Shri Vile Parle Kelavani Mandal's

**MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE &
AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS
(AUTONOMOUS)**

NAAC Reaccredited 'A' grade, CGPA: 3.57 (February 2016),
Granted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of India
Best College (2016-17), University of Mumbai

Affiliated to the

UNIVERSITY OF MUMBAI

Program: Bachelor of Science

Course: Physics

Semester: V and VI

Choice Based Credit System (CBCS) with effect from the Academic year 2020-21

PROGRAM SPECIFIC OUTCOMES (PSO'S)

On completion of the B.Sc - Physics, the learners should be enriched with knowledge and be able to-

PSO1: **Knowledge**: Understand fundamental theories and principles of Physics, which includes Nuclear Physics, Electrodynamics, thermodynamics, waves & optics, materials science, Atomic and Molecular Physics, Classical Mechanics, Quantum Mechanics, Statistical Mechanics, Mathematical Physics, Solid state Physics, Electronics, C++ programming language, AVR microcontroller and its applications in different areas of science and technology.

PSO2: **Analytical abilities and practical skills:** Develop analytical abilities towards complex problem solving and acquire laboratory practical skill required to transform Physics knowledge into real life applications for society.

PSO3: **Skills and Life-long learning**: Acquire skills like collaboration, communication, and independent learning and prepares for lifelong learning to overcome challenges ahead

PSO4: **Competitive examinations:** Clear entrance tests for higher studies and competitive examination for public sectors and Civil service

PSO5: **Conduct investigations of complex problems in physical science:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

PSO6: **Ethics:** Demonstrate professional behaviour such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behaviour such as fabricating, falsifying or misrepresenting data or committing plagiarism; (ii)the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment.

PREAMBLE

This is an undergraduate program (Six Semesters) in Physics, to be taught in Semester V & VI from the academic year 2020-21 onwards. All the ten theory courses are devoted to fundamentals of Physics including Mathematical Physics, Analog and Digital Electronics, Nuclear Physics, Electrodynamics, C++ Programming, Classical Mechanics, Solid State Physics, Atomic and Molecular Physics, Special Theory of Relativity, AVR Microcontroller and VHDL. The laboratory practical component in course consists of combination of laboratory experiment related to theory topics, skill experiments and demonstration experiment.

This syllabus is planned to hone the learners for understanding of fundamental concepts of Physics along with practical skill required to achieve excellence in recent advances of Physics and its applications to society. This course shall motivate learners for higher studies in Physics and build-up successful career in various branches of science and technology.

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

SYLLABUS

TYBSC, PHYSICS, SEMESTER-V

Program: Bachelor of Science				Semester : V	
Course : Mathematical Physics					Course Code: USMAPH501
Teaching Scheme				Evaluation Scheme	
Lecture (per week) 48 min each	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks -)	Term End Examinations (TEE) (Marks- ______)
4	-	-	2.5	25	75

Pre-requisite: Basic knowledge of matrices, differential equation and complex numbers.

Learning Objectives:

1. To provide in depth knowledge of Matrices and Complex Analysis, Differential equations, special functions, Fourier series and transform, Numerical Techniques.
2. To learn programming in MATLAB.
3. To solve problem based on topics covered.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Describe and recognize different types of matrices, complex numbers, differential equations, transforms, errors in programs.

CO2: Discuss and explain eigenvalues, Hermitian matrices, orthogonal matrices, De Moivre's theorem, partial differential equation, Fourier series, different numerical techniques

CO3: Solve problems on all units based on Fourier transform, differential equations, complex analysis, matrices, write programs in Matlab.

CO4: Investigate the eigen vectors, diagonalization of matrix, roots of complex numbers, demonstrate use of Laplace transform in solving differential equations.

CO5: Evaluate the integrals and roots using numerical techniques, evaluate matrix multiplication, differential equations.

CO6: Derive solutions to theorems, derive formulas, Laplace equation, etc.

Outline of Syllabus: (per session plan)

Unit	Description	Duration 48 min each
1	**Matrices and Complex Analysis**	15
2	**Differential equations and special functions**	15

3	**Fourier series and transform**	**15**
4	**Numerical Techniques and introduction to MATLAB**	**15**
	Total	**60**
DETAILED SYLLABUS		
1	**UNIT -I: Matrices and Complex Analysis** Matrices, Eigenvalues and Eigen vectors, orthogonal, unitary and hermitian matrices, Diagonalization of Matrices, Applications to Physics problems. Introduction to Tensor Analysis. **Complex Analysis**: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula.	**15**
2	**UNIT II: Differential equations and special functions** First and Second-order nonhomogeneous linear differential equations with constant coefficients: the method of successive integrations and the method of undetermined coefficients. **Partial Differential Equations**: Solutions to partial differential equations, using separation of variables: Laplace's Equation. **Special functions**: Legendre and Hermite polynomials.	**15**
3	**UNIT - III: Fourier series and transform** **Fourier Series:** Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. **The Laplace transform** and its use in the solution of differential equations. **Fourier transforms**: introduction, formal development of the complex Fourier transform, cosine and sine transforms, the transforms of derivatives (with proofs), solutions of partial differential equations (wave and heat equation) using Fourier transforms.	**15**

4	**UNIT - IV: Numerical Techniques and introduction to MATLAB** **Numerical Techniques**: Bisectors, Newton's Raphson, method, Euler's method, Trapezoidal rule, Simpson rules, Runge Kutta method. **Introduction to MATLAB**: Introduction, Basics of MATLAB, Matrix and Array operations, Character strings, Functions, Command-Line Functions, Using Built-in Functions, Script Files, Function Files, Application.	15

Reference Books:

1. Mathematical Physics : A K Ghatak, Chua – 1995 Macmillian India Ltd.
2. Getting started with MATLAB: Rudrapratap, Oxford Univ Press.
3. Mathematical Methods in the Physical sciences :- Mary L. Boas Wiley India 3rd ed.
4. Mathematical Physics: H.K. Dass, S. Chand Ltd.
5. SCILAB (A free software to MATLAB): Achuthsankar, S. Nair, S. Chand Ltd.

Program: Bachelor of Science				**Semester : V**	
Course :	**Analog and Digital Electronics**			**Course Code: USMAPH502**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (per week) 48 min each	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - 25)**	**Term End Examinations (TEE) (Marks- 75)**
4	--	-	2.5	25	75

Pre-requisite:

Basic understating of semiconductor, semiconductor diode, transistor and operational amplifier. General working and application of transistor and operational amplifier

Learning Objectives:

1. To teach basics of semiconductor devices and their applications and design its prototype in real life.
2. To teach the basic electronic circuits for universal logic building blocks and basic concepts of digital communication.
3. Develop quantitative problem solving skills in all the topics covered.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Describe construction and properties of different electronic power devices including JFET, MOSFET, TRIAC, DIAC, design of power supplies, OPAMP applications, special purpose amplifiers, oscillator timers, digital electronics and communication circuits.

CO2: Explain the working of power electronic devices OPAMP, ADC DAC, Digital circuits and communication circuits.

