गोविन्द गुरु जनजातीय विश्वविद्यालय बाँसवाड़ा

चयन आधारित क्रेडिट व्यवस्था की पाठ्यचर्या के अंतर्गत अधिस्नातक पाठ्यक्रम

(Choice Based Credit System) M.Sc.

विषय नाम : PHYSICS

प्रश्न पत्र सूची

प्रथम सेमेस्टर

क्रम	पेपर कोड	प्रकार	प्रश्न पत्र निर्धारण	पेपर नाम	क्रेडिट
1		विषय केन्द्रित अनिवार्य कोर्स (DCC)	1	**Mathematical Methods in Physics (L+T)**	4
2		विषय केन्द्रित अनिवार्य कोर्स (DCC)	1	**Classical Mechanics (L+T)**	4
3		विषय केन्द्रित अनिवार्य कोर्स (DCC)	1	**Quantum Mechanics-I (L+T)**	4
4		विषय विशिष्ट ऐच्छिक कोर्स (DSE)	1	**Electronics (L+T)**	4
5		सामान्य ऐच्छिक कोर्स (GE)	1	**General Physics Lab (P)**	4
			Total		**20**

राजेन्द्र प्रसाद अग्रवाल
कुलसचिव
गोविन्द गुरु जनजातीय विश्वविद्यालय
बाँसवाड़ा (राजस्थान)

GOVIND GURU TRIBAL UNIVERSITY BANSWARA

M.Sc.

Two Year Post Graduate Course

Semester I

PHYSICS

DCC 1

Mathematical Methods in Physics

Unit I

Coordinate Systems: Curvilinear coordinates, differential vector operations, special coordinate systems – rectangular Cartesian, spherical polar and circular cylindrical coordinates. Expressions of gradient, divergence, curl and Laplacian in terms of curvilinear coordinates.

Tensors: Coordinate transformations, scalars, contravariant and covariant vectors, definition of contravarient, mixed and covariant tensor of second rank, Addition, subtraction and contraction of tensors, quotient rule.

Matrices: Orthogonal matrices, Orthognality conditions- two and three dimensional cases, Hermitian and unitary matrices, Pauli matrices, Dirac matrices, Diagonalization of matrices - Eigen value and Eigen vectors.

Unit II

Elementary Group Theory: Definition of group, isomorphism and homomorphism, Matrix representation- reducible and irreducible groups, subgroup-invariant subgroup, discrete groups-two objects two-fold symmetry axis, three objects-three-fold symmetry axis, continuous groups- orthogonal group O3+, special unitary group SU(2).

Second Order Differential Equations: Separation of variables-ordinary differential equations, singular points, series solutions – Frobenius method and its limitations, Wronskian-linear independence and linear dependence.

Special Functions: Bessel functions of the first kind and its integral representation and Legendre functions with their generating function, recurrence relations and orthogonality. Associative Legendre functions, spherical harmonics, Hermite functions and Laguerre functions and their orthogonality.

49

राजेन्द्र प्रसाद अग्रवाल
अधिष्ठाता
गोविन्द गुरु जनजातीय विश्वविद्यालय
बाँसवाड़ा (राजस्थान)

Unit III

Complex Variables: Functions of complex variable, Cauchy- Rieman conditions, Cauchy Integral theorem, Cauchy integral formula, Laurent expansion, calculus of residues-poles, essential singularities and branch points, Residue theorem, Jordan's lemma, Singularities on contours of integration, Evaluation of definite integrals.

Fourier Series and Fourier Transforms: Fourier series- General properties and uses, Differentiation and integration of Fourier series, Fourier transforms, Fourier integral-exponential form, Fourier transform-inversion theorem, convolution theorem.

Laplace Transform: Elementary Laplace transforms, Laplace transform of derivatives, substitution properties of Laplace transform, use of Laplace transform.

Text Books:

1. Mathematical methods for Physicists G. B. Arfken & Hans J. Weber, Academic Press (1966).
2. Mathematical Physics, B.D. Gupta, Vikas Publishing House, Ghaziabad (U.P.).
3. Mathematical Physics, B.S. Rajput, Pragati Prakashan, Meerut.

