UG PHYSICS COURSE

QUESTION PAPER PATTERN (2015-16 onwards)

For all Self Learning Papers:

1. Total number of questions may vary from 10 to 15
2. Total marks = 100
3. Questions must be taken for 150 marks and 2/3 of the paper carries full marks (100 marks)
4. Each question carries marks according to the particular question and answer and marks must be specified for the individual questions.
QUESTION PAPER PATTERN (2015-16 onwards)

For the Elective Papers:
(1) Astrophysics,
(2) Medical Physics
(3) Information Technology

Section A: 
Short answer type
8 questions to be answered out of 10

Section B: 
Paragraph answer type
4 questions to be answered out of 6

Section C: 
Detailed answer type
4 questions to be answered out of 6

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Total = 100
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M. Sc. (Physics)
### Arul Anandar College (Autonomous), Karumathur

**Department of Physics - M. Sc. (Physics)**

**CBCS (2015-2016 Onwards)**

<table>
<thead>
<tr>
<th>SEMESTER I</th>
<th>Hours</th>
<th>Credit</th>
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<tbody>
<tr>
<td>15PPYC11 Classical &amp; Statistical Mechanics</td>
<td>6</td>
<td>5</td>
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<tr>
<td>15PPYC21 Mathematical Physics-I</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>15PPYC31 Electromagnetic theory</td>
<td>6</td>
<td>5</td>
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<td>15PPYE11 Elective - I - Energy and Environmental Physics</td>
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<td>15PPYC52 Quantum Mechanics –I</td>
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<td>Electromagnetic Theory</td>
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<td>Nuclear &amp; Particle Physics</td>
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Non-major elective for other students: Energy physics

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**List of Electives**

1. Energy & Environmental Physics
2. Applied Electronics
3. Nanophysics
4. Applied Optics & LASER Physics
5. Photonics
6. Astrophysics
7. Microprocessor
CLASSICAL AND STATISTICAL MECHANICS

Objective :
(i) To understand the necessary concepts of equations of motions and small oscillations
(ii) To understand the principles of classical and quantum statistics

UNIT 1 Hamiltonian Methods (15 hrs)
Hamiltonian equations of motion - Cyclic coordinates and Routh’s procedure – Physical significance of the Hamiltonian – Hamilton’s equations from variations principle – The Principle of least action.

UNIT 2 Canonical Transformations: (15 hrs)

UNIT 3 Small Oscillations: (20 hrs)
Formulation – The Eigenvalue equation and the principal axis transformation – frequency of free vibration and normal coordinates – Free vibration of a linear triatomic molecule - Double pendulum.

UNIT 4 Classical Statistical Mechanics: (20 hrs)

UNIT 5 Quantum Statistical Mechanics: (20 hrs)
REFERENCES:
7. E.S. Rajagopal, Statistical mechanics and Properties of Matter
### Arul Anandar College (Autonomous), Karumathur

**Department of Physics - M.Sc. (Physics) Syllabus – 2015 - 16 onwards**

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**Total hours : 90**

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**MATHEMATICAL PHYSICS – I**

**Objective**: To study the mathematical concepts applicable in physics

**UNIT 1**  
**Vectors**: (15hrs)  

**UNIT 2**  
**Vector Spaces And Transformation**: (15 hrs)  

**UNIT 3**  
**Operational Methods**: (20 hrs)  

**UNIT 4**  
**Special Function I**: (25 hrs)  
The Gamma function – The factorial Gauss’s pi functions – The values of (1/2) Graph of the Gamma function – The Beta function - The connection of the beta function and the gamma functions.  
Bessel’s Differential Equation – Series solution of Bessel’s Differential equation – The Bessel function of order n of the second kind – value of Jn(X) and Yn(X) for large and small values of x – Recurrence formulas for Jn(x)- Jn(x) when n is half and odd integer

**UNIT 5**  
**Special Function II**: (15 hrs)  
Legendre’s Differential Equation – Rodrigues formula for the Legendre polynomials – Legendre’s function of the second kind – The generating function for Pn(x) – The Legendre coefficients – The Orthogonality of Pn(x).