CO3: Apply circuits based on analog and digital electronics for different kind of integrated circuits

CO4: Analyze the circuits designed and implemented in the proto board.
CO5: Evaluate the working of analog and digital circuits with its ideal and real characteristics.
CO6: Design a prototype for commercial use in consumer and industrial applications

Outline of Syllabus: (per session plan)

Unit	Description	Duration 48 min each
1	**MOSFET, Thyristors and special purpose amplifiers:**	15
2	**Filters, Oscillators and Timers**	15
3	**Digital Electronics**	15
4	**Electronic communication techniques**	15
	Total	60

DETAILED SYLLABUS

1	**MOSFET, Thyristors and special purpose amplifiers:** • MOSFET: Depletion and enhancement mode, MOSFET operation and characteristics, digital switching. • Thyristors: SCR – Working, Equivalent circuit, important terms, I-V Characteristics, SCR as a switch, half wave rectifier and full wave rectifier. • TRIAC: Construction, Operation, I-V Characteristics, Applications. • DIAC: Construction, Operation, Characteristics and applications. • Special purpose amplifiers: Instrumentation amplifier, isolation amplifier, operational trans-conductance amplifier, logarithmic and anti-logarithmic amplifier. Introduction to ADC and DAC.	15
2	**Filters, Oscillators and Timers** • Active Filters: Basic filter response, filter characteristics, active low-pass filters, active high-pass filters, active band-pass filters, activeband-stop filters, filter response measurements. • Oscillators and Timers: Feedback oscillators, principle of sinusoidal feedback oscillator (with RC feedback circuit and LC feedback circuit), relaxation oscillator circuits, introduction to 555 Timer, astable, monostable, ramp generators, VCO.	15
3	**Digital Electronics** Review number system, operations and codes, logic gates	15

	• **Combinational logic circuits**: Implementation of combinational logic circuits, universal properties of NAND and NOR, • **Functions of combinational logic circuits**: Half adder, full adder, comparators, decoders, encoders, multiplexers. Latches, flip-flops, and timers, multivibrators, shift registers, counters (synchronous and asynchronous)	
4	**Electronic communication techniques** Radio broadcasting, Analog Modulation- Transmission and reception, Modulation, Amplitude modulation, Modulation factor, Analysis of amplitude modulated wave, Side band frequencies in AM wave, Transistor amplitude modulator, Power in AM wave, Limitations of AM, Frequency modulation, Phase locked loop, Introduction to Digital Modulation techniques.	**15**

Reference Books:

1. Electronic Principles: A. P. Malvino and D.J. Bates, (7th Ed.) – (TMH).
2. Principles of Electronics: V. K. Mehta and Rohit Mehta. S. Chand Publications. (11th Ed.)
3. Functional Electronics: K .V. Ramanan (TMH).
4. Electronic Devices and Circuits : Allen Mottershed, PHI learning 2013 Ed
5. Digital Principles and Applications: Malvino and Leach (4th Ed) (TMH).
6. Integrated Electronics: Millman and Halkias, McGraw Hill International.

Program: Bachelor of Science				**Semester : V**	
Course : Nuclear Physics				**Course Code: USMAPH503**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (per week) **48 min each**	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - 25)**	**Term End Examinations (TEE) (Marks - 75)**
4	--	--	2.5	25	75

Pre-requisite:
Knowledge of basic properties of nucleus, nuclear stability, binding energy, types of nuclear decay, half-lives.

Learning Objectives:
Teach properties of the nucleus, radioactivity and types of radioactive equilibrium, Q-value of nuclear reactions and possible solutions, fundamentals of origin of alpha, beta and gamma decay, their energetics and decay schemes, liquid drop model and its applications, introduction to shell model, nuclear reactors and applications, particle detectors and accelerators.

Course Outcomes:
After completion of the course, learners would be able to:

CO1: Describe properties of the nucleus, phenomenon of radioactivity, nuclear chain reaction, nuclear fission and fusion.
CO2: Discuss types of radioactive equilibrium and nuclear reactions, explain Q-value of nuclear reactions and possible solutions, nuclear models, nuclear energy, working of particle detectors and accelerators.
CO3: Solve problems on nuclear reactions, radioactivity, nuclear models, nuclear reactors, particle detectors and accelerators, calculate energetics of radioactive decay and decay schemes.
CO4: Investigate the different types of radioactivity, nuclear models (liquid drop model and shell model) for studying nuclear structure, analyze the various types of nuclear reactors, particle detectors and accelerators.
CO5: Assess the applications of radioactivity, nuclear models, nuclear reactors, particle detectors and accelerators, nuclear fission and fusion.
CO6: Design the schematic of various types of nuclear reactors.

Outline of Syllabus: (per session plan)

Unit	Description	Duration 48 min each
1	**Basic properties of nucleus and nuclear reactions.**	**15**
2	**Radioactive decay**	**15**
3	**Nuclear models and nuclear energy**	**15**
4	**Particle detectors and accelerators**	**15**
	Total	**60**

DETAILED SYLLABUS

Unit	Description	Duration
1.	**1. Basic properties of nucleus and nuclear reactions.** Basic properties of the nucleus: Estimation of size of nucleus by Hofstadter's method, magnetic moment, quadrupole moment, parity, binding energy, fission, fusion, radioactive equilibrium. **2. Nuclear Reactions:** Types of Nuclear Reactions, Balance of mass and energy in Nuclear Reaction, the Q-equation and Solution of Q-equation.	15
2.	**Radioactive Decay** **1. Alpha Decay:** Velocity, energy, and Absorption of alpha particles: Range, Ionization and stopping power, Nuclear energy levels. Range of alpha particles, alpha particle spectrum, Fine structure, long range alpha particles, Alpha decay paradox: Barrier penetration (Gamow's theory of alpha decay and Geiger-Nuttal law),	15

	2. Beta decay: Introduction, Velocity and energy of beta particles, Energy levels and decay schemes, Continuous beta ray spectrum-Difficulties encountered to understand it, Pauli's neutrino hypothesis, Detection of neutrino, Energetics of beta decay. **3. Gamma decay:** Introduction, Internal conversion, nuclear isomerism, Mossbauer effect.	
3.	**Nuclear models and nuclear energy** **1. Nuclear Models:** Liquid drop model, Weizsacher's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Shell model (Qualitative), Magic numbers in the nucleus. **2. Nuclear energy:** Introduction, Asymmetric fission - Mass yield, Emission of delayed neutrons, Nuclear energy release in fission, Nature of fission fragments, Energy released in the fission of U^{235}, Fission of lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor (Four Factor Formula), Nuclear reactors, Natural fusion, Possibility of controlled fusion.	15
4.	**Particle detectors and accelerators** **1. Particle Detectors:** Gas detectors (Ionization, Proportional and GM counters), NaI (Tl) detector, Semiconductor detectors (Ge (Li), Si (Li)), Cloud chamber, Bubble chamber, Scintillation counter. **2. Particle Accelerators:** DC accelerators - Van de Graaff Generator, RF accelerators - Cyclotron, Synchrotron, Betatron, Introduction to Radiofrequency Qudrupole accelerator, Idea of Large Hadron Collider.	15

Reference Books:

1. Nuclear Physics: S.B. Patel (Wiley Eastern Ltd.).
2. Modern Physics: Kenneth Krane (2nd Ed.) John Wiley & Sons.
3. Nuclear Physics: S. N. Ghoshal (S. Chand & Co.)
4. Introduction to Nuclear Physics: Harald A. Enge, Addison-Wesley Pub. Co., 1966.
5. Concepts of Nuclear Physics: B L Cohen, McGraw Hill publication, 1st edition.

Additional Reference Books:

1. Nuclear Physics: Irving Kaplan (2nd Ed.) (Addison Wesley).
2. Concepts of Modern Physics: Arthur Beiser,ShobhitMahajan,S Rai Choudhury(6th Ed.) (TMH).
3. Nuclear Physics: D. C. Tayal (Himalayan Publishing House) 5th ed.

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Program: Bachelor of Science				Semester : V	
Course : Electrodynamics				Course Code:USMAPH504	
Teaching Scheme				Evaluation Scheme	
Lecture (per week) 48 min each	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks)	Term End Examinations (TEE) (Marks)
4	-	-	2.5	25	75

Pre-requisite: Basic Knowledge of electrostatics and Magnetostatics.

Learning Objectives: To teach Special techniques for calculating potentials, Polarization, Magnetism and Varying Fields and Electromagnetic Waves.

