SYLLABUS

FOR

B. Sc. (Hons.) Physics
(Second Year)

PRAYAGRAJ

FACULTY OF BASIC AND APPLIED SCIENCES

Syllabus for B.Sc. (Hons.)Physics

Course Title: **MATHEMATICAL PHYSICS-II** **Course Code:** **SCUCPH301T**

Semester: III

L	T	P	C
4	0	0	4

Course Objective:

To familiarize students with Fourier series, differential equations functions and errors.

Unit	Content	Hours
1	**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. Term-by-Term differentiation and integrationof Fourier Series. Parseval Identity.	**10**
2	**Partial Differential Equations:** Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients. Applications of Partial Differential Equations: Classification of linear partial differential equation of second order, Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Equations of Transmission lines	**12**
3	**Frobenius Method:** Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations.	**6**
4	**Special Functions:** Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions and Orthogonality.	**9**
5	**Some Special Integrals and Theory of Errors:** Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error.	**8**

COURSE OUTCOMES

- Understand the concept of Fourier Series
- Understand the concept of partial differential equation and its application
- Understand Frobenius method and its applications to differential equations.
- Understand the concept of special function.
- Understand the concepts of theory or errors and special integrals.

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
3. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books
4. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.

Text Books:

1. Mathematical Physics: H.K. Dass, 2021, S.Chand.
2. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press Mathematical Physics, Goswami, 1st edition, Cengage Learning

Syllabus for B.Sc. (Hons.)Physics

Course Title: **MATHEMATICAL PHYSICS-II- LAB** **Course Code:** **SCUCPH301P**

Semester: III **L T P C**

Objective: **0 0 4 2**

Introduction to Numerical computationsoftware Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate spring constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes)Solution of coupled spring mass systems (3 masses)

Solution of ODE
 	
First order Differential equation Euler, modified Euler and Runge-Kutta secondorder methods
 	
Second order differential equation Fixed difference method
	First order differential equation
	• Radioactive decay
	• Current in RC, LC circuits with DC source
	• Newton's law of cooling
	• Classical equations of motionSecond order Differential Equation
	• Harmonic oscillator (no friction)
	• Damped Harmonic oscillator
	  ◦ Over damped
	  ◦ Critical damped
	  ◦ Oscillatory
	• Forced Harmonic oscillator
	  ◦ Transient and
	  ◦ Steady state solution
	• Apply above to LCR circuits also

Using Scicos / xcos	• Generating square wave, sine wave, saw tooth wave • Solution to harmonic oscillator • Study of beat phenomenon • Phase space plots

Reference Books:

- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
- Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
- Getting started with Matlab, Rudra Pratap, 2010, Oxford University Press.
- Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, ambridge University Press

Syllabus for B.Sc. (Hons.)Physics

Course Title: **THERMAL PHYSICS** **Course Code:** **SCUCPH302T**

Semester: III

L	T	P	C
4	0	0	4

Objective:

To familiarize students with laws of thermodynamics and concept of kinetic theory of gases.

Unit	Content	Hours
1	**Zeroth and First Law of Thermodynamics:** Extensive and intensive Thermodynamic Variables, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes.	8
2	**Second law of Thermodynamics:** Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency, Refrigerator & coefficient of performance, Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.	10
3	**Entropy:** Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics.	10
4	**Thermodynamic Potentials:** Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations.	10
5	**Kinetic Theory of Gases:** Maxwell's speed distribution, Mean free path, Elementary treatment of transport phenomena in ideal gases, Viscous flow and Thermal conducion in gases. Real gases, Andrew's curves, Equation of state, Virial coefficients, Van der Waals equation, values of critical constant.	7

Course Outcome

- Understand the concept of temperature and first law of thermodynamics
- Understand the second law of thermodynamics.
- Understand the concept of entropy and different processes.
- Study the thermodynamic potentials.
- Study the kinetic theory of gases.

Recommended Text Books

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press

Recommended Reference Books

1. Thermal Physics: S. Garg, R. Bansal and Ghosh, 2nd Edition, Tata McGraw-Hill.
2. Thermal Physics: B.K. Agarwal.
3. Heat and Thermodynamics: Brij Lal and N. Subramanyam.
4. Heat and Thermodynamics: Dayal, Verma and Pandey.

