MANONMANIAM SUNDARANAR UNIVERSITY,
TIRUNELVELI-12

SYLLABUS

UG - COURSES – AFFILIATED COLLEGES

Course Structure for B. Sc. Physics
(Choice Based Credit System)
(with effect from the academic year 2023-2024 onwards)

Semester-V				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
III	CORE	ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM		4
III	CORE	ATOMIC AND NUCLEAR PHYSICS		4
III	CORE	ANALOG AND COMMUNICATION ELECTRONICS		3
III	CORE	PHYSICS PRACTICAL V		3
III	CORE	PHYSICS PRACTICAL VI		3
III	CORE	PROJECT (GROUP)		2
III	ELECTIVE	**SPECTROSCOPY**/ MATHEMATICAL PHYSICS/ PYTHON PROGRAMMING AND BASICS OF AI AND DATA SCIENCE		2
IV		INTERNSHIP/ INDUSTRIAL VISIT/ FIELD VISIT/ KNOWLEDGE UPDATING ACTIVITY		2
IV	NAAN MUDHALVAN	NAAN MUTHALVAN / MODERN PHYSICS		2

Total Marks: 100 Internal Exam: 25 marks + External Exam: 75 marks

A. **Scheme for internal Assessment**:
Maximum marks for written test: **20 marks**
3 internal tests, each of **I hour** duration shall be conducted every semester.
To the average of the **best two** written examinations must be added the marks scored in. The **assignment** for 5 marks.

The break up for internal assessment shall be:
Written test- 20 marks; Assignment -5 marks Total - 25 marks

B. Scheme of External Examination
3 hrs. examination at the end of the semester
A – Part : 1 mark question two - from each unit
B – Part : 5 marks question one - from each unit
C – Part : 8 marks question one - from each unit

- **Conversion of Marks into Grade Points and Letter Grades**

S.No	Marks	Letter Grade	Grade point (GP)	Performance
1	90-100	O	10	Outstanding
2	80-89	A+	9	Excellent
3	70-79	A	8	Very Good
4	60-69	B+	7	Good
5	50-59	B	6	Above Average
6	40-49	C	5	Pass
7	0-39	RA	-	Reappear
8	0	AA	-	Absent

- **Cumulative Grade Point Average (CGPA)**

$$\mathbf{CGPA} = \frac{\mathbf{\Sigma\,(GP \times C)}}{\mathbf{\Sigma C}}$$

- **GP** = Grade point, **C** = Credit
- CGPA is calculated only for Part-III courses
- CGPA for a semester is awarded on cumulative basis

- **Classification**
  a) First Class with Distinction : CGPA $\geq$ 7.5*****
  b) First Class : CGPA $\geq$ 6.0
  c) Second Class : CGPA $\geq$ 5.0 and $<$ 6.0
  d) Third Class : CGPA$<$ 5.0

ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM

COURSE OBJECTIVES

- To classify materials based on their electrical and magnetic properties.
- To analyse the working principles of electrical gadgets.
- To understand the behaviour of dc, ac and transient currents.
- To know about the communication by electromagnetic waves.

UNIT-I

CAPACITORS AND THERMO ELECTRICITY

Capacitor - principle - capacitance of a parallel plate capacitor (with and without dielectric slab) - effect of dielectric - Carey Foster bridge - temperature coefficient of resistance - Seebeck effect - Laws of thermo emf - Peltier effect - Thomson effect - Thermoelectric diagrams and their uses - thermodynamics of thermo couple.

UNIT-II

MAGNETIC EFFECT OF CURRENT

Biot and Savart‘s law - magnetic induction due to circular coil - force on a current element by magnetic field - force between two infinitely long conductors - torque on a current loop in a field - moving coil galvanometer - damping correction - Ampere‘s circuital law - differential form – divergence of magnetic field - magnetic induction due to toroid.