Course Outcomes:

After completion of the course, learners would be able to:

- **CO1:** Describe different Coordinate systems, understand Method of separation of variables, define Poisson's equation , recognize meaning of bound charges and bound currents
- **CO2:** Discuss Uniqueness theorems, Express Maxwell's equations in differential and integral forms, recognize Gauss law in dielectrics.
- **CO3:** Demonstrate the reflection and transmission at boundary between two mediums, use method of image for solving simple problems in electrostatics, differentiate dia-magnets, paramagnets and Ferro magnets.
- **CO4:** Investigate the effect of polarization of dielectric material on electric potential, Investigate the effect of bound current on magnetic vector potential due to magnetized object., analyze the plane polarized electromagnetic waves.
- **CO5:** Evaluate the energy and momentum carried by electromagnetic fields, Evaluate the energy stored in dielectric system.
- **CO6:** Derive expressions for potential due to different charge distributions, derive expressions for Poynting theorem, derive wave equations for electric and magnetic components of wave

Outline of Syllabus: (per session plan)

Unit	Description	Duration 48 min each
1	**Special techniques for calculating potentials:**	15
2	**Polarization :**	15
3	**Magnetism and Varying Fields**	15
4	**Electromagnetic Waves**	15
	Total	60

DETAILED SYLLABUS		
1	**UNIT- I : Special techniques for calculating potentials:** Spherical polar coordinate system, Electric field and potential , Gauss law, Poisson's equation, , Laplace equation, Uniqueness Theorems, Solution to Laplace equation for different boundary conditions and Method of Separation of variables.	**15**
2	**UNIT- II : Polarization :** Dielectrics, Induced Dipoles, Alignment of polar molecules, Polarization, Potential due to polarized object, Bound charges and their physical interpretation, Gauss' law in presence of dielectrics, A deceptive parallel, Susceptibility, Permittivity, Dielectric constant, Energy in dielectric systems.	**15**
3	**UNIT -III : Magnetism and Varying Fields** Biot-savert law, Ampere's law, magnetic vector potential, Dia-magnets, Paramagnets Ferro magnets, Magnetization, Bound currents and their physical interpretation, Ampere's law in magnetized materials, A deceptive parallel, Magnetic susceptibility and permeability. Energy in magnetic fields, Electrodynamics before Maxwell, to Ampere's law, Maxwell's equations, Magnetic charge, Maxwell'sequations in matter, Boundary conditions.	**15**
4	**UNIT- IV : Electromagnetic Waves** The continuity equation, Poynting's theorem, Newton's third law in electrodynamics. The wave equation for E and B, Monochromatic Plane waves, Energy and momentum in electromagnetic waves, Propagation in linear media, Reflection and transmission of EM waves.	**15**

Reference Books:
References :

1. Introduction to Electrodynamics: David J. Griffiths (3rd Ed) Prentice Hall of India.
2. Introduction to Electrodynamics: A. Z. Capria and P. V. Panat. Narosa Publishing House.
3. Engineering Electrodynamics: William Hayt Jr. & John H. Buck (TMH).
4. Electricity and Magnetism : Navina Wadhwani (PHI – 2010).

Program: Bachelor of Science				**Semester : V**	
Course :	**Physics Practical-I**			**Course Code: USMAPHP512**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- _______ in Question Paper)**
--	per week	-	3	20	80

	2 sessions of 192 min each				

Pre-requisite:

Measuring units, Conversion to SI and CGS. Familiarization with Vernier calliper, Screw gauge, Spectrometer, travelling microscope, thermometer, LCR meter, DMM, CRO and DSO. Instruments accuracy, precision, sensitivity, resolution range. Errors in measurements.

Learning Objectives:

1. To give exposure to students to perform experiments based on applications of electronics devices and programming in MATLAB.
2. To develop analytical abilities towards real world problems related to experimental Physics
3. To familiarize with current and recent scientific and technological developments.

Learning Outcomes:

On successful completion of this course students will be able to:

1. Acquire skills in use of laboratory equipment.
2. Demonstrate an ability to collect data through observation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts of electronics and visualizing them as authentic phenomena

List of experiments:		Duration
1.	**Demonstration experiments:** 1. Millikan's Oil Drop Experiment	**per week 2 sessions of 192 min each**
2.	**Audio Visual Lab:** 1. Documentary on application of mathematical physics 2. Documentary on evolution of microprocessor	
3.	**Regular Experiments:** 1. Experiments with MATLAB/SCILAB.	

2. Experiments with MATLAB/SCILAB.
3. Experiments with MATLAB/SCILAB.
4. I-V characteristics of DIAC/TRIAC.
5. Relaxation oscillator .
6. Instrumentation Amplifier.
7. 555 as Astable multivibrator and VCO
8. 555 as RAMP generator.
9. Counters Mod 2,5 10.
10. High pass (first order active filter).
11. Study of Encoder and Decoder.
12. Project work equivalent to two practical.
13. Study visit to industry.
14. Study of gates-Half adder and Full adder.

Reference Books:

1. Advanced course in Practical Physics D. Chattopadhya, PC. Rakshit & B. Saha. (6th Edition) Book & Allied Pvt. Ltd.
2. BSc Practical Physics – Harnam Singh S. Chand & Co. Ltd. – 2001
3. A Text book of advanced Practical Physics – Samir Kumar Ghosh, New Central Book Agency – (3rd edition)
4. B Sc. Practical Physics – CL Arora (1st Edition) – 2001 S. Chand & Co. Ltd.
5. Practical Physics – CL Squires – (3rd Edition) Cambridge University Press.
6. University Practical Physics – D C Tayal. Himalaya Publication.
7. Advanced Practical Physics – Worsnop & Flint.

Any other information:

Note:

1. Minimum 8 experiments and all skill/demonstration experiments should be completed in the semester. Certified journal is a must to be eligible to appear for the semester end practical.
2. Exemption of two experiments may be given if student carries out any one of the following activity.
   - Execute a mini project to the satisfaction of teacher in-charge of practical.
   - Participate in a study tour or visit & submit a study tour report.

Program: Bachelor of Science				**Semester : V**	
Course : Physics Practical-II				**Course Code: USMAPHP534**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical** (Hours per week)	**Tutorial** (Hours per week)	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks)**	**Term End Examinations (TEE) (Marks)**
--	per week 2 sessions of 192 min each	-	3	20	80

Pre-requisite:

Measuring units, Conversion to SI and CGS. Familiarization with Vernier calliper, Screw gauge, Spectrometer, travelling microscope, thermometer, LCR meter, DMM, CRO and DSO. Instruments accuracy, precision, sensitivity, resolution range. Errors in measurements.

Course Objectives:

1. To give exposure to students for experiments related to Nuclear Physics and electrodynamics.
2. To develop analytical abilities towards real world problems related to experimental Physics
3. To familiarize with current and recent scientific and technological developments.

Learning Outcomes:

On successful completion of this course students will be able to:

5. Acquire skills in use of laboratory equipment, tools.
6. Demonstrate an ability to collect data through observation and interpreting data.
7. Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
8. Demonstrate a deeper understanding of abstract concepts in Nuclear Physics & Electrodynamics and visualizing them as authentic phenomena.