Reference Books:

1. Mathematical Physics, H.K. Dass and R. Verma, S. Chand Publishing, New Delhi.
2. Applied Mathematics for Physicists and Engineers - L. A. Pipes, Tata McGraw Hill.
3. Mathematical Methods in Classical and Quantum Physics, Tulsi Dass and Satish K. Sharma, University Press, Hyderabad.(1990)
4. Methods of Mathematical Physics, Jeffreys and Jeffreys, Third Edition, Cambridge Mathematical Library, Cambridge Press (1999)

Suggested e-resources:

1. https://link.springer.com/book/10.1007/978-1-4612-0049-9.
2. https://www.lehman.edu/faculty/anchordoqui/307.html

Unit III

Complex Variables: Functions of complex variable, Cauchy- Rieman conditions, Cauchy Integral theorem, Cauchy integral formula, Laurent expansion, calculus of residues-poles, essential singularities and branch points, Residue theorem, Jordan's lemma, Singularities on contours of integration, Evaluation of definite integrals.

Fourier Series and Fourier Transforms: Fourier series- General properties and uses, Differentiation and integration of Fourier series, Fourier transforms, Fourier integral-exponential form, Fourier transform-inversion theorem, convolution theorem.

Laplace Transform: Elementary Laplace transforms, Laplace transform of derivatives, substitution properties of Laplace transform, use of Laplace transform.

Text Books:

1. Mathematical methods for Physicists G. B. Arfken & Hans J. Weber, Academic Press (1966).
2. Mathematical Physics, B.D. Gupta, Vikas Publishing House, Ghaziabad (U.P.).
3. Mathematical Physics, B.S. Rajput, Pragati Prakashan, Meerut.

Reference Books:

1. Mathematical Physics, H.K. Dass and R. Verma, S. Chand Publishing, New Delhi.
2. Applied Mathematics for Physicists and Engineers - L. A. Pipes, Tata McGraw Hill.
3. Mathematical Methods in Classical and Quantum Physics, Tulsi Dass and Satish K. Sharma, University Press, Hyderabad.(1990)
4. Methods of Mathematical Physics, Jeffreys and Jeffreys, Third Edition, Cambridge Mathematical Library, Cambridge Press (1999)

Suggested e-resources:

1. https://link.springer.com/book/10.1007/978-1-4612-0049-9.
2. https://www.lehman.edu/faculty/anchordoqui/307.html

GOVIND GURU TRIBAL UNIVERSITY BANSWARA

M.Sc.

Two Year Post Graduate Course

Semester I

PHYSICS

DCC 2

Classical Mechanics

Unit I

Many particle systems: conservation laws, Constraints; their classification; degrees of freedom, D'Alembert's principle, generalized coordinates, Lagrange's equations from D'Alembert's principle, velocity dependent potentials and dissipative forces, Jacobi integral.

Gauge invariance, generalized momenta, cyclic coordinates, integrals of motion, Symmetries of space and time with conservation laws

Variational principles: Techniques of the calculus of variations, Example of use of the variational principle to find the shortest distance between two points, Hamiltons principle: derivation of Lagrange's equations from Hamilton's principle, equations of motion.

Unit II

Canonical transformation: generating functions, Hamilton-Jacobi equation; solution: Hamilton's principal function, Solution of harmonic oscillator problem by H-J method.

Poisson brackets: fundamental PB, some properties, Poisson theorems, Angular momentum PBs, Invariance of PB under canonical transformations, relation of PB to quantum mechanics.

Central force: definition and characteristics; properties, closure and stability of circular orbits, Two-body collisions, scattering in laboratory frame, scattering centre-of-mass frame.

Unit III

Rotating frames: transformation equations, pseudo (fictitious) forces, Rigid body dynamics: Angular momentum and Kinetic energy of motion about a point, Moment of inertia tensor.