UNIT-III

MAGNETISM AND ELECTROMAGNETIC INDUCTION

Magnetic induction B - Magnetization M - relation between B, H and M - magnetic susceptibility - magnetic permeability - experiment to draw B-H curve - energy loss due to hysteresis - importance of hysteresis curve - Faraday and Lenz laws - vector form - self-inductance -coefficient of self-inductance of solenoid - Anderson‘s method - mutual inductance - coefficient of mutual inductance between two coaxial solenoids - coefficient of coupling.

UNIT-IV

TRANSIENT AND ALTERNATING CURRENTS

Growth and decay of current in a circuit containing resistance and inductance- growth and decay of charge in a circuit containing resistance and capacitor- growth and decay of charge in an LCR circuit (expression for charge only)-peak, average and rms values of ac-LCR series-parallel circuits-resonance condition –Q factor -power factor.

UNIT-V

MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES

Maxwell's equations in vacuum, material media- physical significance of Maxwell's equations-displacement current-plane electromagnetic waves in free space-velocity of light-Poynting vector- electromagnetic waves in a linear homogeneous media-refractive index.

TEXT BOOKS

1. Murugeshan. R., - Electricity and Magnetism, 8thEdn, 2006, S.Chandand Co, New Delhi.
2. Sehgal D.L., Chopra K.L, Sehgal N.K., - Electricity and Magnetism,
3. Sultan Chand and Sons, New Delhi.
4. M. Narayanamurthy and N. Nagarathnam, Electricity and Magnetism, 4th Edition.
5. National Publishing Co., Meerut.

REFERENCE BOOKS

1. Brijlal and Subramanian, Electricity and Magnetism, 6th Edn., Ratan and Prakash, Agra.
2. Brijlal, N.Subramanyan and Jivan Seshan, Mechanics and Electro dynamics (2005),
3. Eurasia Publishing House (Pvt.) Ltd., New Delhi.
4. David J. Griffiths, Introduction to Electrodynamics, 2nd Edn. 1997, Prentice Hall of India Pvt. Ltd., New Delhi
5. D. Halliday, R. Resnik and J. Walker - Fundamentals of Physics, 6th Edn., Wiley, NY, 2001.

WEB RESOURCES

1. https://www.edx.org/course/electricity
2. https://www.udemy.com/courses/electricity
3. https://www.edx.org/course/magnetism
4. http://www.hajim.rochester.edu/optics/undergraduate/courses.html

ATOMIC AND NUCLEAR PHYSICS

Course Objectives

- To make students understand the development of atom models, quantum numbers, coupling schemes and analysis of magnetic moments of an electrons;
- To gain knowledge on excitation and ionization potentials, splitting of spectral lines in magnetic and electric fields;
- To get knowledge on radioactive decay; To know the concepts used in nuclear reaction;
- To understand the quark model of classification of elementary particles.

UNIT-I

VECTOR ATOM MODEL: Introduction – Vector atom model – electron spin – spatial quantisation – quantum numbers associated with vector atom model. Coupling Schemes L-S and j-j coupling. Pauli's Exclusion Principle. Magnetic dipole moment due to orbital motion and spin motion of the electron – Bohr magnetron – Stern-Gerlach experiment.

UNIT-II

ATOMIC SPECTRA: Spectral terms and notations – Zeeman Effect – quantum mechanical explanation of normal Zeeman effect. Anomalous Zeeman Effect – quantum mechanical theory – fine structure of sodium D-lines. Paschen-Back Effect, Stark Effect.

UNIT-III

STRUCTURE OF NUCLEI: General Nuclear Properties – charge, size, shape, mass, density, spin, parity. Mass defect and Binding energy – Binding energy curve. Nuclear force – characteristics of nuclear forces. Nuclear Models – Liquid Drop Model – similarities between nucleus and liquid drop – mass formula. Shell Model - magic numbers – evidences that led to shell structure.