**REFERENCES:**

Unit I: Ch: 1.2, 1.3, 1.7, 1.9, 1.15 (b,c,d), 1.19 (a,1,2,b)  
Unit II:Ch: 2.2 – 2.15, 2.17, 2.18, 2.23, 2.26 – 2.32, 2.34  
Unit III:Ch: 8.1 – 8.4, 8.12, 8.13, Ch: 10.1 – 10.3, 10.9, 10.10, 10.15, 10.17,10.22 (a), (b)  
Unit IV: 4.1 – 4.7, 4.9, 4.10, Ch: 7.21, 7.22, 7.25, 7.26, 7.27, 7.28, 7.30
Objective: To understand the concepts of electrostatics, magnetostatics, and electrodynamics.

UNIT 1  Electrostatic Fields I & II  (20 hours)

UNIT 2  Electrostatic Fields III  (20 hours)

UNIT 3  Magnetic Fields II  (15 hours)

UNIT 4  Propagation of Electromagnetic Waves  (15 hours)
UNIT 5  Guided Electromagnetic Waves  
(20 hours)

REFERENCES:
   [Unit – I : Chap (2) Secs. 2.6 – 2.11, Chap (3) 3.1 – 3.10
   Unit – II : Chap (4) Secs. 4.1, 4.2, 4.4. 4.5, Chap (7) Secs 7.1 – 7.7
   Unit – III : Chap (8) Secs. 8.1 – 8.3, Chap (10) Secs.10.1, 10.2, 10.2.1, 10.3 – 10.7, Unit –
   IV : Chap (11) Secs. 11.1 – 11.5,
2. Griffiths David, J., Introduction to Electrodynamics –
3. Jackson John, Classical Electrodynamics
6. J.D.Kraus, Electromagnetics – McCraw Hill
Arul Anandar College (Autonomous), Karumathur
Department of Physics - M.Sc. (Physics) Syllabus – 2015-16 onwards

Class : I year  Part : Core Elective-1
Semester : I  Credit : 4
Code : 15PPYE11  Total hours : 90

ENERGY AND ENVIRONMENTAL PHYSICS (Elective)

Objective : To study the necessary non-conventional energy sources and the need of environmental protection

UNIT 1 Various Energy Sources & Power Production (20 hrs)

UNIT 2 Solar Radiation And Solar Collectors: (25 hrs)

UNIT 3 Applications of Solar Energy: (15 hrs)

UNIT 4 Fuel Cells: (15 hrs)

UNIT 5 Air And Water Pollution : (15 hrs)
Water and air pollution – Sources of water and air pollution – Classification of water and air pollution – Effects of water and air pollution – Purification and control devices of water and air pollution. (Design and working of settling chambers, cyclone separators and gaseous pollution control methods) – Global air pollution problems.

REFERENCES:
2. Recent trends in fuel cell files and technology, Edited by Sudhoy Atwa, Springer publishers, New Delhi. (Unit IV related topics in this book)
6. B.S.N. Raju, Air Pollution
7. K. Kumaraswamy, A. Alagappa Moses and M. Vasanthy, Environmental Studies (Bharathidasan University).
PG Laboratory – I

Objective : To apply the physics principles in the non-electronics experiments and measure different physical parameters.

Any 10 of the following practicals

1. Cauchy’s constant – Spectrometer
2. Four Probe Method – Conductivity Measurement (Ge - Crystal)
3. Ultrasonic Interferometer- Liquid
4. Determination of unknown wavelengths using comparator
5. Determination of Planck’s constant (h) by using Photo cell/LED’s
6. Quincke’s method- Susceptibility (χ) – Solution
7. FET Characteristics
8. FET amplifier design
9. Two stage RC- coupled transistor amplifier without feedback
10. OP-AMP- Differentiator, Integrator, Adder, Subtractor
12. Filter circuits using OP-AMP
13. Hyperbolic fringes- Determination of Elastic constants
14. Bi - Prism – Optic Bench
15. Energy Gap (Ge)- Determination
16. SCR characteristics and applications
17. Wien’s bridge oscillator- using Op-amp
18. Dual Power supply – Using IC’s
19. OP-AMP – Characteristics & Parameters
Arul Anandar College (Autonomous), Karumathur
Department of Physics - M.Sc. (Physics) Syllabus – 2015 - 16 onwards