Types of equilibria, Periodic motion, small oscillations and normal modes, Free vibrations of a symmetric linear triatomic ,Special theory of relativity, Lorentz transformations, Velocity transformations, mass energy equivalence, Four vectors :

velocity and acceleration 4 vectors.

Text Books:

1. Classical Mechanics, J.C. Upadhyaya, Himalaya Publishing House, New Delhi (1999).
2. Classical Mechanics, H. Goldstein, C. P. Poole and J. Safko, Classical Mechanics, 3rd Edition, Pearson (2018).
3. Classical Mechanics, P.S. Joag and N.C. Rana, 1st Edition, McGraw Hill (2010).
4. Classical Mechanics, B.D. Gupta and Satya Prakash, Keder Nath Publishers, Meerut, Revised Edition (2015).

Reference Books:

1. Classical Mechanics, R.D. Gregory, Cambridge University Press. (2015).
2. Classical Mechanics: An introduction, D. Strauch, Springer. (2009).
3. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, Oxford University Press (2010).
4. Classical Dynamics, D.T. Greenwood, PH International, London (1977).
5. S. N. Biswas, Classical Mechanics, Books and Allied (P) Ltd., Kolkata (2004).
6. Classical mechanics: System of particles and Hamiltonian dynamics, W. Greiner, New York: Springer-Verlag (2004).
7. Classical mechanics - A modern perspective, V. Barger, M. Olsson, 2nd Edition Tata McGraw Hill (1995).
8. Introduction to Classical Mechanics, R.G. Takwale and P.S. Puranik, Tata Mc Graw Hill, New Delhi (1989).
9. Classical Mechanics, S.L. Gutpa, V. Kumar and H.V. Sharma, Pragati Prakashan, Meerut (2016).
10. Classical Mechanics of Particles and Rigid Bodies K.C. Gupta, New Age International Publishers, New Delhi, Third edition (2018).
11. Classical Mechanics, G. Aruldhas, PHI Learning Private Limited, New Delhi (2015).

Suggested e-resources:

1. https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/
2. https://www.math.ucla.edu/~laurenst/Resources/classical_mechanics.pdf
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
4. https://users.ox.ac.uk/~math0391/CMlectures.pdf
5. https://www.math.toronto.edu/khesin/biblio/GoldsteinPooleSafkoClassicalMechanics.pdf
6. https://courses.physics.ucsd.edu/2010/Fall/physics200a/LECTURES/200_COURSE.pdf
7. https://www.physics.rutgers.edu/~shapiro/507/book.pdf
8. https://sites.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf

GOVIND GURU TRIBAL UNIVERSITY BANSWARA

M.Sc.

Two Year Post Graduate Course

Semester I

PHYSICS

DCC 3

QUANTUM MECHANICS

Unit I

Classical picture and its inadequacy- Black body radiation, Specific heat of solids, Young's double split experiment and its relevance, Hamilton's principle.
Schrödinger equation, Normalization, probability interpretation of Ψ, Admissible wave functions.

Linear Vectors Space: Definition and properties, examples, norm of a vector, orthonormality and linear independence, Basis and dimensions, Completeness (Closure property), Hilbert space, subspace, Inequalities.
Operators: Equality, product, sum, power, function, inverse of operators, eigen values and eigenvectors of an operator, Positive definite, continuous and bounded operators, Linear operators, Hermitian operators, Unitary operators, Projection operators.
Dirac space: Completeness of eigen functions, Bra and Ket notation for vectors, Dirac-Delta function, Matrix elements of change of basis, Unitary transformation.
Representation Theory: Representation theory, Coordinate and momentum representations and Fourier transform.
Postulates of Quantum Mechanics & Uncertainty Relations: Postulates of Quantum mechanics, Uncertainty relations, States with minimum uncertainty product, Commutators, Theorem of simultaneous eigenfunctions.
Quantum Dynamics: The equations of motion, Schrodinger picture, Heisenberg picture, Linear Harmonic Oscillator: Solutions from Schrodinger and Heisenberg Pictures, the method of second quantization.