UNIT-IV

RADIOACTIVITY: Discovery of radioactivity – exponential decay law– half-life, mean-life. Natural and Artificial radio activity. Properties of alpha rays, beta rays and gamma rays – Gamow's theory of alpha decay (qualitative study) – Geiger-Nuttal law – beta decay spectra

UNIT-V

Nuclear Reactor, Accelerator and Detectors: Nuclear fusion – Nuclear fission. Nuclear Reactor – construction and working – radio isotopes and its applications. Charged Particle Accelerators - Cyclotron – Detectors of Nuclear Radiation – GeigerMuller Counter – Scintillation Counter. Nuclear facilities in India.

TEXT BOOKS

1. R.Murugesan, Modern Physics, S. Chand and Co. (All units) (Units I and II-Problems)
2. Brijlal and N. Subrahmanyam, Atomic and Nuclear Physics, S. Chand and Co. (All units)
3. J. B. Rajam, Modern Physics, S. Chand and Co.
4. Sehgal and Chopra, Modern Physics, Sultan Chand, New Delhi
5. Arthur Beiser– Concept of Modern Physics, McGraw Hill Publication, 6th Edition.

REFERENCE BOOKS

1. Perspective of Modern Physics, Arthur Beiser, McGraw Hill.
2. Modern Physics, S. Ramamoorthy, National Publishing and Co.
3. Laser and Non-Linear Optics by B.B.Laud, Wiley Easter Ltd., New York,1985.
4. Tayal, D.C.2000 – Nuclear Physics, Edition, Himalaya Publishing House, Mumbai.
5. Irving Kaplan (1962) Nuclear Physics, Second Edition, Oxford and IBH Publish and Co, New Delhi.
6. J.B. Rajam– Atomic Physics, S. Chand Publication, 7th Edition.
7. Roy and Nigam, – Nuclear Physics (1967) First edition, Wiley Eastern Limited, New Delhi.

WEB RESOURCES

1. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
2. https://makingphysicsfun.files.wordpress.com/2015/01/photoelectric-effect.pptx
3. https://www.khanacademy.org/science/physics/quantum-physics/in-in-nuclei/v/types-of-decay
4. https://www.khanacademy.org/science/in-in-class-12th-physics-india/nuclei

ANALOG AND COMMUNICATION ELECTRONICS

Course Objectives

- To study the design, working and applications of semiconducting devices.
- To construct various electronic circuits.
- To study them in details.
- To study the basis of audio and video communication systems and the aspects of satellite and Fibre Optic Communications.

UNIT-I

DIODES: Diode characteristics –half wave rectifier, center tapped and bridge fullwave rectifiers, calculation of efficiency and ripple factor - clipper circuits, clamping circuits. DC power supply: Block diagram of a power supply, Zener diode as voltage regulator.

UNIT-II

TRANSISTOR AMPLIFIERS: Transistor configurations: CB, CE and CC modes – I-V characteristics and hybrid parameters – DC load line – Q point self-bias - RC coupledCE amplifier – power amplifiers – push pull amplifiers – tuned amplifiers.

UNIT-III

TRANSISTOR OSCILLATORS: feedback amplifier - principle of feedback, positive and negative feedback - voltage and current gain - advantages of negative

feedback - Barkhausen‘s criterion- Transistor oscillators: Hartley, Colpitts, Phase shift oscillators.

UNIT-IV

OPERATIONAL AMPLIFIERS AND TIMER: Differential amplifiers – OP-AMP characteristics – IC 741 pin configuration – inverting and non-inverting amplifiers– summing and difference amplifiers – differentiator and integrator –IC 555 pin configuration- a stable multi vibrator (square wave generator) – monostable vibrator

UNIT-V

MODULATION AND DEMODULATION: Theory of amplitude modulation - frequency modulation – comparison of AM and FM – phase modulation – pulse width modulation – pulse modulation systems: PAM, PPM, and PCM – Demodulation: AM and FM detection.

TEXT BOOKS

1. V.K.Mehta - Principles of Electronics, S.Chand and Co. Ltd., 2004.
2. V.Vijayendran - Integrated Electronics, S.Vishwanathan Publishers, Chennai.
3. B.L. Theraja - A Text Book of Electrical Technology.
4. John D. Ryder - Electronic fundamentals and Applications.
5. Malvino - Electronic Principles, Tata McGraw Hill.