List of experiments:		Duration
4.	**Demonstration experiments:**	

<table>
<tr><td></td><td>2. Van de Graff Generator.</td><td rowspan="3">per week 2 sessions of 192 min each</td></tr>
<tr><td>5.</td><td>Audio Visual Lab:
3. Documentary on Nuclear physics</td></tr>
<tr><td>6.</td><td>Regular Experiments:
1. Study of beta decay
2. Determination of absorption coefficient of Al for beta and gamma rays.
3. Determination of range of beta particles in matter
4. Determination of dead time of GM counter
5. Study of Poisson/ Gaussian distribution
6. Study of GM counter characteristics and error analysis.
7. Mutual inductance by BG.
8. Magnetic Susceptibility measurement.
9. Hysteresis by magnetometer
10. Energy band gap of semiconductor material.
11. Study visit to research institute. (particle accelerator/ nuclear reactor)
12. Study of EM waves propagation through transmission line
13. Nuclear Magnetic Resonance (NMR): measurement of magnetic moment of proton and nucleus.
14. Project work equivalent to two practical</td></tr>
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Reference Books:

8. Advanced course in Practical Physics D. Chattopadhya, PC. Rakshit & B. Saha. (6th Edition) Book & Allied Pvt. Ltd.
9. BSc Practical Physics – Harnam Singh S. Chand & Co. Ltd. – 2001
10. A Text book of advanced Practical Physics – Samir Kumar Ghosh, New Central Book Agency – (3rd edition)
11. B Sc. Practical Physics – CL Arora (1stEdition) – 2001 S. Chand & Co. Ltd.
12. Practical Physics – CL Squires – (3rdEdition) Cambridge University Press.
13. University Practical Physics – D C Tayal. Himalaya Publication.

14. Advanced Practical Physics – Worsnop & Flint.

Any other information:

Note:

3. Minimum 8 experiments and all skill/demonstration experiments should be completed in the semester.
4. Exemption of two experiments may be given if student carries out any one of the following activity.
    - Execute a mini project to the satisfaction of teacher in-charge of practical.
    - Participate in a study tour or visit & submit a study tour report.

APPLIED COMPONENT

Program: Bachelor of Science				Semester : V	
Course :	C++ Programming			Course Code: USMAPHAC5	
Teaching Scheme				Evaluation Scheme	
Lecture (per week) 48 min each	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - ______)	Term End Examinations (TEE) (Marks- ______ in Question Paper)
4	-	-	2	25	75

Pre-requisite: Basic knowledge of algorithm

Learning Objectives:

1. To teach the fundamental programming concepts and techniques which are essential to building good C++ programs.
2. To teach to develop well tested, well-structured, robust computer program using the C++ programming language to solve scientific and engineering problems.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: State the different types of operators, data types, variables, constants and control structures and function in C++. Describe the different parts of the C++ program. Define the functions, arrays, pointers, classes and objects in C++ program.

CO2: Translate algorithm/ pseudo-code into C++ program using correct syntax and execute it.

CO3: Demonstrate the use of the functions, arrays, pointers, classes and objects. Use various programming techniques to solve scientific and engineering problems.

CO4: Analyze the C++ program and troubleshoot it to find the errors.

CO5: Asses the C++ program and evaluate it to find the output of the program.

CO6: Formulate algorithm/pseudo-code for given problem and Develop it into working C++ program using different programming techniques.

Outline of Syllabus: (per session plan)

Unit	Description	Duration 48 min each
1	Introduction to C++, Decision making and looping	15
2	Functions and Arrays	15
3	Pointers, Object initialization and cleanup	15

4	classes, Polymorphism and virtual member functions	**15**
	Total :	**60**
DETAILED SYLLABUS		
1	**Introduction to C++, Decision making and looping** **C++ Programming** Introduction to Computers and Programming: Programs and programming languages, the programming process, Procedural and Object oriented programming. **Introduction to C++:** The parts of a C++ program, The cout object, pre-processor directive (#include), variables and constants, Identifiers and rules for naming identifiers, Data types(integer, char, floating point, bool), variable assignment and initialization, scope of a variable, Arithmetic operators, comments. Expressions and Interactivity: The cin object, entering multiple values, reading strings, mathematical expressions, operator precedence and associativity, type conversion, overflow and underflow, typecast operator, #define directive, multiple and combined assignment, formatting input and output, precision, mathematical library functions. **Making Decisions:** Relational operators, if statement, flags, concept of compound statement, if/else statement, if/else if statement, trailing else, nested if statements, logical operators, validating user input, scope of variable, comparing strings, conditional operator, switch statement. **Looping:** Increment and decrement operators, while loop, sentinels, dowhile loop, for loop, nested loops, break and continue statement.	**15**
2	**Functions and Arrays:** **Functions:** need for functions, defining and calling functions, function prototypes, sending information into a function (parameter passing),changing the value of the parameter, the return statement, returning a value from a function, local and global variables, static local variables, default arguments to a function, reference arguments, overloaded functions. **Arrays:** Concept of arrays, accessing array elements, array initialization, processing array contents, copying and printing contents of an array, arrays as function arguments, two-dimensional arrays, arrays of strings.	**15**

3	**Pointers:** concept of a pointer, pointer variables, relationship between arrays and pointers, pointer arithmetic, Initializing pointers, comparing pointers, pointers as function parameters, dynamic memory allocation. **Object oriented terms:** object, class, data hiding, encapsulation, inheritance and polymorphism Website for Object oriented terms http://java.sun.com/docs/books/tutorial/java/concepts/ Introduction to classes: Introduction to class, access Specifiers (private and public) defining member functions, instance of a class(object), need for private members, inline member functions. **Object initialization and cleanup:** constructors, destructors, constructors that accept arguments, overloaded constructors, default constructor and destructor, arrays of objects Introduction to Classes.	**15**
4	**Classes , Polymorphism and virtual member functions:** **More about classes:** static members, friends of classes, member wise assignment, copy constructors. TG: Chapter 14.1 to 14.4 Operator Loading: Overloading assignment operator, this pointer, Overloading Math operators, overloading relational operators. [exclude >> and << operators] **Inheritance:** Basics of inheritance, types of inheritance, protected Members and class access, constructors and destructors, Overriding base class functions. **Polymorphism and virtual member functions:** Concept of polymorphism, abstract base class and pure virtual functions, base class pointers, classes derived from derived classes, Multiple inheritance (concept only).	**15**

Reference Books:

1. Tony Gaddis "Programming in C++" 3rd Edition.
2. Garry Bronson "C++ for Engineers and Scientists
3. Object Oriented Programming with C++ by E Balagurusamy, Third/ Fourth Edition, Tata McGraw-Hill Publishing Company Limited.

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<table>
<tr><td colspan="3">Program: Bachelor of Science</td><td colspan="3">Semester : V</td></tr>
<tr><td colspan="2">Course :</td><td colspan="2">Practical of C++ Programming</td><td colspan="2">Course Code: USMAPHPAC5</td></tr>
<tr><td colspan="4">Teaching Scheme</td><td colspan="2">Evaluation Scheme</td></tr>
<tr><td>Lecture (Hours per week)</td><td>Practical (Hours per week)</td><td>Tutorial (Hours per week)</td><td>Credit</td><td>Continuous Assessment and Evaluation (CAE) (Marks - _____)</td><td>Term End Examinations (TEE) (Marks- _______)</td></tr>
<tr><td>--</td><td>per week 1 session of 192 min</td><td>--</td><td>2</td><td>20</td><td>80</td></tr>
<tr><td colspan="6">Pre-requisite/Preamble:
This course is planned to hone the learners for understanding of fundamental concepts of Software programming in C++</td></tr>
<tr><td colspan="6">Learning Objectives:
1. To provide in depth knowledge of fundamental concepts C++ programming.
2. Develop analytical abilities towards computer interfacing of electronic devices.</td></tr>
<tr><td colspan="6">Course Outcomes:
On successful completion of this course students will be able to:
1. Get hands on experience on use of various digital electronics devices and their application.
2. Learn the syntax and semantics of the C++ programming language.
3. Discover errors in a C++ program and describe how to fix them. Critique a C++ program and describe ways to improve it
4. Analyze a problem and construct a C++ program that solves it</td></tr>
</table>