Syllabus for B.Sc. (Hons.) Physics

Course Title: **THERMAL PHYSICS LAB** **Course Code:** **SCUCPH302P**

Semester: III

L	T	P	C
0	0	4	2

Objective:

To familiarize students with different apparatus and their applications in measuring various physical quantities.

List of Experiments:

At least 5 experiments from the following

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne‟s constant flow method.

2. To determine the Coefficient of Thermal Conductivity of Cu by Searle‟s Apparatus.

3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom‟s Method.

4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton‟s disc method.

5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).

6. To study the variation of Thermo-emf of a Thermocouple with Difference of Temperature of its Two Junctions using a null method. And also calibrate the 24 Thermocouple in a specified temperature range.

7. To calibrate a thermocouple to measure temperature in a specified Range using Op-Amp difference amplifier and to determine Neutral Temperature.

Reference Books:

1. Advanced Practical Physics for students, B. L. Flint and H.T.Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011,Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal,1985, Vani Pub.

Syllabus for B.Sc. (Hons.) Physics

Course Title: DIGITAL SYSTEMS AND APPLICATIONS
Semester: III

Course Code:

L	T	P	C
4	0	0	4

ETSECSC31T

Objective:

- Design & analyze synchronous sequential logic circuits
- Analyze various logic families.
- To acquire the basic knowledge of digital logic levels & application of knowledge tounderstand digital electronics cicuits.
- To prepare students to perform the analysis and design of various digital electronic circuits.

Unit	Topic	Proposed Lecture
1	**Introduction to Semiconductors and PN Junction Diode:** Introduction of digital systems. Number system, Properties of semiconductors, Intrinsic and extrinsic semiconductors, P and N type of impurities and doping, Charge densities and potential barrier, Draft and diffusion currents, PN junction work tug and characteristics, It's applications as Rectifier: Half wave, Full wave. Bridge Rectifier and their calculation for ripple, Efficiency and PIV; Clipper, Clamper and voltage doublets. Zener and Avalanche breakdown diodes, Tunnel diode, Varactor diode.	**09**
2	**Number system and Logic Gates:** Number representation: BCD, floating point numbers Introduction of number systems, Radix, Radix Interco versions. Radix Complement, Diminished radix complement .Basic theorem of Boolean algebra. Boolean function and minimization, Karnaugh map, Quine McCluskey method. Introduction to Verilog, combinational circuits and their analysis. Universal Gates, Realization ofPrimary gates using Universal gates only.	**09**
3	**Combinational logic circuits:** Binary adder and Subtractor circuits, Magnitude comparator, Decoders, Encoders, Multiplexer and demultiplexer, Realization of switching expressions by decoders, encoders, multiplexer and Demultiplexer, Programmable logic circuits, Tri-state logic, Memory Elements**, Arithmetic circuits:** Adder, subtractor, multiplier, comparator.	**09**
4	**Sequential Logic Circuits:** Sequential circuits, latches and Flip Flops (SR, JK, T, D), counters, Registers, introduction to behavior modeling in Verilog. Analysis of clocked sequential circuits. State reduction and assignment, design of synchronous circuits, shift registers, ripple counters, synchronous counters, **Finite state machine, state graphs and tables.** Reduction of state table and state assignments. Arithmetic circuits using sequential design.	**09**
5	**Digital Integrated Circuits:** Characteristics of digital ICs, Introduction to logic families-RTL, DTL, TTL, ECL. MOS and CMOS circuits and comparison **Register transfer level (RTL) design, RTL design examples.** FPGA, VLSI design flow using HDL, introduction to behavior, logic and physical synthesis. Application of Digital System	**09**

Course Outcome:

- Understand the numerical information in different forms and Boolean Algebra theorems
- Postulates of Boolean algebra and to minimize combinational functions
- Design and analyze combinational and sequential circuits
- Known about the logic families and realization of logic gates.
- Acquire the basic knowledge about VLSI design flow using HDL & its use.