REFERENCE BOOKS

1. B.Grob - Basic Electronics, 6th edition, McGraw Hill, NY, 1989.
2. Herbert Taub and Donald schilling - Digital Integrated Electronics, McGraw Hill, NY.
3. Ramakant A. – Op amp principles and linear integrated circuits, Gaykward
4. Bagde and S. P. Singh - Elements of Electronics.
5. Millman and Halkias- Integrated Electronics, Tata McGraw Hill.

WEB RESOURCES

1. https://www.queenmaryscollege.edu.in/eresources/undergraduateprogram/py157
2. www.ocw.mit.edu >...> Circuits and Electronics
3. www.ocw.mit.edu >...> Introductory Analog Electronics Laboratory
4. https://www.elprocus.com > semiconductor devices
5. https://www.britannica.com >technology

ELECTIVE: ***Spectroscopy/ Mathematical Physics/ Python Programming and Basics of AI and Data Science***

SPECTROSCOPY

Course Objectives

- This course facilitates an understanding of atomic and molecular spectra and the instrumentations.
- The paper needs a basic knowledge about atomic structure and the learners are expected to gain knowledge to identify materials with the help of various spectra

UNIT-I

MICROWAVE SPECTROSCOPY: Rotation of molecules – Classification of molecules – Rotation spectra of diatomic molecules – Intensities of spectral lines – Effect of isotopic substitution – non-rigid rotator – Spectrum of a non-rigid rotator- Techniques and Instrumentation of Microwave spectroscopy (Microwave spectrometer)

UNIT-II

INFRARED SPECTROSCOPY: I.R. spectroscopy – Vibrating diatomic molecules – Simple Harmonic Oscillator - Anharmonic oscillator – Diatomic vibrating rotator - Analysis by IR techniques. Difference between IR and Microwave spectroscopy.

UNIT-III

RAMAN SPECTROSCOPY: Raman effect- Discovery – Quantum theory of Raman effect – Classical theory of Raman Effect –Pure rotational Raman spectra of Linear molecules – Advantages and disadvantages of Raman spectroscopy-Raman spectrometer.

UNIT-IV

ELECTRONIC SPECTROSCOPY: Vibrational coarse structure-Frank-Condon principle – Rotational fine structure of electronic - vibration spectra- Dissociation energy — Fortrat parabola.

UNIT-V

NMR SPECTROSCOPY: Introduction –Theory of NMR spectroscopy and origin of NMR signal – NMR instrumentation – Application of NMR spectroscopy - Magnetic resonance imaging (MRI) – Interpretation of NMR spectra- Advantages and disadvantages of MRI.

TEXT BOOKS

1. Fundamentals of Molecular Spectroscopy - Colin N Banwell Elaine- M Mccash Fifth Edition
2. Molecular Structure and Spectroscopy - G. Aruldhas, PHI Learning Pvt. Ltd, India

REFERENCE BOOKS

1. Hand book of Analytical Instruments -R.S. Khandpur, Tata MC Grow Hill Ltd.
2. Spectroscopy -G.R. Chatwal and S.K. Anand, Himalaya publishing House, NewDelhi.

MATHEMATICAL PHYSICS
CREDITS
2
COURSE
OBJECTIVES
To understand higher mathematical concepts which are applied to solve problems in Physics and similar situations
UNITS
COURSE DETAILS
UNIT-I
MATRICES:Types of matrices – symmetric, Hermitian, unitary and orthogonal matrices– characteristic equation of a matrix –Cayley-Hamilton theorem – inverse of matrix by Cayley-Hamilton theorem –diagonalization of 2x2 real symmetric matrices.
UNIT-II
VECTOR CALCULUS: Vector differentiation – directional derivatives –definitions & Physical significance of gradient, divergence, curl and Laplace operators– vector identities – line, surface and volume integrals – statement and proof for Gauss‘s divergence theorem and Stoke‘s theorem
UNIT-III
ORTHOGONAL CURVILINEAR COORDINATES: Basis vectors –unit vectors in Cartesian,cylindrical and spherical coordinate systems –gradient of a scalar – divergence and curl of a vector – Laplacian in these coordinate systems.
UNIT-IV
FOURIER SERIES: Periodic functions – Dirichlet‘s conditions – general Fourier series – even and odd functions and their Fourier expansions – Fourier cosine and sine –Fourier analysis of square wave, saw-tooth wave, half wave/full wave rectifier wave forms.
FOURIER TRANSFORMS: Fourier Integral theorem(Statement only)–Fourier, Fourier sine and Fourier cosine transforms,– Fourier transform ofsingle pulse –

