गोविन्द गुरु जनजातीय विश्वविद्यालय, बाँसवाड़ा

चयन आधारित क्रेडिट व्यवस्था की पाठ्यचर्या के अंतर्गत अधिस्नातक पाठ्यक्रम

Choice Based Credit System

विषय का नाम—भौतिक शास्त्र

M. Sc. Physics

Course Structure for Semester -I

S. No.	Paper Code	Course Type	Course Title	Delivery Type (L+ T+P)	Credit (L + T + P)
1.		DCC	Mathematical Methods in Physics	L +T	3+1+0=4
2		DCC	Classical Mechanics	L +T	3+1+0=4
3		DCC	Quantum Mechanics-I	L +T	3+1+0=4
4		DSE	Electronics	L +T +P	2+1+1=4
5		GE	General Physics Lab	P	0+0+4=4

Course Structure for Semester -II

S. No.	Paper Code	Course Type	Course Title	Delivery Type (L+ T+P)	Credit (L + T + P)
1.		DCC	Electrodynamics	L +T	3+1+0=4
2		DCC	Statistical Physics	L +T	3+1+0=4
3		DCC	Quantum Mechanics-II	L +T	3+1+0=4
4		DSE	Computational Methods in Physics	L +T +P	2+1+1=4
5		GE	Electronics Projects and Microprocessor Lab	P	0+0+4=4

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Govind Guru Tribal University, Banswara

M.Sc.

Two Year Post Graduate Course

Physics

Semester II

DCC 4

Electrodynamics

Unit I

Coulomb law and electrostatics, Field lines, flux and Gauss law and applications , Laplace and Poisson equations, uniqueness theorem, boundary-value problems, method of images, dielectrics.

Magnetostatics: Biot-Savart law, Ampere's theorem, electromagnetic induction. Magnetic fields in matter, magnetization.

Maxwell's equations in free space and linear isotropic media, boundary conditions on fields at interfaces. Scalar and vector potentials, Gauge invariance.

Unit II

Electromagnetic waves in free space, dielectrics and conductors, reflection and refraction, polarization, Fresnel's law, Dispersion relations in plasma.

Transmission lines: lossless line, terminated transmission line and general lossy line.

Rectangular wave guide, classification of waves (TEM, TE, TM), Electromagnetic cavities: time average electric and magnetic energies, damping constant, quality factor (no derivation).

Relativistic formulation of electrodynamics, Maxwell equations in covariant form, gauge invariance and four-potential, the action principle and electromagnetic energy momentum tensor.

Unit III

Radiating Systems and Multipole fields: retarded potential, field and radiation of a localized oscillating source, electric dipole fields and radiation.

Lienard-Wiechert potential, dynamics of charged particle in static and electromagnetic

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field, electric and magnetic fields due to a uniformly moving charge and an accelerated charge.

Radiation from moving charges, Qualitative discussion of Bremsstrahlung, synchrotron radiation(no derivations), Radiation reaction: The Abraham-Lorentz formula, radiation damping.

Basic properties and occurrence: definition of plasma, natural occurrence of plasma, Astrophysical plasmas. Criteria for plasma behaviour, plasma oscillation, quasineutrality and Debye shielding, plasma parameter and plasma production, thermal ionization, Saha equation (No derivation). Brief discussion of methods of laboratory plasma production, steady stage glow discharge, microwave breakdown and induction discharge.

Text Books:

1. Introduction to Electrodynamics by David J. Griffiths, 2nd Edition, Prentice Hall (1989).
2. Classical Electrodynamics by J.D. Jackson, 3rd Edition, Wiley (1999).
3. Elements of Electromagnetics by M. Sadiku, 3rd Edition, Oxford University Press (2000).
4. Plasma Physics by Chen, 2nd Edition, Plenum Press (1984).
5. Principles and applications of electromagnetic fields by P & C – Robert Plonsey and R.E Collins, McGraw Hill (1961).
6. Electromagnetic Waves and Radiating Systems by E. C. Jordan and K. G. Balmain, 2nd Edition, Pearson (1968).

Reference Books:

1. Classical Electricity and Magnetism by W.K.H. Panofsky and M. Phillips, 2nd Edition, Dover Publications (2005).
2. Electrodynamics by H J W Muller Kirsten, 2 nd Edition, World Scientific (2011).
3. Classical Electrodynamics by W. Greiner, Springer (1998).
4. Electrodynamics of Continuous Media: Volume 8 by L. D. Landau, L. P. Pitaveskii and E. M. Lifshitz, Butterworth-Heinemann (1984).
5. Principles of plasma physics by N. A. Krall, A. W. Trivelpiece, San Francisco Pr. (1986).