Text books:

1. Digital Design: M. Morris Mario (PHI)
2. Digital circuits & logic design: S. C. Lee (PHI)
3. Digital electronics: W. H. Gothmann (PHI)

Text/Reference Books:

1. R.P. Jain, "Modern Digital Electronics," Tata McGraw Hill, 4th edition, 2009.
2. A. Anand Kumar, "Fundamental of Digital Circuits," PHI 4th edition, 2018.
3. W. H. Gothmann, "Digital Electronics- An Introduction to Theory and practice," PHI, 2Nd edition,2006.
4. D.V. Hall, "Digital Circuits and Systems," Tata McGraw Hill, 1989.
5. A.K. Singh, "Foundation of Digital Electronics & Logic Design," New Age Int. Publishers.
6. Subrata Ghosal, "Digital Electronics," Cengage publication, 2nd edition, 2018

Syllabus for B.Sc. (Hons.) Physics

Course Title:	**DIGITAL SYSTEMS AND APPLICATIONS LAB**	**Course Code:**	**ETSECSC31P**
Semester:	**III**		

L	**T**	**P**	**C**
0	**0**	**4**	**2**

Objective: To understand the digital logic and create various systems by using these logics.

List of Experiments

At least 5 experiments from the following

1. Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet,
2. Concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs.
3. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
4. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
5. Implementation and verification of Decoder/De-multiplexer and Encoder using logic gates
6. Implementation of 4x1 multiplexer using logic gates.
7. Implementation of 4-bit parallel adder using 7483 IC.
8. Design, and verify the 4-bit synchronous counter.
9. Design, and verify the 4-bit asynchronous counter.

Course Outcome

- Understand the numerical information in different forms and Boolean Algebra theorems
- Postulates of Boolean algebra and to minimize combinational functions
- Design and analyze combinational and sequential circuits
- Known about the logic families and realization of logic gates.
- Acquire the basic knowledge about counters.

Syllabus for B.Sc. (Hons.)Physics

Course Title: NEURAL NETWORK **Course Code: ETSECS32T**

Semester: III

L	T	P	C
4	0	0	4

Objective: The main objective of Neural Network Techniques to Improve Data Analysis Solutions.

Unit	Topic	Proposed Lecture
1	**Introduction to ANN**: Features , structure and working of Biological Neural Network , Trends in Computing Comparison of BNN and ANN **Basics of Artificial Neural Networks** -History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture. What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates	**09**
2	**Back propagation networks:** (BPN) Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, back propagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning. Back propagation learning methods, effect of learning rule co-efficient;back propagation algorithm, factors affecting back propagation training, applications. **Activation & Synaptic Dynamics**: Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks.	**09**
3	**Basic functional units of ANN for pattern recognition tasks:** Basic feed forward, Basic feedback and basic competitive learning neural network. Pattern association, pattern classification and pattern mapping tasks. a) Feedforward neural networks – - Linear responsibility X-OR problem and solution. - Analysis of pattern mapping networks summary of basic gradient search methods. b) Feedback neural networks Pattern storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning Competitive learning neural networks : Components of CL network pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network **Associative Memory:** Autocorrelators, Heterocorrelators, Wang et al's Multiple Training Encoding Strategy, Exponential BAM, Associative Memory for Real coded pattern pairs, Applications.	**09**
4	**Adaptive Resonance Theory:** Cluster Structure, Vector Quantization, Classical ART Network, Simplified ART Architecture,ART1 and ART2 Architecture and algorithms, Applications, Sensitivities of ordering of data. Introduction to Fuzzy logic, Genetic Algorithm. **Fuzzy Systems:** Crisp Logic, Predicate Logic, Fuzzy logic, Fuzzy rule based system, Defuzzification Methods, Applications. **Integration of Neural Network, Fuzzy logic and Genetic Algorithm:** Hybrid system. Neural Networks, Fuzzy logic, and Genetic Algorithm Hybrids	**09**
5	**Applications of ANN:** Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation.	**09**

Course Outcome:

- To organize synaptic connectivity as the basis of neural computation and learning. Also learn the ideological basics of artificial neural networks
- To learn the origins of artificial neural networks
- To know some application of artificial neural networks. Also identify the different structures of artificial neural networks.
- Perceptron and dynamical theories of recurrent networks including amplifiers, attractors, and hybrid computation would be studied.
- To learn how to design and how to supervised and unsupervised artificial neural networks

Text books:

1. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
2. Neural Networks,Fuzzy Logic and Genetic Algorithms, by S.Rajasekaran and G.A. Vijayalakshmi Pai.
3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
4. Build_Neural_Network_With_MS_Excel_sample by Joe choong
5. Yegnanarayana - Artificial neural network PHI Publication.