Unit II

The Hydrogen Atom:Two body equation, Separation of variables for spherically symmetric potential, Radial wave equation, Radial wavefunctions and energy states.
Quantization of Angular Momentum: Definition, angular momentum of a system of particles, Matrix representation, Pauli matrices, the spin eigenvectors.
Orbital angular momentum: Solutions, Spherical harmonics and properties, addition

theorem (no proof). Matrices of J=$\hbar/2$ and $\hbar$
Addition of angular momenta: Clebsch-Gordan coefficients, the selection rules, properties of CG coefficients (without proof): symmetry, orthogonality and recursion relations. Examples- $J_1= \hbar/2$ and $J_2= \hbar/2$; $J_1= \hbar/2$ and $J_2= \hbar$

Unit III

Perturbation Theory (Non-degenerate case):Basic formulation of the method and applications: Anharmonic oscillator (x^4), linear harmonic oscillator, infinite square well.
Degenerate case: Formulation and applications: Stark and Zeeman effects in H, Infinite cube well, Relativistic correction.

Path Integrals in Quantum Theory: Interaction picture, Path Integral-Perspective and recipe, Approximation of U(t) for a free particle, Path integral evaluation of a free particle propagator, Equivalence to the Schrodinger equation. Potentials of the form $V=a+bx+cx^2+d(dx/dt)+ex(dx/dt)$.
Derivation of Path Integrals: Configuration space path integrals (no application), Phase space path integral (No application), Coherent state path integral (No application), Path integral of the imaginary time propagator. Illustrative example of simple harmonic oscillator.

Text Books:

1. Quantum Mechanics, V.K. Thankappan, Wiley Eastern Ltd. (1986).
2. Principles of Quantum Mechanics, R. Shankar, Plenum Press, New York (1994)
3. Quantum Mechanics and Path Integrals, Emended Edition, R.P. Feynman, A.R. Hibbs and D.F. Styler, Dover Publications, Mineola, USA (2005).

Reference Books:

1. Introduction to Quantum Mechanics, D.J. Griffiths, Pearson Education Inc. (2005).
2. Modern Quantum Mechanics, J.J. Sakurai, Addison and Wesley (1994).

Suggested e-resources:

1. https://www.youtube.com/watch?v=jANZxzetPaQ
2. https://youtube.be/22g_tbl191 ; https//youtube.be/HEV_3k4avh

GOVIND GURU TRIBAL UNIVERSITY BANSWARA

M.Sc.

Two Year Post Graduate Course

Semester I

PHYSICS

DSE / GE 1

ELECTRONICS

Unit I

Basics of Operational Amplifier (OP-AMP): Differential amplifier: circuit configurations, dual input, balanced output differential amplifier, DC analysis and AC analysis, inverting and non inverting inputs, Block diagram of typical OP-AMP, constant current-bias level translator. OP-AMP Parameters: input offset voltage, bias currents, input offset current, output offset voltage, CMRR, Slew rate.

Open loop configuration, inverting and non-inverting amplifiers, frequency response of OP-AMP. OP-AMP with negative feedback, effect of feed-back on closed loop gain, input and output resistance, band width, voltage series feedback OP-AMP, voltage shunt feedback OP-AMP.

OP-AMP based instrumentations and their application: DC and AC amplifier, voltage follower, adder, subtractor, multiplier, phase changer, active filters, active Integrator and active differentiator.

Oscillators and wave shaping Circuits: Oscillator Principle, Oscillator types, Frequency stability criterion, Phase shift oscillator, Wien bridge oscillator, LC tunable oscillators, multivibrators: monostable and astable, Comparators, square and triangle wave form generators.

Unit II

Voltage regulators: Block diagram of Power supply, fixed voltage regulators, adjustable voltage regulators, switching regulators. Clipping and clamping circuits.

Boolean algebra and logic gates: Canonical and standard forms, IC logic families, Simplification of Boolean functions: Karnaugh map of up to 4 variables, don't care conditions, NAND and NOR implementation.

Combinational logic circuits: Adders, subtractors, binary parallel adders, magnitude comparator, decoders/Demultiplexers encoders/multiplexers.