<table>
<tr><td colspan="2">List of experiments:</td><td></td></tr>
<tr><td></td><td>Group A: Practical based on Control structures and functions:
1. Temperature Conversion
2. Triangle classification problem
3. A function calculator (Rational expression evaluator)
4. Binary, Hex, Octal equivalents of decimal numbers in range 1 through 256</td><td>per week 1 sessions of 192 min each</td></tr>
<tr><td></td><td>Group B: Practical based on Functions
1. Use functions:
a) To find if an integer is a perfect number &
b) Print all perfect numbers in the range 1 to 1000
2. Use functions
a) To find if a given integer is a prime or not.
b) To Print all prime numbers between 1 and 500
3. Use functions: To find GCD of two integers.</td><td></td></tr>
</table>

	Group C: Practical based on Arrays 1. Mean, Variation and Deviance of a set of numbers 2. Linear Search / Binary Search 3. Selection Sort / Bubble Sort / Insertion Sort	
	Group D: Practical based on Pointers and Objects Oriented programing 1. Rectangle Class 2. Complex class for performing arithmetic with complex numbers 3. Class called Rational for addition, subtraction & multiplication 4. Time Class / Date class	

Reference Books:

1. Tony Gaddis "Programming in C++" 3rd Edition.
2. Garry Bronson "C++ for Engineers and Scientists
3. Object Oriented Programming with C++ by E Balagurusamy, Third/ Fourth Edition, Tata McGraw-Hill Publishing Company Limited.

Any other information:

Students have to perform 10 experiments, with at least two experiments from each group.

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SYLLABUS

TYBSC-PHYSICS, SEMESTER-VI

Program: Bachelor of Science				Semester : VI	
Course : Classical Mechanics				Course Code: USMAPH601	
Teaching Scheme				Evaluation Scheme	
Lecture (per week) 48 min each	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment and Evaluation (CAE) (Marks - ______)	Term End Examinations (TEE) (Marks- _______)
4	--	-	2.5	25	75

Pre-requisite/Preamble: Basic knowledge of Newtonian mechanics.

Learning Objectives:

1. To understand motion under central force field, Kepler problems and Ruthreford's scattering.
2. Understand rotating coordinate system and use it to analyze motion on earth: Foucault pendulum motion
3. Understand mechanics on fluid motion and use it to demonstrate the conservation laws.
4. Learn Lagrangian mechanics and apply it for getting equation of motions for motion of Physical systems.
5. Learn Eulurs equation of rigid body rotation and use it for earth rotation as a symmetric top.
6. Learn anharmonic oscillator and formulation of Duffing equation and understand different aspects chaotic behavior.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Describe properties of motion of particle under a central force, describe equation of motion under moving coordinate system, State Generalized coordinates, describe motion for ideal fluid, motion of rigid body, recognize anharmonic oscillator

CO2: Explain the motion under inverse square law force, discuss the Larmor's theorem, discuss the Conservation laws for fluid motion, explain the constraints of motion in Lagrangian formulation, discuss anharmonic oscillator and aspects of Bifurcations and strange attractors.

CO3: Apply the equation of orbit to understand the path of orbit for bounded and unbounded motion, demonstrate the effect of Coriolis force, use Lagangian formula for getting equation of motion. Use Eulers equation to free symmetric top,

CO4: Investigate Bounded and unbounded motion under inverse square law force, Duffing oscillator, analyse logistic map.

CO5: Evaluate pression of plane of oscillations for Foucault's pendulum,

CO6: Derive equation of orbit, Rutherford's scattering cross section formula Coriolis theorem, derive Lagrange equation of motion from D' Alembert's principal of virtual work, Euler's equations of motion for fluid motion, reduced Duffing equation for anharmonic oscillator		
Outline of Syllabus: (per session plan)		
Unit	**Description**	**Duration**
1	**Central Force**	**15**
2	**Lagrangian Mechanics**	**15**
3	**Fluid Motions and Rigid body rotation**	**15**
4	**Nonlinear Mechanics**	**15**
	Total	**60**
DETAILED SYLLABUS		
1	**UNIT I: Central Force** 1. Motion under a central force, The central force inversely proportional to the square of the distance, Elliptical orbits. The Kepler problem. Hyperbolic Orbits: The Rutherford problem – Scattering cross section. 2. Moving origin of co-ordinates, Rotating co-ordinate systems, Laws of motion on the rotating earth, Foucault pendulum, Larmor's theorem.	**15**
2	**UNIT II: Lagrange's equations** Lagrange's equations: D'Alembert's principle, Generalized coordinates, Lagrange's equations using D'Alembert's principle, Examples, Systems subject to constraints, Examples of systems subject to constraints, Constants of motion and ignorable coordinates.	**15**
3	**UNIT III: Fluid Motion and Rigid body rotation** Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow. The rotation of a Rigid body: Motion of a rigid body in space, Euler's equations of motion for a rigid body, Euler's angles, Heavy symmetrical top.	**15**
4	**UNIT IV: Non Linear Mechanics** Non-linear mechanics: Qualitative approach to chaos, The anharmonic oscillator, Numerical solution of Duffing's equation, Transition to chaos: Bifurcations and strange attractors, Aspects of chaotic behaviour.	**15**

Reference Books:

1. Mechanics: Keith R. Symon (Addision Wesly) 3rd Ed.
2. Classical Mechanics: Herbert Goldstein, (Narosa 2nd Ed.)
3. An Introduction to Mechanics : Daniel Kleppner & Robert Kolenkow, Tata McGraw Hill (Indian Ed. 2007)
4. Chaotic Dynamics- an introduction. : Baker and Gollup.
5. Classical Mechanics: P.S. Joag, N.C.Rana.
6. Classical Mechanics , Gupta Kumar and Sharma, Pragati Prakashan.

Program: Bachelor of Science				**Semester : VI**	
Course : Solid state physics				**Course Code: USMAPH602**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week) 48 min each	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - 25)**	**Term End Examinations (TEE) (Marks – 75)**
4	--	-	2.5	25	75

Pre-requisite:

Basic knowledge of metals, semiconductors and insulators, magnets, solving differential equations and integration.

Learning Objectives:

Learn fundamentals of classical and quantum theory of metals, thermionic emission, origin of superconductivity, BCS theory, effect of magnetic field on superconductors, types of superconductors, basic theory of diamagnetism, paramagnetism and ferromagnetism, Curie-Weiss law, applications of magnetic materials, conduction in semiconductors and diode.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: State the assumptions of classical and quantum theory of metals, describe types of magnetic materials and semiconductors.

CO2: Explain drawbacks of classical theory and it's solutions using quantum approach, phenomenon of superconductivity, describe properties and types of superconductors, brillouin zones, semiconductors

CO3: Solve problems on electrical properties of metals, superconductivity, magnetism, semiconductors, demonstrate applications of superconductivity, magnetism.

CO4: Investigate the origin of phenomenon of thermionic emission, superconductivity, diamagnetism, classical and quantum theory of paramagnetism, ferromagnetism, Hall effect, analyze the solutions of Kronig-Penny model

CO5: Assess the properties and applications of superconductors, ferromagnetic materials, discriminate between metals, semiconductors and insulators, estimate the charge densities, fermi level, carrier lifetime in semiconductors.

CO6: Formulate the expression for density of states, fermi function, parameters of electrons in metals, derive expressions for mass of electron inside matter, susceptibility in matter, donor and acceptor concentrations in intrinsic and extrinsic semiconductors, formulate the band structure of open-circuit p-n junction diode.