Class : I year Part : Core - 4
Semester : II Credit : 5
Code : 15PPYC42 Total hours : 90

MATHEMATICAL PHYSICS-II

Objective : To study the necessary mathematical methods and apply them in physics

UNIT 1 COMPLEX VARIABLES: (20 hrs)

UNIT 2 RESIDUES: (15 hrs)
Residues - Singular points of an analytic function – The point at infinity – Evaluation of residues at simple poles – at a multiple pole – Cauchy’s Residue theorem – Evaluation of complex integral – definite integrals of the type integral 0 to 2π : ∫f(sinθ, cosθ) dθ - integral from – ∞ to + ∞ : ∫q(x) dx.

UNIT 3 TENSOR ANALYSIS: (20 hrs)

UNIT 4 GROUP THEORY: (20 hrs)

UNIT 5 NUMERICAL METHODS : (15 hrs)

REFERENCES:
   Unit I: Ch: 6.1 – 6.3, 6.7 – 6.10, 6.12, 6.13 (Relevant Topic), 6.14 (Relevant topic), 6.16, 6.20, 6.21
   Unit II: Ch: 6.22, 6.23 (1,2,3), 6.24, 6.25
   Unit V: Ch: 14.2 (a, b, c, d), 14.5 (1,a,b,c), 14.6 (a, b, c, e)
3. G.Aruldass, 2004, Molecular structure and spectroscopy- Prentice Hall of India Pvt. Ltd. (Unit IV: Chap.5.1-5.11)
Arul Anandar College (Autonomous), Karumathur
Department of Physics - M.Sc. (Physics) Syllabus – 2015 - 16 onwards

Class : I year  Part : Core-5
Semester : II  Credit : 5
Code : 15PPYC52  Total hours : 90

QUANTUM MECHANICS –I

Objective: To get an idea about the quantum mechanical nature and understand the behaviour of particles in microscopic concepts

UNIT 1  The Physical Basis: (20 hrs)

UNIT 2  Eigenfunctions And Eigenvalues Of Some Systems (15 hrs)

UNIT 3  Matrix Formulations: (20 hrs)

UNIT 4  Angular Momentum: (20 hrs)
The angular momentum operators– Commutation relations – eigenvalues &eigenfunctions of $L_z^2$&$L_x$– General angular momentum- angular momentum matrices – spin angular momentum - matrices, eigenvalues and eigenvectors of spin -1/2 system – addition of angular momenta – Clebsch-Gordan coefficients – Recursion relations –evaluation of coefficients for $j_1=1$ and $j_2=1/2$

UNIT 5  Perturbation Theories: (15 hrs)
Time independent perturbation – basic concepts – non-degenerate energy levels- 1st order correction- 2nd order correction- Ground state of Helium- Stark effect – Degenerate energy levels – 1st order correction - Zeeman effect ($^1P-^1S$ transition) – variational principle – Ground state of Helium- The WKB method
REFERENCES:
7. S. Devanarayanan, 2010, Quantum Mechanics - SCITECH
Arul Anandar College (Autonomous), Karumathur
Department of Physics - M.Sc. (Physics) Syllabus – 2015 - 16 onwards

Class : I year  Part : Core Elective-2
Semester : II  Credit : 4
Code : 15PPYE22  Total hours : 90

APPLIED ELECTRONICS

Objective : To understand the concepts of Applied Electronics and their applications.

UNIT I  Electronic Devices  (15 hours)
SCR – Characteristics and Parameters – SCR Control circuits - TRIAC and DIAC operation and characteristics, UJT Characteristics – Parameters – Relaxation Oscillator – UJT control of an SCR- Seven segment display – LED and LCD.