trigonometric,exponential and Gaussianfunctions – inverse Fourier transform

UNIT-V

NUMERICAL METHODS:Determination of zeros of polynomials – roots of algebraic and transcendental equations using bisection methods – Newton-Raphson method to find square root and cube roots – Evaluation of definite integral using trapezoidal rule, Simpson‘s 1/3 and 1/8 rule

TEXT BOOKS 1. Mathematical Physics - Satya prakash, Sultan Chand, Meerut

2. Mathematical Physics – B. D. Gupta.

3. Mathematical Physics – H. K. Das, S. Chand & Co, New Delhi.

4. Numerical methods,Singaravelu,Meenakshipublication,4th Edn., 1999.

5. Numerical methodsP.Kandasamy, K.Thilagavathy, K. Gunavathi, S.Chand, 2016

REFERENCE BOOKS

1. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.

2. Engineering Mathematics III- B, M. K. Venkataraman,

3. Applied Mathematics for Scientists and Engineers, Bruce R. Kusse & Erik A. Westwig, 2nd Ed, WILEY-VCH Verlag, 2006.

4. Vector space & Matrices – J. C. Jain, Narosa Publishing House Pvt. Ltd.

METHOD OF EVALUATION:

Continuous InternalAssessment

End Semester Examination

Total

Grade

25

75

100

32

COURSE

FIFTH SEMESTER –ELECTIVE COURSE (EC -3)

COURSETITLE

PYTHON PROGRAMMING AND BASICS OF AI & DATA SCIENCE

CREDITS

2

COURSE

OBJECTIVES

Objective of the course is to provide knowledge about the basics of Computerprogramming in Python and to solve problems by writing programs. Basic knowledge of AI and Data Science. The paper does not need any special prerequisite and the learners are expected to come out with the ability to apply the computer language PYTHON to solve PHYSICS problems.

UNITS

COURSE DETAILS

UNIT-I

BASICS - Python Introduction – Tokens:literals, Variables, Reserved Words, Operators, Delimiters and Escape sequences - Standard Data Types -Expressions – Comments in Python - InputandOutput functions -Simple Physics formula based programming in Python..

UNIT-II

CONTROL STATEMENTS: Control Flow Statements andSyntax with examples-Looping statements - string operations- LISTS: List- list slices - list methods - list loop –Tuples assignment– sets - Dictionaries.

UNIT-III

FUNCTIONS: Definition and types- Passing parameters to a Function- Scope–Typeconversion-PassingFunctionstoaFunction-Modules-StandardModules–Inbuilt Function- Scope of Variables.

UNIT-IV

OBJECT ORIENTED FEATURES: Introduction-Defining Classes- Public and private Data member-Creating Object-Accessing class members-Using objects. Constructors-Destructors- Introduction of simple Inheritance – Introduction of simple Polymorphism- ERROR HANDLING :Run Time Errors - Exception Model

UNIT-V

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE: Introduction - History of AI - Applications of AI – Defining Algorithm – A* Algorithm.

DATA SCIENCE: Introduction – Defining Data , Information and Data structure-Basic concept of Probability and Statistics.