Outline of Syllabus: (per session plan)

Unit	Description	Duration 48 min
1	**Electrical properties of metals**	15
2	**Band Theory of Solids and Superconductivity**	15
3	**Theory of Magnetism**	15
4	**Semiconductor Physics**	15
	Total	60

DETAILED SYLLABUS

1.	**UNIT I: Electrical properties of Metals** Introduction to crystal structures, Quantum theory of free electrons, Fermi Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, The Fermi distribution function, Heat capacity of the Electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from quantum mechanical considerations, Thermionic Emission – Richardson - Dushman equation (Derivation not included).	15
2.	**UNIT II: Band Theory of Solids and Superconductivity** **1. Band theory of solids:** The Kronig-Penny model, Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Distinction between metals, insulators and intrinsic semiconductors. **2. Superconductivity:** A survey, Mechanism of Superconductors, BCS Theory, Effects of magnetic field, Critical Currents, The Meissner effect, The penetration depth, Type I and Type II Superconductors, High Tc Superconductors.	15
3.	**UNIT III: Theory of Magnetism**	15

	Diamagnetism and Paramagnetism, The origin of permanent magnetic dipoles, Diamagnetism and Larmor precession, The static paramagnetic susceptibility, Quantum theory of paramagnetism, Ferromagnetism- the Weiss molecular field, Comparison of the Weiss theory with experiment, Qualitative remarks about domains, Qualitative idea about antiferromagnetism and ferrites.	
4.	**UNIT IV: Semiconductor Physics** 1.Electrons and Holes in an Intrinsic Semiconductor, Conductivity, Carrier concentrations in an intrinsic semiconductor, Donor and Acceptor impurities, Charge densities in a semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, Hall Effect. 2. Semiconductor-diode Characteristics: Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction.The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics, Diode resistance.	15

Reference Books:

1. Solid State Physics: S. O. Pillai, New Age International. 6th ed.
2. Electronic Devices and Circuits:Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill.
3. Modern Physics and Solid State Physics: Problems and solutions New Age International.
4. Solid State Physics: A. J. Dekker, Prentice Hall.
5. Introduction to solid state physics: Charles Kittel.
6. Solid State Physics: Ashcroft and Mermin

Program: Bachelor of Science				**Semester : VI**	
Course :	**Atomic and Molecular Physics**			**Course Code: USMAPH603**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week) 48 min each	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks)**	**Term End Examinations (TEE) (Marks)**
4	-	-	2.5	25	75

Pre-requisite:

Basic Knowledge of Quantum mechanics and Schrodinger's Equation and its application.

Learning Objectives:

To teach quantum theory of Hydrogen atom, harmonic oscillator, electronic spin orbit coupling, and magnetic field effect on atomic systems, molecular spectra and Raman Effect.

Course Outcomes:

After completion of the course, learners would be able to:

- **CO1:** Describe dynamics of quantum harmonic oscillator and electron in H-atom. Describe the atomic spectra of one and many electron atoms.
- **CO2:** Explain the quantum theory of hydrogen atom and hydrogen atom structure. Explain the observed dependence of atomic spectral lines on externally applied magnetic fields. Explain motion of atoms in a molecule and its effect on molecular spectra. Explain the interaction of photon with molecule and structure of molecule.
- **CO3:** Solve Schrodinger's wave equation for harmonic oscillator and electron in a hydrogen atom. Demonstrate quantitative problem-solving skills in all the topics covered.
- **CO4:** Analyze the wavefunction of harmonic oscillator and electron in a hydrogen atom. Inspect the effect of magnetic field on atom. Analyze the motion of atoms in a molecule and its interaction with Photon.
- **CO5:** Evaluate the dynamics of electron in coulomb potential. Measure shift in energy of atomic spectra because of magnetic perturbation. Evaluate effect vibrational and rotational motion of atoms on molecular physics. Measure the Raman shift.
- **CO6:** Formulate the vibrational and rotational spectra of diatomic molecule. Formulate the quantum and classical theory of Raman Effect.

Outline of Syllabus: (per session plan)

Unit	Description	Duration 48 min each
1	**Quantum Mechanics of harmonic oscillator and Hydrogen atom**	15
2	**Electron Spin and spin orbit coupling**	15
3	**Effect of Magnetic field on atoms**	15
4	**Molecular spectra and Raman effect**	15
	Total	60

DETAILED SYLLABUS

1	**Quantum Mechanics of harmonic oscillator and Hydrogen atom**	15

	Schrödinger's equation for Harmonic oscillator, its solution by operator method. Graphical representation of its energy level and wave functions. Hydrogen atom: Schrödinger's equation for Hydrogen atom, Separation of variables, Quantum Numbers: Total quantum number, Orbital quantum number, Magnetic quantum number. Angular momentum, Electron probability density (Radial part).	
2	**Electron Spin and spin orbit coupling** Electron Spin: The Stern-Gerlach experiment, Pauli's Exclusion Principle, Symmetric and Antisymmetric wave functions. Spin orbit coupling, Hund's Rule, Total angular momentum, Vector atom model, L-S and j-j coupling. Origin of spectral lines, Selection rules.	**15**
3	**Effect of Magnetic field on atoms** Effect of Magnetic field on atoms, The normal Zeeman effect and its explanation (Classical and Quantum), The Lande-g factor, Anomalous Zeeman effect**,** Electron spin resonance (ESR). Paschen-Back effect, Paschen-Back effect of principal series doublet, Selection rules for Paschen-Back effect.	**15**
4	**Molecular spectra and Raman effect** Molecular Spectra (Diatomic Molecules): Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational-Rotational spectra. Electronic Spectra of Diatomic molecules: The Born-Oppenheimer approximation, Intensity of vibrational-electronic spectra: The Franck-Condon principle. Raman Effect: Quantum Theory of Raman effect, Classical theory of Raman effect, Pure Rotational Raman spectra: Linear molecules, symmetric top molecules, Asymmetric top molecules, Vibrational Raman spectra: Raman activity of vibrations.	**15**

Reference Books:

1. Perspectives of Modern Physics : Arthur Beiser McGraw Hill.
2. Introduction to Atomic & Nuclear Physics: H. Semat& J. R. Albright(5th Ed.) Chapman & Hall.

3. Introduction to Atomic Spectra: H. E. White. McGraw Hill.
4. Fundamentals of Molecular Spectroscopy: C. N. Banwell & E. M. McCash (TMH). (4th Ed.)
5. Introduction to Quantum Mechanics: P. T. Mathews (TMH).

Program: Bachelor of Science				**Semester : VI**	
Course : Special Theory of Relativity				**Course Code: USMAPH604**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (per week) 48 min each	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks -)**	**Term End Examinations (TEE) (Marks-)**
4	--	-	2.5	25	75

Pre-requisite: Basic knowledge of Newtonian mechanics.

Learning Objectives:

To teach Special Theory of Relativity**,** Relativistic Kinematics, Relativistic Dynamics and Relativity and Electromagnetism

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Describe Michelson Morley experiment, state the laws of relativity, simultaneity.

CO2: Summarize the experimental background of special theory of relativity, Discuss and explain Doppler effect, relativistic electromagnetism, Minkowski space-time diagrams.

CO3: Solve problems on all units based on Lorentz, transformation equation, consequences of transformation, relativistic addition of velocities, Doppler effect, etc

CO4: Investigate the effect of relative velocity on kinematics and dynamics, relativistic effects in daily life.

CO5: Evaluate the length contraction, time dilation effects.