UNIT II  Digital electronics  (20 hours)

UNIT III  8085 Instructions And Programming Techniques:  (15 hours)

UNIT IV Communication System  (20 hours)

UNIT V  Operational Amplifier  (20 hours)
REFERENCES:
2. Morrismano, Digital Logic and Computer Design- S.Prentice Hall of India [UNIT :II Ch.3.0-3.1, 3.3, 3.5-3.6, 3.8, Ch.6.2, 6.4, 6.7-6.8, Ch.7.1-7.5 ]
5. Millman& Halkias, Integrated electronics [UNIT : V Ch. 15.2-3, 15.6-8, 15.10-12, 16.1, 16.4-6.] 
Objective: To get an idea about the necessary non-conventional energy sources to manage the energy crisis.

UNIT 1: An Introduction To Energy Sources
An Introduction – Energy consumption as a measure of prosperity – conventional sources (coal, oil and gas) and energy production – availability and problems associated.

UNIT 2: Radiation Measurements
Solar constant – solar radiation at the earth’s surface- solar radiation measurement [Pyroheliometer (Angstrom, Abbot silver disk, Eppeley) – Pyranometer].

UNIT 3: Solar Energy Collectors
Introduction – physical principle of the conversion of solar radiation into heat – flat plate collectors (water and air heaters only) - concentrating collectors [Focusing type (parabolic trough reflector, mirror – strip reflector)] advantages and disadvantages of concentrating collectors over flat plate collectors.

UNIT 4: Some Other Applications Of Solar Energy
Solar water heating (pressurized natural circulation) - space heating (basic hot water and air systems) - Solar electric power generation (Introduction to solar photo-voltaic only) – Solar distillation – Solar cooking (design principle and constructional detail of a box type solar cooker).

UNIT 5: Other Forms of Energy
Wind energy (formation, character and production) – Basics principles of - biomass and biogas- ocean thermal energy conversion system – geothermal energy – hydro power production – thermo electric power generation – nuclear power generation.

REFERENCES:
2. Recent trends in fuel cell files and technology, Edited by Sudhoy Atwa, Springer publishers, New Delhi. (Unit IV related topics in this book)
6. B.S.N.Raju, Air Pollution
7. K.Kumaraswamy, A.Alagappa Moses and M.Vasanthy, Environmental Studies (Bharathidasan University).
Objective: To apply the physics principles in the electronic experiments and measure different physical parameters.

Any 10 of the following practicals

1. UJT characteristics and applications
2. Two stage RC-coupled transistor amplifier with feedback
3. Regulated Power supply – Using IC’s
4. Schmidt trigger using IC 555
5. D/A converter (4-bit binary weighted register)
6. OP-Amp wave generator
7. Michelson Interferometer
8. Elliptic fringes - Determination of Elastic constants
9. Hall Effect
10. Hartmann’s formula - Spectrometer
11. Stefan’s constant – Determination
12. Experiments with LASER
13. Constant deviation spectrograph (Al/Cu/Fe)
14. e/m - Magnetron method
15. Dielectric constant of liquid
16. Experiments using Solar photo-voltaic system
17. OP-AMP - Solving Simultaneous Equations & Differential Equations
18. PCB design and circuit construction
Section A: No Choice – Short Answer Questions (10)  
10 \times 2 = 20  
All Mandatory

Section B: Open Choice – Long Answer Questions (5 / 8)  
5 \times 16 = 80

Note:  
1. Questions may include a) Theory, b) Derivation, c) Experiment  
2. Problems may be asked as a part of the big question in any two/three questions

Total = 100
QUANTUM MECHANICS – II

Objective: To get an idea about the perturbation, identical particles and their spin, scattering theory, and relativistic quantum mechanics.