Suggested e-resources:

https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/

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Govind Guru Tribal University, Banswara
M.Sc.
Two Year Post Graduate Course
Physics
Semester II
DCC 5
Statistical Physics

Unit I

Classical Statistical Mechanics: The Postulate of Classical Statistical Mechanics, Microcanonical Ensemble, Derivation of Thermodynamics, Equipartition theorem, classical ideal gas, Gibbs Paradox.

Canonical Ensemble and Grand canonical Ensemble: Canonical Ensemble, Energy fluctuations, Grand Canonical ensemble, Density fluctuations in the Grand Canonical Ensemble, The Chemical potential, Equivalence of the canonical ensemble and grand canonical ensemble.

Quantum Statistical Mechanics: The postulates of Quantum Statistical mechanics, Density Matrix, Ensembles, Third law of Thermodynamics, The Ideal Gases: Micro canonical and Grand Canonical Ensemble, Foundations of Statistical Mechanics.

Unit II

The General Properties of Partition function, Classical Limit of Partition functions, Singularities and Phase transitions.

Identical particles and symmetry requirement, difficulties with Maxwell-Boltzmann statistics, quantum distribution functions, Bose Einstein and Fermi- Dirac statistics and Planck's formula.

Classical cluster expansion, quantum cluster expansion, Virial coefficient, variational Principles, imperfect gases at low temperatures.

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Unit III

Bose Einstein condensation, liquid He4 as a Boson system, quantization of harmonic oscillator and creation and annihilation of phonon operators, quantization of fermion operators.

The Ising Model: Definition of Ising model, Spontaneous Magnetization, The Bragg-Williams Approximation, The One dimensional Ising Model.

Landau theory of Phase transition, critical indices, scale transformation and dimensional analysis, Thermodynamic fluctuation.

Text Books:

1. Statistical Mechanics. K. Huang. John Wiley & Sons, 2^{nd} edition.
2. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2^{nd} Ed., 1996, Oxford University Press.
3. Statistical Mechanics: L.D. Landau and E. M. Lifshitz, Pergamon.

Reference Books:

1. Fundamentals of Statistical and Thermal Physics: F. Reif (McGraw-Hill, New York NY)
2. Statistical Mechanics, R. Kubo, North Holland Publishing, Amsterdam
3. Introduction to Statistical Mechanics by S.K. Sinha, Narosa Publication
4. Statistical Mechanics by B.K. Agarwal & Melvin Eisner, Wiley Eastern.

Suggested e-resources:

1. https://ocw.mit.edu/courses/8-08-statistical-physics-ii-spring-2005/
2. https://www.damtp.cam.ac.uk/user/tong/statphys.html

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Govind Guru Tribal University, Banswara
M.Sc.
Two Year Post Graduate Course
Physics
Semester II
DCC 6
Quantum Mechanical-II

Unit I

Approximation methods: WKB approximation: Introduction of the method, The Classical region, Tunneling, The WKB wavefunction and connection formulae, Criterion for validity of approximation, Applications to potential well with a vertical wall and no vertical walls, Energy of one dimensional bound system.

The Variational method: Basic formulation and principle of the method, bound state (Ritz method), Applications to linear harmonic oscillator, Ground state energy under delta potential, Helium atom (Screening effect).

Theory of scattering: The scattering experiment, Classical and quantum mechanical scattering, Relationship of scattering cross-section to the wavefunction, Scattering amplitude, Method of partial waves, Expansion of a plane wave into partial waves.

Unit II

Scattering by a central potential V(r): Dependence of phase shift on V(r), angular momentum and energy, Zero energy scattering, Scattering length, Scattering by a square well potential, effective range theory.

Born approximation and Integral equation of scattering: Born approximation, Green Function, The integral equation for scattering, The Born series, Criterion for the validity of the Born approximation, Low energy soft-sphere scattering, Yukawa Scattering, Scattering of electrons by atoms, Rutherford scattering.

Identical particles: The identity of particles, the indistinguishability principle, symmetry of wave functions, spin and statistics, Pauli exclusion principle,

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Illustrative example: scattering of identical particles, case of spin half and spin zero particles.