CO6: Derive transformation equations for space, time, velocity acceleration, force, momentum. Doppler effect

Outline of Syllabus: (per session plan)

Unit	**Description**	**Duration (48 min each)**

1	**Special Theory of Relativity**	**15**
2	**Relativistic Kinematics**	**15**
3	**Relativistic Dynamics**	**15**
4	**Relativity and Electromagnetism**	**15**
	Total	**60**
DETAILED SYLLABUS		
1	**Special Theory of Relativity** Experimental background of special theory of relativity and relativistic kinematics: Galilean transformations, Newtonian relativity, Electromagnetism and Newtonian relativity. Attempts to locate absolute frame: Michelson- Morley experiment, Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction and ether drag hypothesis, Attempt to modify electrodynamics, postulates of the special theory of relativity. Relativistic Kinematics: Simultaneity, Derivation of Lorentz transformation equations Some consequences of the Lorentz transformation equations : length contraction, time dilation and meson experiment, The observer in relativity	**15**
2	**Relativistic Kinematics** Relativistic Kinematics (continued): The relativistic addition of velocities and acceleration transformation equations, Aberration and Doppler effect in relativity, The common sense of special relativity. The Geometric Representation of Space-Time: Space-Time Diagrams, Simultaneity, Length contraction and Time dilation, The time order and space separation of events, The twin paradox	**15**
3	**Relativistic Dynamics**	**15**

	Relativistic Dynamics: Mechanics and Relativity, The need to redefine momentum, Relativistic momentum, Alternative views of mass in relativity, The relativistic force law and the dynamics of a single particle, The equivalence of mass and energy, The transformation properties of momentum, energy and mass.	
4	**Relativity and Electromagnetism** Relativity and Electromagnetism: Introduction, The interdependence of Electric and Magnetic fields, The Transformation for E and B, The field of a uniformly moving point charge, Force and fields near a current-carrying wire, Force between moving charges, The invariance of Maxwell's equations.The principle of equivalence and general relativity, Gravitational red shift.	**15**
Reference Books: 6. Introduction to Special Relativity : Robert Resnick (Wiley Student Edition) **7.** Special theory of Relativity : A. P. French		

Program: Bachelor of Science				**Semester : VI**	
Course :	**Physics Practical-I**			**Course Code: USMAPHP612**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- ________)**
--	per week 2 sessions of 192 min each	-	3	20	80
Pre-requisite:					

Measuring units, Conversion to SI and CGS. Familiarization with Vernier calliper, Screw gauge, Spectrometer, travelling microscope, thermometer, LCR meter, DMM, CRO and DSO. Instruments accuracy, precision, sensitivity, resolution range. Errors in measurements.

Learning Objectives:

1. To give exposure to students to perform experiments based on Mechanics and properties of solids.
2. To develop analytical abilities towards real world problems related to experimental Physics
3. To familiarize with current and recent scientific and technological developments.

Learning Outcomes:

On successful completion of this course students will be able to:

1. Acquire skills in use of laboratory equipment, tools.
2. Demonstrate an ability to collect data through observation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts and visualizing them as authentic phenomena

PRACTICALS		Duration
	Demonstration experiments: 3. Zeeman Effect	per week 2 sessions of 192 min each
	Audio Visual Lab: 4. Documentary on Semiconductor Processes. **5.** Documentary on theory nonlinear dynamics	
	Regular Experiments: 1. Determination of "g" by Kater's pendulum. 2. Determination of Young's Modulus of flat spring 3. Quincke's method for surface tension of Mercury 4. Energy band gap of Ge diode	

5. Modulus of rigidity by Searle's method.
6. Coupled oscillations.
7. Diameter of Lycopodium powder
8. Diode as temperature sensor
9. To measure the transition temperature of high temperature superconductor
10. Study of nonlinear dynamics-CHUA circuit.
11. Neutral Iron - Copper thermocouple.
12. Study of Superconductivity in high TC superconductors

Reference Books:

15. Advanced course in Practical Physics D. Chattopadhya, PC. Rakshit & B. Saha. (6th Edition) Book & Allied Pvt. Ltd.
16. BSc Practical Physics – Harnam Singh S. Chand & Co. Ltd. – 2001
17. A Text book of advanced Practical Physics – Samir Kumar Ghosh, New Central Book Agency – (3rd edition)
18. B Sc. Practical Physics – CL Arora (1st Edition) – 2001 S. Chand & Co. Ltd.
19. Practical Physics – CL Squires – (3rd Edition) Cambridge University Press.
20. University Practical Physics – D C Tayal. Himalaya Publication.
21. Advanced Practical Physics – Worsnop & Flint.

Any other information:

Note:

1. Minimum 8 experiments from each group and all skill/demonstration experiments should be completed in the semester. Certified journal is a must to be eligible to appear for the semester end practical.
2. Exemption of two experiments may be given if student carries out any one of the following activity.

    - Execute a mini project to the satisfaction of teacher in-charge of practical.
    - Participate in a study tour or visit & submit a study tour report.

Details of Semester-end examination:

A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical. The duration of each practical examination will be three hours. There will be one experiments of 80 marks, through which the candidate will be examined in practical.

Details of Continuous Assessment (CA)

Practical Skill in performing experiments, data presentation, analysis and interpretation of results (Marks: 20)

Program: Bachelor of Science				**Semester : VI**	
Course :	**Physics Practical-II**			**Course Code: USMAPHP634**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- _______)**
--	per week 2 sessions of 192 min each	-	3	20	80

Pre-requisite:
Measuring units, Conversion to SI and CGS. Familiarization with Vernier calliper, Screw gauge, Spectrometer, travelling microscope, thermometer, LCR meter, DMM, CRO and DSO. Instruments accuracy, precision, sensitivity, resolution range. Errors in measurements.

Learning Objectives:
1. To give exposure to students to perform experiments based on properties of atoms and molecules and theory of relativity.
2. To develop analytical abilities towards real world problems related to experimental Physics
3. To familiarize with current and recent scientific and technological developments.

Learning Outcomes:
On successful completion of this course students will be able to:
1. Acquire skills in use of laboratory equipment, tools.
2. Demonstrate an ability to collect data through observation and interpreting data.
3. Demonstrate an understanding of laboratory procedures including safety, and scientific methods.
4. Demonstrate a deeper understanding of abstract concepts and visualizing them as authentic phenomena

<table>
<tr><th colspan="2">List of experiments:</th><th>Duration</th></tr>
<tr><td>1.</td><td>Demonstration experiments:
1. Iodine absorption spectra.
2. Michelson's interferometer</td><td rowspan="3">per week
2 sessions of 192 min each</td></tr>
<tr><td>2.</td><td>Audio Visual Lab:
1. Documentary on Special theory of relativity</td></tr>
<tr><td>3.</td><td>Regular Experiments:
1. To determine the Hall coefficient of semiconductor sample
2. Study of dielectric constant of dielectric material using frequency.
3. Study of LVDT
4. To determine Carrier life time in semiconductor diode.
5. Study of Electron Spins Resonance (ESR): determination of electron spin.
6. Study of dependence of electron spins resonance frequency on magnetic field.
7. Measurement of mobility using Van der Pauw method.
8. Experiments using Michelson's Interferometer
9. Faraday rotation –Verdet constant
10. Franck-Hertz experiment.
11. Project work equivalent to three practical</td></tr>
</table>

Reference Books:

1. Advanced course in Practical Physics D. Chattopadhya, PC. Rakshit & B. Saha. (6th Edition) Book & Allied Pvt. Ltd.
2. BSc Practical Physics – Harnam Singh S. Chand & Co. Ltd. – 2001
3. A Text book of advanced Practical Physics – Samir Kumar Ghosh, New Central Book Agency – (3rd edition)
4. B Sc. Practical Physics – CL Arora (1st Edition) – 2001 S. Chand & Co. Ltd.
5. Practical Physics – CL Squires – (3rd Edition) Cambridge University Press.
6. University Practical Physics – D C Tayal. Himalaya Publication.
7. Advanced Practical Physics – Worsnop & Flint.

Any other information:

1. Minimum 8 experiments from each group and all skill/demonstration experiments should be completed in the semester.
2. Exemption of two experiments may be given if student carries out any one of the following activity.

   - Execute a mini project to the satisfaction of teacher in-charge of practical.
   - Participate in a study tour or visit & submit a study tour report.

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APPLIED COMPONENT

Program: Bachelor of Science				**Semester : VI**	
Course : AVR Microcontroller and VHDL				**Course Code: USMAPHAC6**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (per week) 48 min each	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- _______)**
4	--	-	2	25	75

Pre-requisite: Basic knowledge of digital electronics and programming.