UNIT 1 Perturbation Theory (20 hours)

UNIT 2 Identical Particles & Spin (15 hours)

UNIT 3 Scattering (20 hours)

UNIT 4 Relativistic Wave Equations (20 hours)

UNIT 5 Quantum Field Equation (15 hours)
Classical and quantum field equations – classical Lagrangian and Hamiltonian equation – quantisation equation for the this field – Quantisation of non-relativistic Schrodinger wave equation – Anti commutation relation – Electromagnetic field in vacuum – commutation relation.
REFERENCES:
   [Unit – I : Chap.8, Sec.35 and Chap.11, Sec.44 (relevant titles)
   Unit – II : Chap.10, Sec40 and Sec.41 (relevant titles)
   Unit – IV : Chap.13, Secs.51, 52 and 53 (hydrogen atom discussion only
   qualitatively)
   Unit – V : Chap.14, Secs.54, 55 and 56]
   [Unit – III : Chap.14]
3. SathyaPrakash and Swati Saluja, 26, Quantum Mechanics-Kedarnath Ram nath& co,
   UNIT - IV
   education.
8. S.Devanarayanan, Quantum Mechanics – SCITECH
Objectives: To get an idea about the basics of crystals, phonons, free electron theory, and semiconductors.

**UNIT 1 Crystal Structure & Reciprocal Lattice (20 hours)**
Periodic arrangement of atoms – concepts of a lattice – lattice translation vectors – primitive lattice cell – two and three dimensional lattice types – Miller indices of crystal planes – Simple crystal structures like sodium chloride type – cesium chloride type – hexagonal and face centered close packed structures – diamond structure and cubic zinc sulphide structure.

**DIFFRACTION OF WAVES BY CRYSTALS:**
Bragg’s law – Reciprocal lattice vectors – Laue equations – Brillouin zones – Reciprocal lattices to sc, bcc and fcc lattices – Fourier analysis of the basis and structure factors of bcc and fcc lattices.

**UNIT 2 Crystal Binding And Elastic Constants (15 hours)**

**UNIT 3 Phonons (15 hours)**

**UNIT 4 Free Electron Fermi Gas and Energy Bands (20 hours)**
Energy levels in one dimensions – Fermi-Dirac distribution for a free electron gas – periodic boundary condition and free electron gas in three dimensions – Heat capacity of the electron gas – Ohm’s law – Matthiessen’s rule and Umklapp process – Hall effect – Wiedemann – Franz law – Nearly free electron model and the origin and magnitude of the energy gap – Bloch functions – Motion of an electron in a periodic potential – Kronig-Penny model – Bloch theorem – Approximate solution near a zone boundary

**UNIT 5 SEMICONDUCTOR CRYSTALS, FERMI SURFACES and METALS (20 hours)**
cohesive energy – Quantization of orbits in a magnetic field – De Hass-Van Alphen effect.

REFERENCES:
   [Unit I – Ch.1 and 2 (relevant titles)
   Unit II – Ch.3 (relevant titles)
   Unit III – Ch.4 and 5 (relevant titles)
   Unit IV – Ch.6 and 7 (relevant titles)
   Unit V – Ch.8 and 9 (relevant titles) ]
ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS - M. SC. (PHYSICS)

Class : II year          Part : Core
Semester : III          Credit : 5
Code : 12PHC335          Total hours : 90

ELECTROMAGNETIC THEORY

Objective : To understand the concepts of electrostatics, magnetostatics, electrodynamics.

UNIT 1 ELECTROSTATIC FIELDS I & II  (20 Hours)
Electrostatic fields in a vacuum – The equations of poisson and of Laplace
– conductors – calculation of the electric field produced by a simple charge
distribution – The elastic dipole – The linear electric quadrupole – Electric
multipoles. Dielectric Materials, The electric polarization – Electric field at
an exterior point – Electric field at an interior point – The local field – The
electric susceptibility – The divergence of E – The electric displacement D-
Calculation of electric fields involving dielectrics – The Clausius –
Mossotti equation – Polar dielectrics – Frequency dependence, Anisotropy
and non homogeneity.