Supplementary Resources:

Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Syllabus for B.Sc. (Hons.) Physics

Course Title: **PROFESSIONAL PROFICIENCY** **Course Code:** **PTSPPSC30T**
B.Sc. (Hons.) Physics- III
Semester: III

L	T	P	C
4	0	0	4

Objectives:

Listening, Speaking, Reading, and Writing skills to be developed to enable the students to read and write correct English, attain reasonable fluency in the Language and should also be exposed to introductory lessons of Aptitude Building

Unit	Content	Hours
1. **Hard Skills**	Phrasal Verbs, Idioms and Phrases, Interchange of Sentences (Affirmative to Negative), Composition (Expressing opinions and critical thoughts on current issues), Comprehension (Advanced Level),Cloze Test. **The goal is to teach Grammar implicitly through reading comprehensions. A short story/paragraph should be given for the students to identify the parts of speech and the other topics mentioned above. The classes should be learner centric and the students should be able to apply the lessons learnt in their daily conversations.**	**15**
2. **Soft Skills**	**Speaking activities, Describe a Picture:** Tell a story around an idiom you have studied, Finish the sentence, Would you Rather and Why?,Talk about an activity you enjoy doing, Give directions, Timed discussion. **The aim should be to attempt to immerse the students in the language so that they develop exposure to it and develop confidence for further professional exposure.**	**15**
Practice Sheet	Questions (Subjective and Objective) based on the instruction given for hard skills to be distributed every week. **The aim should be to bring the instruction given in practice by making them write, speak and think along the lines of the instruction given. The practice sheet should be evaluated and necessary feedback must be given. Some exercise on compositional skills must be given so that they develop a sense of writing and expressing themselves through the written word.**	
3.	**Quantitative Aptitude & Logical Reasoning** ● Blood Relation ● Direction and Distance ● Percentage	**15**

Course Outcomes

- Better representation of himself/herself in terms of communication skills, overall personality development and aptitude building required for jobs.
- This program will help students employable and ready for Industries /corporate and other Public and Private Sector jobs.

Syllabus for B.Sc. (Hons.) Physics

Course Title: MATHEMATICAL PHYSICS-III **Course Code:** SCUCPH401T

Semester: IV

L	T	P	C
4	0	0	4

Course Objective:

To familiarize students with Laplace Transform, Integral transform and Function of Complex Variable.

Unit	Content	Hours
1	**Laplace Transforms :** Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.	10
2	**Integral Transform:** Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.	10
3	**Function of Complex Variable-I:** Complex Numbers and their Graphical Representation, Functions of complex variable, Analytic functions, Cauchy- Riemann equations (Cartesian and Polar form), Harmonic function, Method to find Analytic functions.	8
4	**Function of Complex Variable-II:** Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Integral theorem, Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.	9
5	**Orthogonal Curvilinear Coordinates & Dirac Delta function:** Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. **Dirac Delta function and its properties** Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular Function, Properties of Dirac Delta function.	8

COURSE OUTCOMES

- Understand the Laplace Transform and Inverse Laplace Transfoem.
- Understand the concept of Fourier Transforms and Inverse Fourier Transforms
- Illustrate the working methods of complex functions and apply for finding analytic functions.
- Apply the complex functions for finding Taylor's series, Laurent's series and evaluation of definite integrals.
- Understand about Orthogonal Curvilinear Coordinates & Dirac Delta function

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books
3. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.

Text Books:

1.Mathematical Physics: H.K. Dass, 2021, S.Chand.

2.Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press Mathematical Physics, Goswami, 1st edition, Cengage Learning.

Syllabus for B.Sc. (Hons.)Physics

Course Title:	**MATHEMATICAL PHYSICS-III LAB**	**Course Code:**	**SCUCPH401P**
Semester:	IV	**L T P C**	**0 0 4 2**

Course Objective:

C^{++}/C/Sci lab based simulations experiments on Mathematical Physics problems like

1. Solve differential equations:
   $dy/dx = e^{-x}$ with y = 0 for x = 0
   $dy/dx + e^{-x} y = x^2$
   $d^2y/dt^2 + 2\ dy/dt = -y$
   $d^2y/dt^2 + e^{-t} dy/dt = -y$
2. Dirac Delta Function:

   Evaluate $\frac{1}{\sqrt{2\pi}\sigma^2} \int e^{\frac{-(x-2)^2}{2\sigma^2}} . (x+3) dx$, for $\boldsymbol{\sigma}$ = 1, 0.1, 0.01 and show it tends to 5
3. Fourier Series:
   Program to sum $\sum_{n=1}^{\infty} (0.2)^n$
   Evaluate the Fourier coefficients of a given periodic function (square wave)
4. Frobenius method and Special functions:

   $$\int_{-1}^{+1} P_n(\mu) . P_m(\mu) d\mu = \delta_{m,n}$$

   Plot $P_n(x)$, (x)
   Show recursion relation
5. Evaluation of trigonometric functions e.g. *sin θ,* Given Bessel"s function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration.
6. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).
7. Calculation of least square fitting manually for a given data set and confirmation of least square fitting of data through computer program.
8. Integral transform: Fast Fourier Transform of e^{-x^2}

Reference Books:

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J.Bence, 3rd ed., 2006, Cambridge University Press
- Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
- Getting started with Matlab, Rudra Pratap, 2010, Oxford University Press.

Syllabus for B.Sc. (Hons.)Physics

Course Title: **Elements of Modern Physics** **Course Code:** **SCUCPH402T**

Semester: IV

L	T	P	C
4	0	0	4

Objective:

To familiarize the students with concept of radiation, quantum mechanics and nuclear physics.

Unit	Content	Hours
1	**Wave Particle Duality:** Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Heisenberg uncertainty principle.	10
2	**Quantum Mechanics:** Physical significance of wave function, probabilities and normalization, Schrödinger's wave equations, Momentum and energy operator, one dimensional box of infinitely rigid box, eigen values and eigen function.	8
3	**Nuclear Structure:** Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and bindingenergy, Nuclear Shell Model and magic numbers.	9
4	**Radioactivity and Nuclear Reactions:** Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life;Alpha decay; Beta decay, Pauli's prediction of neutrino;Gamma ray emission.Fusion-mass deficit, generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions)	10
5	**Laser:** Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's Coefficients, Population inversion, various levels of Laser, Ruby Laser, He-Ne Laser, laser applications. **Fiber Optics:** Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalised frequency, Classification of optical fibers, Attenuation and Dispersion in optical fibers.	8

Course Outcome

- Understand the concept of radiation and wave particle duality.
- Understand the concept of wave function and energy of a particle.
- Study the nuclear structure.
- Study the stability of nucleus and nuclear reactions.
- Understand the concept of absorption and emission of radiation and working of optical fibers.

Recommended Text Books

1. Concepts of Modern Physics - Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.

Recommended Reference Books

1. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010,
2. Cengage Learning. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
3. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W.
4. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
5. Six Ideas that Shaped Physics:Particle Behave like Waves, T.A.Moore,2003, McGraw Hill.

Syllabus for B.Sc. (Hons.) Physics

Course Title:	**ELEMENTS OF MODERN PHYSICS LAB**	**Course Code:**	**SCUCPH402P**
Semester:	IV		

L	**T**	**P**	**C**
0	**0**	**4**	**2**

Objective:

To familiarize students with different apparatus and their applications in measuring various physical quantities.

List of Experiments:

At least 06 experiments from following:

1. Measurement of Planck‟s constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine the Planck‟s constant using LEDs of at least 4 different colours.
4. To determine the wavelength of H-alpha emission line of Hydrogen atom.
5. To determine the ionization potential of mercury.
6. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
7. To setup the Millikan oil drop apparatus and determine the charge of an electron.
8. To show the tunneling effect in tunnel diode using I-V characteristics.
9. To determine the wavelength of laser source using diffraction of single slit.
10. To determine the wavelength of laser source using diffraction of double slits.
11. To determine angular spread of He-Ne laser using plane diffraction grating.
12. To measure the DC voltage by using CRO.
13. To display the action of junction Diode as (a) Half wave rectifier and (b) Full wave rectifier using CRO

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn, 2011,Kitab Maha

UNITED UNIVERSITY PRAYAGRAJ

Syllabus for B.Sc. (Hons.)- Physics

Course Title: PYTHON PROGRAMMING **Course Code: CASPYSC40T**

Semester: IV

L	T	P	C
4	0	0	4

Course Objective:

- Master the fundamentals of writing Python programs.
- Learn core Python scripting elements such as variables and flow control structures
- Discover how to work with lists and sequence data
- Write Python functions to facilitate code reuse
- Use Python to read and write files
- Work with the Python standard library and modules.