Learning Objectives:

This course instructs the students to provide knowledge of different Smart System applications. To familiarize students with AVR/Arduino as IDE, programming language & platform. To provide knowledge of Arduino boards and basic components. Develop skills to design and implement various smart system application. VHDL ((Very High Speed Integrated Circuit Hardware Description Language) for describing the behavior of digital systems. VHDL is a standardized design language used in computer/ semiconductor industry. This course will teach students the use of the VHDL language for representation of digital signals, use of IEEE standard logic package/library, design description, design of arithmetic, combinational, and synchronous sequential circuits.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: outline microcomputing including its generic architecture, design and classifications of microcontrollers, describe the VHDL programming language
CO2: understand the basics of embedded system development and product development with a brief introduction to Arduino, understand the machine level implementation of digital circuits with VHDL
CO3: operate Arduino, FPGA with C and VHDL.
CO4: analyse the circuit designed with Arduino VHDL.
CO5: evaluate input/output operations and manipulation for arithmetic and logical operations in arduino and VHDL
CO6: student shall be able to create design, fabricate, test and run the programs

Outline of Syllabus: (per session plan)

Unit	**Description**	**Duration (48 min each)**
1	AVR Microcontroller introduction	**15**
2	AVR Programming in C	**15**

3	VHDL-I	**10**
4	VHDL-II	**15**
	Total	**60**
DETAILED SYLLABUS		
1	**AVR Microcontroller introduction** The AVR microcontroller history and features AVR Architecture: The general Purpose Register in the AVR, The AVR Data memory, using instruction with data memory, AVR status register. AVR Data formats and Directives, Introduction to Assembly language programming, Assembling an AVR program, the program counter and program ROM space in the AVR, RISC architecture in the AVR, Viewing registers and Memory with AVR studio IDE.	**15**
2	**AVR Programming in C** Data types and time delays in C, I/O programming in C, Logic Operations in C, Data Conversion program in C, Data serialization in C, Memory allocation in C, AVR fuse bits, Programming timer interrupts.	**15**
3	**VHDL-I** Introduction to VHDL: VHDL Terms, Describing Hardware in VHDL, Entity, Architectures , Concurrent Signal Assignment , Event Scheduling, Statement concurrency, Structural Designs, Sequential Behavior, Process Statements, Process Declarative Region, Process Statement Part, Process Execution, Sequential Statements, Architecture Selection, Configuration Statements, Power of Configurations.	**15**
4	**VHDL-II** Behavioral Modeling: Introduction to Behavioral Modeling, Transport Versus Inertial Delay, Inertial Delay, Transport Delay, Inertial Delay Model, Transport Delay Model, Simulation Deltas, Drivers, Driver Creation, Bad Multiple Driver Model, Generics, Block Statements, Guarded Blocks. Sequential Processing: Process Statement, Sensitivity List, Process Example, Signal Assignment Versus Variable Assignment, Incorrect Mux Example, Correct Mux Example, Sequential Statements, IF Statements, CASE Statements, LOOP statements, NEXT Statement, EXIT Statement, ASSERT Statement, Assertion BNF, WAIT Statements, WAIT ON Signal,	**15**

	WAIT UNTIL Expression, WAIT FOR time expression, Multiple WAIT Conditions, WAIT Time-Out, Sensitivity List Versus WAIT Statement, Concurrent Assignment Problem, Passive Processes. Data Types: Object Types, Signal, Variables, Constants, Data Types, Scalar Types, Composite Types, Incomplete Types, File Types, File Type Caveats, Subtypes. Subprograms and Packages: Subprograms Function, Conversion Functions, Resolution Functions, Procedures, Packages, Package Declaration, Deferred Constants, Subprogram Declaration, Package Body.	

Reference Books:

1. VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw-Hill
2. FPGA Prototyping by VHDL Examples: Xilinx Spartan-3 Version
   Embedded systems Architecture, Programming and Design 2nd edition

Program: Bachelor of Science				**Semester : VI**	
Course :	**AVR Microcontroller and VHDL - Practical**			**Course Code: USMAPHPAC6**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment and Evaluation (CAE) (Marks - ______)**	**Term End Examinations (TEE) (Marks- ______)**
-	per week 1session of 192 min	-	2	20	80

Pre-requisite: Basic knowledge of Electronics and programming language.

Learning Objectives: To learn and design computer interfacing of electronic circuits with real world machine and gadgets

Course Outcomes:

On successful completion of this course students will be able to:

1. Understand the concept of embedded system.
2. Learn computer interfacing of electronic circuits with real world machine and gadgets.
3. Implement hardware description language and design application specific processors.

		Duration
	List of Practicals: 1. Interfacing LED's: flashing LED's, to display bit pattern, 8-bit counter. 2. Interfacing Push Buttons: to increment and decrement the count value at the output by recognizing of push buttons, etc 3. Interfacing Relay: to drive an ac bulb through a relay; the relay should be tripped on recognizing of a push button. 4. Interfacing buzzer: the buzzer should be activated for two different frequencies, depending on recognizing of corresponding push buttons. 5. Interfacing Sensor: LM35 temperature sensor, Humidity sensor, etc. 6. Write VHDL programs to realize: logic gates, half adder and full adder 7. Write VHDL programs to realize the following combinational designs: 2 to 4 decoder, 8 to 3 encoder without priority, 4 to 1 multiplexer, 1 to 4 de-multiplexer 8. Write VHDL programs to realize the following: SR – Flip Flop, JK – Flip Flop, T – Flip Flop 9. Interfacing stepper motor: write VHDL code to control direction, speed and number of steps. 10. Interfacing dc motor: write VHDL code to control direction and speed using PWM. 11. Interfacing relays: write VHDL code to control ac bulbs (at least two) using relays	per week 1 session of 192 min

Reference Books:

1. VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw-Hill
2. FPGA Prototyping by VHDL Examples: Xilinx Spartan-3 Version
3. VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw-Hill
4. FPGA Prototyping by VHDL Examples: Xilinx Spartan-3 Version

Any other information:

1. Minimum 9 experiments should be completed and reported in journal.
2. Exemption of two experiments may be given if student carries out project assigned by teacher in-charge of practical.

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

EVALUATION PATTERN

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Continuous Evaluation – 25% of the total marks per theory course:

Particulars	**Percentage**
Component I -Class test	15
Component II - Assignment / Project/ VIVA	10

b) Semester end Examination-75% of the total marks per theory course:

i) Duration – These examinations shall be of a duration of two and a half hours.

ii)Question paper pattern of semester end examination for TYBSc, Semester-V and VI, to be implemented from academic year 2020-21.

Q1.	**Attempt any Two.** (Questions on unit- I : Theory and problem solving)		**(Marks)**
	i)		09
	ii)		09
	iii)		09
Q2.	**Attempt any Two.** (Questions on unit- II : Theory and problem solving)		
	i)		09
	ii)		09
	iii)		09
Q3.	**Attempt any Two.** (Questions on unit- III: Theory and problem solving)		
	i)		09
	ii)		09
	iii)		09
Q4.	**Attempt any Two.** (Questions on unit- IV: Theory and problem solving)		
	i)		09
	ii)		09
	iii)		09
Q5	**Attempt any One.**		
		(Questions on unit –I/unit- II : Short answer type question)	3

	ii)	(Questions on unit- III/unit- IV: Short answer type question)	3

c) **Details of Semester-end examination for practical courses:**
A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical. There will be one experiment of 80 marks, through which the candidate will be examined in practical. The duration of the practical examination will be three hours.

d) **Details of Continuous Assessment for practical courses:**
Practical Skill in performing experiments, data presentation, analysis and interpretation of results: Marks: 20

Signature	Signature	Signature
HOD	Approved by Vice Principal	Principal