UNIT 2 ELECTROSTATIC FIELDS III  (20 Hours)
Continuity of V, D, E at the interface between two different media – The
uniqueness theorem – Solution of Laplace’s equation in rectangular
coordinates.Legendre’s equation - Legendre polynomials – Solution of
Legendre’s equation in spherical coordinates. MAGNETIC FIELDS I:
Steady current and non magnetic materials – Magnetic forces – The
magnetic induction B – The BiotSavart law – The divergence of a point
charge moving in a magnetic field – The divergence of the magnetic
induction B – The vector potential – The curl of the magnetic induction B –
Ampere’s circuital law.

UNIT 3 MAGNETIC FIELDS II  (15 Hours)
The Faraday induction law – The induced electric field intensity E in terms
of the vector potential – A-Induced Electromotance in a moving system –
Maxwell’s equations : The conservation of electric charge – The potentials
V and A – retarded potential – The Lorentz condition – The divergence of
E and the non homogeneous wave equation for V – Non-homogeneous
equation for A – The curl of B – Maxwell’s equations.

UNIT 4 PROPAGATION OF ELECTROMAGNETIC WAVES  (15 Hours)
Plane wave in infinite media – Plane electromagnetic waves in free space
– Poynting vector and Poynting theorem – The E and H vectors in
homogeneous, isotropic, linear and stationary media – propagation of
place electromagnetic waves in nonconductors – propagation of plane electromagnetic waves in good conductors.

UNIT 5 GUIDED ELECTROMAGNETIC WAVES (20 Hours)

REFERENCES:
   [Unit – I : Chap (2) Secs. 2.6 – 2.11, Chap (3) 3.1 – 3.10
   Unit – II : Chap (4) Secs. 4.1, 4.2, 4.4, 4.5, Chap (7) Secs 7.1 – 7.7
   Unit – III : Chap (8) Secs. 8.1 – 8.3, Chap (10) Secs 10.1, 10.2, 10.2.1, 10.3 – 10.7,
   Unit – IV : Chap (11) Secs. 11.1 – 11.5,
7. Griffiths David, J., Introduction to Electrodynamics –
8. Jackson John, Classical Electrodynamics
11. J.D. Kraus, Electromagnetics – McCraw Hill
ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR
DEPARTMENT OF PHYSICS - M. SC. (PHYSICS)

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APPLIED ELECTRONICS

Objective: To understand the concepts of Applied Electronics and their applications.

UNIT I Electronic Devices (15 Hours)
SCR – Characteristics and Parameters – SCR Control circuits - TRIAC and DIAC operation and characteristics, UJT Characteristics – Parameters – Relaxation Oscillator – UJT control of an SCR- Seven segment display – LED and LCD.

UNIT II Digital electronics (15 Hours)

UNIT III DAC, ADC& Timer IC (20 Hours)

UNIT IV COMMUNICATION SYSTEM (20 Hours)

UNIT V OPERATIONAL AMPLIFIER (20 Hours)
REFERENCES:
1. David A. Bell, Electronic devices and circuits- III Edition
2. Morrismano, Digital Logic and Computer Design- S.Prentice Hall of India
   [UNIT :II Ch.3.0-3.1, 3.3, 3.5-3.6, 3.8, Ch.6.2, 6.4, 6.7-6.8, Ch.7.1-7.5]
3. Roy Choudhery, D. & Shall Jain, Linear Integrated Circuits-
   [UNIT :III Ch.10.2,10.2.1-10.2.2, 10.2.5, 10.3,10.3.1-10.3.2, 10.3.4, 8.3,8.3.1,8.4,8.4.1, 8.5.]
   [UNIT :IV Ch.5.1, 5.2, 5.3, 13.2.]
5. Millman & Halkias, Integrated electronics
   [UNIT : V Ch. 15.2-3, 15.6-8, 15.10-12, 16.1, 16.4-6.]
Class : II year  
Semester : III  
Code :  

PHYSICS LAB – III

Objective : To apply the physics principles of digital electronics and microprocessor in the following experiments and their applications