TEXT BOOKS

1. Fundamental of Pythons-First program by Kenneth A.Lambert

2. Python Programming-A modular approach by pearson-sheetal Taneja

3. Hands on AI for beginners by Patric D. SmithIntroduction to Data Science by by Dr. Sushil Dohare, Dr. V SelvaKumar Sachin Raval

33

REFERENCE BOOKS

1. Python Crash Course – Eric Matthes No starch press,san fransisco

2. Python programming using problem solving approach – Reema Thareja-Oxford university press 3. Python: The Complete Referenceby Martin C. Brown

4. AI for beginners by Jassim M

WEB LINK

1. https://youtu.be/eWRfhZUzrAc
2. https://youtu.be/kqtD5dpn9C8
3. https://youtu.be/9IgscYw7BnY
4. https://youtu.be/ua-CiDNNj30

PHYSICS PRACTICAL V

Course Objectives

- Demonstrate various optical phenomena principles, working, apply with various materials and interpret the results.

GENERAL PHYSICS EXPERIMENTS - I

Minimum of **Six** Experiments from the list:

1. Potentiometer – Calibration of Voltmeter (High Range)
2. Spectrometer– Grating - Normal incidence - Wave length of Mercury spectral lines.
3. Spectrometer – Grating - Minimum deviation - Wave length of Mercury spectral lines.
4. Young‘s Modulus – Elliptical Fringes
5. Bi-prism – Determination of Wavelength.
6. Thevenin‘s and Norton‘s Theorem verification
7. Y – by Cornus method.
8. Forbe‘s method – Thermal conductivity of a metal rod.
9. Spectrometer – (i-d) curve.
10. Spectrometer – (i-i′) curve.
11. Ballistic Galvanometer – High resistance by leakage
12. Desauty‘s Bridge – Determination of C, C1 & C2 in series and parallel

PHYSICS PRACTICAL VI

Course Objectives

- To perform basic experiments on characteristics of electronic devices and then get into the applications such as amplifiers, oscillators, counters, multi vibrators. Perform fundamental experiments on microprocessor 8085 and learn to write programs by themselves.

ELECTRONICS EXPERIMENTS - I

Minimum of **Six** Experiments from the list:

1. V-I Characteristics of Junction diode and Zener diode
2. Zener diode – voltage regulations bridge rectifier
3. Dual power supply using IC‘s
4. OPAMP – Adder & Subtractor
5. OPAMP – Low Pass & High Pass Filter
6. Characteristics of a transistor – (CE mode)
7. RC coupled CE transistor amplifier - single stage.
8. Colpitt‘s oscillator -transistor.
9. FET - characteristics.
10. UJT –characteristics
11. Astable multivibrator using 555 timer
12. Bistable multivibrator – 555 timer

NAAN MUTHALVAN / MODERN PHYSICS

Course Objectives

- The paper provides a basic knowledge in basic physics and some advance technology in semiconductor

UNIT-I

Waves and vibrations

Waves- Generation of waves by vibrating particles- Types of wave motion, transverse, and longitudinal wave motion- Simple harmonic motion- Vibration of spring mass system.

UNIT-II

Electrostatics

Coulomb‘s Law - Intensity of Electric Field - Intensity due to a Point Charge- Electric Flux - Electric Potential - Electric Potential due to a Point Charge

UNIT-III

Electricity

Ohm‘s law- Resistance of a conductor - specific resistance- Heating effect of current and concept of electric power.

UNIT-IV

Semiconductor physics

Energy bands - intrinsic and extrinsic semiconductor - p-n junction diode – characteristics of diode.

UNIT-V

Super conductivity

Phenomenon of super conductivity - Type I super conductor - Type II super conductor – applications of super conductor.

TEXT BOOKS

1. Modern Physics,R. Murugesan & Kiruthiga Sivaprasath, S. Chand & Co.
2. Concept of Physics Prof. H.C. Verma, Part-1 (Bharti Bhawan)
3. Concept of Physics, Prof. H.C. Verma, Part-2 (Bharti Bhawan)

REFERENCE BOOKS

1. A Text Book of Applied Physics: Egale Parkashan, Jullandha.

.