Unit	Content	Hours
1	**Introduction to Python Language:** Introduction to Python: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc.	9
2	**Control Structures:** Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.	9
3	**Strings, Lists, Tuples and Dictionaries,:** Python Complex data types: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods, List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, Organizing python codes using functions.	9
4	**Functions & Modules:** Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables. Importing module, Math module, Packages and their composition	9
5	**File Handling:** Python File Operations: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations.	9

Course Outcomes:

- Understanding basic programming skills using Python programming language.
- Understanding the notion of data types and complex data types such as lists, tuples etc.
- Understanding the concept of decision making and iterative control structure in python.
- Understanding the concepts of functions and file handling in Python.

Recommended Text Book:

- R Nageswar Rao, *Core Python Programming*, 2018.
- Eric Mathews, Python Crash Course, 2019.

Recommended Reference Books:

- Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.

Exploring Python, Timothy A. Budd, Mc Graw Hill Education

UNITED UNIVERSITY PRAYAGRAJ

Syllabus for B.Sc. (Hons.) Physics

Course Title: PYTHON PROGRAMMING LAB **Course Code: CASPYSC40P**

Semester: IV

L	T	P	C
0	0	4	2

Laboratory Objectives:

- To acquire programming skills in core Python.
- To acquire Object Oriented Skills in Python.
- To develop the skill of designing Graphical user Interfaces in Python.
- To develop the ability to write database applications in Python.

List of Experiments:

Implement all the concepts taught in the Python Programming classes. Some experiments are:

1. Write a program to demonstrate different number data types in Python
2. Write a program to compute distance between two points taking input from the user using Pythagorean Theorem.
3. Write a Program for checking whether the given number is a even number or not.
4. Write a Python script that prints prime numbers less than 20.
5. Write a program to create, concatenate and print a string and accessing sub-string from a given string.
6. Write a program to create, append, and remove lists in python.
7. Write a program to demonstrate working with tuples in python.
8. Write a python program to define a module to find Fibonacci Numbers and import the module to another program.
9. Write a python program to define a module and import a specific function in that module to another program
10. Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be input and written to the second file.
11. Write a Python class to implement pow(x, n) and other user defined functions.

Laboratory Outcomes:

At the end of the course, student will be able to:

- Understand and comprehend the basics of python programming.
- Demonstrate the principles of structured programming and be able to describe, design, implement, and test structured programs using currently accepted methodology.
- Explain the use of the built-in data structures list, sets, tuples and dictionary.

Make use of functions and its applications.

Syllabus for B.Sc. (Hons.) Physics

Course Title: **PROFESSIONAL PROFICIENCY** **Course Code:** **PTSPPSC40T**
B.Sc. (Hons.) Physics- IV

Semester: IV

L	T	P	C
4	0	0	4

Objectives:

Listening, Speaking, Reading, and Writing skills to be developed to enable the students to read and write correct English, attain reasonable fluency in the Language and should also be exposed to introductory lessons of Aptitude Building

Unit	Content	Hours
1. **Hard Skills**	Idioms and Phrases, Clause,(context building), Critical Analysis on News Articles/Current Affairs, Correction of Sentences, Reproduction of story/poem (Creative abilities) **The goal is to teach Grammar implicitly through reading comprehensions. A short story/paragraph should be given for the students to identify the parts of speech and the other topics mentioned above. The classes should be learner centric and the students should be able to apply the lessons learnt in their daily conversations.**	15
2. **Soft Skills**	**Debate, Speech developing activities:** The world in twenty years, Guess the word, Time Trials, Describing a game, brainstorming an idea, listening and repeating. **The aim should be to enable the students to express themselves in the language and gain proficiency and confidence in speaking the language. They should develop skills to be able to better present their ideas and openly express their thoughts and opinions. They should develop independent and critical thinking.**	15
Practice Sheet	Questions (Subjective and Objective) based on the instruction given for hard skills to be distributed every week. **The aim should be to bring the instruction given in practice by making them write, speak and think along the lines of the instruction given. The practice sheet should be evaluated and necessary feedback must be given. Some exercise on compositional skills must be given so that they develop a sense of writing and expressing themselves through the written word.**	
4.	**Quantitative Aptitude & Logical Reasoning** • Order and Ranking • Ratio and Proportion • Time and Work	15

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Course Outcomes

- Better representation of himself/herself in terms of communication skills, overall personality development and aptitude building required for jobs.
- This program will help students employable and ready for Industries /corporate and other Public and Private Sector jobs.