Any 10 of the following list of experiments:
1. R-S, J-K and D-flip flops
2. Different mod counters
3. Encoder / Decoder
4. Shift registers
5. Multiplexer and Demultiplexer
6. Microprocessor – I (addition with carry, subtraction, division and multiplication)
7. Microprocessor – II (shifting a block of data, finding largest in an array of numbers, counting the particular element in an array)
8. Microprocessor – III (shift by 1-bit and 2-bits in a 8-bit and a 16-bit numbers, factorial of a number)
9. Microprocessor – IV (1’s and 2’s complements)
10. Microprocessor – V (interfacing with seven segment display )
11. Microprocessor – VI (interfacing with stepper motor )
12. Microprocessor – VII (interfacing ADC, DAC )
13. Karnaugh Map
14. Comparator, Square and triangular wave generator
15. 4 – bit binary counter
SOLID STATE PHYSICS - II

Objective: To understand the advanced concepts of condensed matter physics and to see their applications.

UNIT I Excitation And Optical Processes In Solids (20 hours)

UNIT II Super Conductivity (20 hours)

UNIT III Magnetism In Solids (20 hours)

UNIT IV Defects And Dislocations (15 hours)

UNIT V Quantum Hall Effects, Alloys And Ferroelectricity (15 hours)
optical phonon – Landau theory of phase transition – first order and second order transition.

REFERENCES:
   [Unit I – Ch.10 and 11 (relevant titles)
   Unit II – Ch.12 (relevant titles)
   Unit III – Ch.14 and 15 (relevant titles)
   Unit IV – Ch.18 and 20 (relevant titles)
   Unit V – Ch. 19, 21 and 13 (relevant titles)]
NUCLEAR AND PARTICLE PHYSICS

Objective: To understand the basics of nuclear properties, forces, models, radioactivity, sub-nuclear particles.

UNIT I     Nuclear Properties And Nuclear Forces (20 hours)

UNIT II    Radio Activity (15 hours)

UNIT III   Nuclear Models (15 hours)

UNIT IV    Nuclear Reactions, Fission And Fusion (20 hours)
Kinds of Nuclear reactions – Conservation Laws – Nuclear reaction kinematics – Nuclear cross section – Compound nucleus – Nuclear transmutations – By alpha particles - by protons – by neutrons – by deuterons – by tritium by heavy ions -Direct reactions (Stripping reactions, Pickup reactions), Stripping reactions and the shell model. Nuclear Fission (Types of Fission, Distribution of fission products, Neutron Emission in Fission, Fissile and Fertile materials, Spontaneous fission, Deformation of liquid drop, Bohr and Wheeler’s Theory – Quantum effects) - Nuclear Fusion and Thermo nuclear reactions – Controlled
thermonuclear reactions (hydrogen bomb, Different methods for the production of fusion reactions)

**UNIT V Sub-Nuclear Physics**

(20 hours)


**REFERENCES:**

   [Unit – I: Chapter 8, Unit- II: Sections 2.1-2.3,2.11,2.12,5.5-5.6, 6.1-6.3, 6.5, 7.1-7.2, 7.4 -7.6, Unit – III, IV: Chapters 9, 10, 13 (relevant titles), Unit V:relevant titles]
Arul Anandar College (Autonomous), Karumathur
Department of Physics - M.Sc. (Physics) Syllabus – 2015 - 16 onwards

Class : II year Part : Core Elective-4
Semester : IV Credit : 4
Code : Total hours : 90

APPLIED OPTICS AND LASER PHYSICS

Objective : To study the applications of optics such as LASERs and fiber optics and the corresponding theory.

UNIT I LASER- I (15 hours)

UNIT II LASER- II (20 hours)
Introduction- Modes of a rectangular cavity and the open planar resonator- Quality factor – The ultimate line width of the Laser – Mode Selection – Q- Switching – Mode locking in Lasers – Modes of a confocal resonator system- General spherical resonator – High order modes

UNIT III laser systems & spatial frequency Filtering (20 hours)
Spatial frequency filtering : Introduction - Fourier Transform and some of its important properties – F.T property of a thin lens – some elementary examples of the Fourier transforming property of a lens

UNIT IV Electro-Optic Effect (15 hours)
Introduction – Electro-optic effect in KDP crystals: longitudinal mode & transverse mode – electro-optic effect in lithium niobate and lithium tantalate crystals- general considerations on modulator design- The index ellipsoid in the presence of an external electric field.