Unit III

Time dependent perturbation theory: Basic principle and formulation of time dependent perturbation theory, constant perturbation, Continuum, Transition to continuum, Fermi's golden rule, scattering cross section in the Born approximation, Harmonic perturbation.

Radiative transitions in atoms: Theory of radiative transitions in atoms, The dipole transitions, Selection rules involving m and ℓ, Forbidden transitions.

Relativistic wave equations: The Klein Gordan equation: Introduction, The Klein-Gordan equation, Interpretation of probability and the equation of continuity.

Dirac equation: The first order wave equation- The Weyl and Dirac equation, Properties of Dirac matrices, Covariant form of Dirac equation, Existence of intrinsic angular momentum of Dirac particle, Solutions of Dirac equation-spinors, Non-relativistic limit of Dirac equation-Pauli equation, spin-orbit coupling, Hole theory and supporting experimental evidences.

Text Books:

1. Quantum Mechanics, V.K. Thankappan, Wiley Eastern Ltd. (1986).
2. Introduction to Quantum Mechanics, D.J. Griffiths, Pearson Education Inc. (2005).

Reference Books:

1. Principles of Quantum Mechanics, R. Shankar, Plenum Press, New York (1994).
2. Modern Quantum Mechanics, J.J. Sakurai, Addison and Wesley (1994).

Suggested e-resources:

https://www.youtube.be /7Y5me3mwXpA

https://www.youtube.be /4BM58741VOg

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Semester II
DSE/GE III
Computational Methods in Physics

Unit I

Computers and Numerical Analysis: IEEE 64 bit Floating point number representation, arithmetic operations, consequences of floating Point representation, computing errors, Error propagation, Introduction to parallel and distributed computing, Measuring efficiencies of Numerical procedures.

System of Linear Equations: Solving a system of Linear equations using Gauss Elimination, Gauss Jordan methods, Inverse of a matrix, Iterative methods to solve Equations: Gauss Seidel iterations, comparison of Iterative and Direct Methods.

Non-linear equations: Bisection and Newton Raphson method, Solution of Polynomial Equations, Newton methods for a system of nonlinear equation.

Interpolation: Lagrange Interpolation, Difference tables, Truncation error, Spline Interpolation.

Unit II

Curve fitting: Straight line fit, fitting using polynomial function of higher degree, Exponential Curve Fit, cubic spline fitting.

Fourier Transform: Fourier analysis and orthogonal functions, Discrete Fourier Transform, Power spectrum of driven pendulum.

Numerical Integration: Simpson and Guass quadrature method.

Numerical Differentiation: Difference approximation of first derivative.

Unit III

Differential equations: Euler and Taylor Series methods, Runge-Kutta Methods, Predictor-corrector Method, Comparison of different methods.

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Elementary ideas of solutions of Partial Differential Equations.

Monte-Carlo simulations: Sampling and Integration, Metropolis Algorithm, Applications in Statistical physics.

Matrices and Eigen values: Eigen values and Eigen vectors, Similarity transformation and Diagonalization, power method to find eigen values, physical meaning of Eigen values and eigen vectors.

Text Books:

1. Computer Oriented Numerical methods, V. Rajaraman, 3rd Edition, PHI (2013).
2. Applied Numerical Analysis, C.F. Gerald and P. Wheatley, Seventh Edition, Pearson Education Inc. (2004).
3. Applied Numerical Methods Using MATLAB, W. Y. Yang, W. Cao, and T.-S. Chung and J. Morris, Wiley (2005).
4. An Introduction to Computational Physics, T. Pang, 2nd Edition, Cambridge University Press (2006).
5. Computational Physics: Problem Solving with Computers, R.H. Landau and M.J. Paez, 2nd Edition, John Wiley & Sons (2007).
6. An Introduction to Computer Simulation Methods: Applications to Physical Systems, H. Gould, J. Tobochnik & W. Christian, 3rd Edition, Addison Wesley (2006).
7. Numerical methods for scientific and engineering computations, M.K. Jain and S.R.K. Iyengar, New Age International (2003).

Reference Books:

1. A Guide to Monte Carlo Simulation in Statistical Physics, D.P. Landau and K. Binder, Cambridge (2000)
2. Introductory Methods of Numerical Analysis, S.S. Sastry, Prentice Hall (2005).
3. Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, McGraw Hill International editions, 2nd edition (1990).
4. An Introduction to Numerical Analysis, K.E. Atkinson, 2nd Edition, John Wiley & Sons (1989).
5. Computational Physics: An Introduction, Franz J. Vesely, 2nd Edition, Springer (2001).
6. Numerical Methods for Physics, A.L. Garcia, 2nd Edition, Prentice - Hall (2015).