UNIT V Optical Fiber & Non- Linear Optics (20 hours)
REFERENCES:

   [UNIT-I : Chapters 8.1 -8.8 Pages 201- 243
   UNIT- IIIChapters: 10.1-10.8 & 6.1 – 6.4 Pages 294-308, 167-169
   UNIT-IV Chapters : 15.1-15.6 ,Pages 461-498
2. B.B.Laud, Laser & Non – Linear Optics.
PHOTONICS

Objective : To understand the properties of light and the linear and non-linear interactions of light with matter.

UNIT 1 Properties And Description of Light (20 hours)

UNIT 2 Linear Interactions With Matter (20 hours)

UNIT 3 Nonlinear Interactions (15 hours)

UNIT 4 Nonlinear Interactions Without Interactions (20 hours)

UNIT 5 Nonlinear Optical Spectroscopy (15 hours)

REFERENCE:
   [relevant sections from Ch.2, 3, 4, 5, 7]
Objective : To study the properties of stars and their evolution and to understand the origin and structure of the universe.

UNIT 1 Astronomical Instruments And Space Astronomy (15 hrs)

UNIT 2 Properties of Stars - I (20 hrs)
Apparent luminosities of stars – Magnitude scale – measurement of apparent luminosity – various magnitude systems – Corrections for observed magnitudes – Stellar distances and absolute luminosity – Measurement of distances within the solar system – Trigonometric parallaxes of stars – The method of luminosity distance.

UNIT 3 Properties of Stars - II (20 hrs)

UNIT 4 Stellar Evolution (20 hrs)
Evolution near the main sequence – Star formation – Pre-main sequence contraction – post-main sequence evolution – Nucleosynthesis – Super dense remnants – Evolution of close binary systems

UNIT 5 External Galaxies and Cosmology (15 hrs)

REFERENCES:
   [ relevant titles from Chs.3,4, 5, 6, 10, 17, 18, 19, 20].
MICROPROCESSORS

Objective : To understand the concepts of microprocessors, programming and interfacing.

UNIT 1  8085 Instructions And Operations :  (15 hrs)

UNIT 2  Programming Techniques With Additional INSTRUCTIONS :  (15 hrs)

UNIT 3  Counters And Time Delays :  (20 hrs)

UNIT 4  Interrupts :  (20 hrs)
The 8085 interrupts – 8085 vectored interrupts – restart as software instructions.
INTERFACING DATA CONVERTERS : – 8255A programmable peripheral interface - Digital to analog converters – Analog to digital converters.

UNIT 5: Other Microprocessors :  (20 hrs)

REFERENCES:
   [Unit – I : Sec.3.1 – 3.5, 5.1 – 5.5, 6.1 – 6.6,Unit – II : Sec.7.1 – 7.6
   [Unit – V : Sec.11.1, 11.2, 11.5]
PROJECT WORK

Objective : (i) To apply the physics principles in a project,
            (ii) to have an idea about research work,
            (iii) to get an experience of writing dissertation for any project

Each candidate has to submit a dissertation on any topic in physics after collecting materials and working out the details during the IV semester. It may be a theoretical work or an experimental work or even a compilation of material of current interest from literature.

The dissertation is evaluated by internal and external examiners with viva on the project work.
ARUL ANANDAR COLLEGE (Autonomous), KARUMATHUR – 625 514.
DEPARTMENT OF PHYSICS
PG Physics
QUESTIONS PAPER PATTERN
2015 – 2016 onwards

PG COURSE

Section A:  No Choice – Short Answer Questions (10)  \[10 \times 2 = 20\]
All Mandatory

Section B:  Open Choice – Long Answer Questions (5 / 8)  \[5 \times 16 = 80\]
Note:
1. Questions may include a) Theory, b) Derivation, c) Experiment
2. Problems may be asked as a part of the big question in any two/three questions

Total = 100