7. Computational Methods in Physics and Engineering, S.S.M. Wong. World Scientific Publishing Co., Singapore (1997).
8. Computational Physics, J.M. Thijssen, 2nd Edition, Cambridge University Press (2007).

Suggested e-resources:

1. https://www.iist.ac.in/sites/default/files/people/compmeth.pdf
2. https://www.cambridge.org/core/books/computational-methods-for-physics/47BC9EA18B56E877F80CB18B87D53904
3. https://farside.ph.utexas.edu/teaching/329/329.pdf

Practicals for Computational methods in Physics

List of Practicals

Section A: (To be performed in C/C++)

1. Gauss elimination Method
2. Gauss Seidel Method
3. Bisection Method
4. False Position Method
5. Secant Method
6. Newton Raphson Method
7. Matrix Transpose
8. Matrix Inverse
9. Fitting of a straight line
10. Trapezoidal Rule
11. Simpson's 1/3 Rule
12. Gauss Quadrature Method
13. First order Numerical Derivative
14. Runge-Kutta Method
15. Predictor-Corrector Method
16. Simpson's 1/3 Rule
17. Euler's Method

Note: Students are required to write and execute **at least ten programs** from above list (The institute should try to include C/C++ on Windows as well as linux or equivalent platforms so that students can adapt to different OS

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environments.

Section B : (To be performed in Matlab/Phython)

1. Find minima and maxima of curve
2. Plotting bisection and regula falsi
3. Solving Differential and Integral equation
4. Curve Plotting
5. Fast Fourier transform and Discrete Fourier Transform (DFT)
6. Linear Interpolation
7. Multiple interpolation
8. Sample three different parabolic functions at the points defined in x
9. Vectors and Matrices operation
10. Curve Fitting
11. Interpolation and Extrapolation
12. Least Squares fitting
13. Cubic spline interpolation
14. Spline Interpolation

Note: Students are required to write and execute **at least ten programs** from above list.

Text Books:

1. Computer Oriented Numerical methods, V. Rajaraman, 3rd Edition, PHI (2013).
2. Y. Kanetkar, Let Us C, BPB Publications, New Delhi, India (2012).
3. Computer Programming in Fortran 77: With an Introduction to FORTRAN 90, V. Rajaraman, Prentice-Hall of India (2003).
4. Matlab: An Introduction With Applications, Amos Gilat 4th Edition, John Wiley & Sons, Inc (2011).
5. Matlab: A Practical Introduction to Programming and Problem Solving, Stormy Attaway, Elsevier (2017).
6. Applied Numerical Methods Using MATLAB, W. Y. Yang, W. Cao, and T.-S. Chung and J. Morris, Wiley (2005).
7. Computational Physics: Problem Solving with Computers, Landau and Paez, 2nd Edition, John Wiley & Sons (2007).

Reference Books:

1. Computational Physics: An Introduction, Franz J. Vesely, 2nd Edition, Springer (2001).
2. Computational Methods in Physics and Engineering - S.S.M. Wong. World Scientific Publishing Co., Singapore (1997).
3. Computational Physics - J.M. Thijssen, 2nd Edition, Cambridge University Press (2007).
4. Computational Physics, R. C. Verma, P. K. Ahluwalia & K. C. Sharma, New Age, 1st Edition (1999).

Suggested e-resources:

1. https://www.mimuw.edu.pl/~mrp/cpp/SecretCPP/O%27Reilly%20-%20Practical%20C++%20Programming.pdf
2. https://www.eidos.ic.i.u-tokyo.ac.jp/~tau/lecture/computational_physics/docs/computational_physics.pdf
3. file:///C:/Users/Gunjan/Downloads/MATLAB_AnIntroductionwithAp-AmosGilat.pdf
4. http://cms.dm.uba.ar/academico/materias/2docuat2018/elementos_calculo_numerico_M/Stormy%20Attaway-MATLAB%20%20A%20Practical%20Introduction%20to%20Programming%20and%20Problem%20Solving-Butterwonh-Heinemann%20(2017).pdf
5. https://farside.ph.utexas.edu/teaching/329/329.pdf

End of Semester Examination:

The duration of the examination shall be Five hours wherein the student has to perform allotted: one programme from section A and one programme from section B. The distribution marks is as follows:

1. One programme from Section A: 25.
2. One programme of Section B: 25.
3. Viva Voce : 20
4. Evaluation of the record book of experiments performed in the semester: 10

Internal Evaluation: 20

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M.Sc.
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Physics
Semester II
DSE/GE IV
Electronics Projects and Microprocessor Lab

Objectives are to enable the students to understand the design and fabrication of electronic circuits; Writing and execution of assembly language programs on 8085 microprocessor kit. Proper conduction and execution of experiments; troubleshoot experiments; appropriately recording of data and their analysis; understand what constitutes "reasonable" data; estimate the error bounds on their measurements. The deduction and presentation of experimental results using graphs and tables.

In section A: students are required to submit a detailed project report and working model (designed and fabricated one electronic circuit) of the project for evaluation. In section B students will write and execute one program based on assembly language programming of 8085 microprocessor. External Assessment will involve presentation and viva –voce. The results of the experimental work and programming carried out by the students will reported to the teacher in regular manner in a specified format written in the Practical records book.

Section A

Design and fabrication of one Experimental Kit

Students will be required to carry out an electronic laboratory project either individually or in groups in the Electronics Laboratory under guidance of a teacher, which involves planning, design & construction of equipments & circuits based on any one of: OP-AMP instrumentation, wave form generators, wave shaping circuits, Power supplies, Combinational and sequential digital systems. It involves about 20 hrs of practical work per student that can be

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used to demonstrate physical principles or to carry out laboratory experiments.

Section B

Microprocessor Assembly Language Programming

Assembly Language Programming of 8085 Microprocessor. At least ten exercises of arithmetical and logical operations involving data transfer and branching operations are to be performed during the semester.

List of Programs

1. Write and execute an assembly language program to count number of 1's in an 8-bit data and store the results accordingly.
2. Write and execute an assembly language program for addition of number of data bytes and store the results accordingly.
3. Write and execute an assembly language program to calculate the 1's and 2's complement of an 8-bit number and store the results accordingly.
4. Write and execute an assembly language program for addition of two decimal numbers with and without carry and store the results accordingly.
5. Write and execute an assembly language program to mask lower nibble/particular bits of data that is stored at memory address 9100 and store results at 9101. The original data must be saved in a register.
6. Write and execute an assembly language program to split a hexadecimal data into two nibbles and store split data in memory.
7. Write and execute an assembly language program for block transfer of data bytes from source address to the destination address.
8. Write and execute an assembly language program to find lowest/largest data byte out of a given set of bytes.
9. Write and execute an assembly language program to multiply two 8-bit data.
10. Write and execute an assembly language program for the addition of two 'BCD' numbers of 4-digits each and store the results at the designated address accordingly.
11. Write and execute an assembly language program to arrange numbers in ascending/descending order and store the results accordingly.
12. Write and execute an assembly language program for a delay of at least 10 seconds
13. Write and execute an assembly language program for unmasking of a masked data.

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Note: any other experiments based on the subject: suggested by the concern expert.

Text Books:

1. Lab and component manuals
2. OP-AMP and Linear Integrated Circuits by Ramakanth, A. Gayakwad, PHI, New Delhi.
3. Digital Logic and Computer design by Morris Mano, PHI, New Delhi.
4. Microprocessors Architecture, Programming and Applications with 8085/8086 by Ramesh S Gaonkar, Wiley - Eastern Ltd., 1987.

Reference Books:

1. Integrated Electronics, by J. Millman and C.C. Halkias, TMH, New Delhi.
2. Electronic Devices and Circuit Theory by Robert Boylestead and Louis Nashelsky, PHI, New Delhi.
3. Digital Principle and Applications by A.P. Malvino and Donald P. Leach, TMH, New Delhi.

Suggested e-resources:

1. https://www.electronics-notes.com/articles/basic_concepts
2. https://www.javatpoint.com/digital-electronics
3. https://www.electronics-tutorials.ws

End of Semester Examination (EoSE)

The duration of the examination shall be Five hours wherein the student has to perform allotted: one electronic project of section A and one ALP program from section B. The distribution marks is as follows:

2. Electronic project of Section A: 30
3. One ALP program of Section B: 20.
4. Viva Voce : 20
5. Evaluation of the record book of experiments performed in the semester: 10

Internal Evaluation: 20

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