Sequential Logic systems: Basic flip-flop, clocked RS flip-flop, T flip-flop, D flip-flop, J-K flip flop, triggering of flip-flops, JK master slave flip-flops; Synchronous and asynchronous counters: Binary counters, Decade counters, Registers.

Unit III

Basics of Microprocessors: Organization of a Microcomputer based system, Microprocessor architecture and its operations, Memory, memory map. The 8085 microprocessor unit and its Functional block diagram.

Assembly Language Programming of 8085: Instruction set of 8085: Data transfer operations, Arithmetic operations, Logic operations, Branch operations, Addressing modes of 8085, Assembly language programs involving data transfer, branch, arithmetic and logic operations.

Text Books:

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

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-tutorials.ws
2. https://myethiolectures.files.wordpress.com/2015/06/programming-8085.
3. https://www.electronics-notes.com/articles/basic_concepts
4. https://www.javatpoint.com/digital-electronics

Electronics Practical

Students are required to complete all experiments allotted to them from Section-A and section-B. Students are expected to carry out the practical work after understanding circuitry and theoretical principle behind each experiment, design of experiments, working principle of the equipments/instruments, sources of errors in experiments etc. Experimental errors must be estimated in all experi- ments. The results of the experiments carried out by the students will reported to the teacher in regular manner in a specified formatwritten in the Practical records book.

List of Practicals

Section A: Analog Electronics

1. Measurement of operational amplifier parameters.
2. Study of low pass, high pass and band pass active filter circuits.
3. Study of an active integrator circuit.
4. Study of an active differentiator circuit.
5. Study of Wien Bridge Oscillator circuit.

6. Study of Square wave generator circuit.
7. Study of triangular wave generator circuit.
8. Study of comparator and Schmitt Trigger circuits.
9. Study of UJT parameters and relaxation oscillator circuit.
10. Study of series voltage regulated power supply.

Section B: Digital Electronics

1. Study of Combinational Systems: (i) Two bit and four bit adders (ii) 4-bit Subtractor (iii) Decoder and 7- segment display device (iv) Multiplexer and (v) Decoder/De-multiplexer circuits.
2. Study of Flip-Flop circuits : RS, JK, JKMS, D &T Flip-Flops
3. Study of Shift Registers.
4. Study of Binary Counters: (i) 4-bit Ripple counter (ii) 4-bit synchronous counter and (iii) BCD counter.

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.

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

GOVIND GURU TRIBAL UNIVERSITY BANSWARA

M.Sc.

Two Year Post Graduate Course

Semester I

PHYSICS

DSE / GE 2

GENERAL PHYSICS LAB

Students are required to complete atleast **seven** experiments. Students are expected carry out the practical after understanding theoretical principle behind each experiment, design of experiments, working principle of the equipment/instruments, sources of errors in experiments etc. Experimental errors must be estimated in all experiments. The results of the experiments carried out by the students will reported to the teacher in regular manner in a specified format written in the Practical records book.

1. To find wavelength of Sodium light using Michelson interferometer and to determine the difference in wavelengths of D_1 and D_2 lines of atomic spectra of Sodium.
2. To plot the polar curve of a filament lamp and to determine its mean spherical intensity.
3. To find refractive index of air and verify the Dale–Gladstone equation using Jamin's interferometer.
4. To find elastic constants of glass by Cornu's optical method.
5. To verify the Fresnel's law of refraction and reflection.
6. To study beam characteristics of a He-Ne laser beam.
7. (a) Measurement of wavelength of a given laser light using ruler. (b) Measurements of thickness of thin wire using laser.
8. To determine the wavelength of a given laser beam using Michelson interferometer.
9. Determination of wavelength of given laser and verify the law governing interference from a Young's double slit experiment.
10. Determination of wavelength of given laser and verify the law governing interference from a circular pin hole aperture.
11. Determination of wavelength of given laser and verify the law governing Interference from a Young's single slit experiment.

राजेन्द्र प्रसाद अग्रवाल
कुलसचिव
गोविन्द गुरु जनजातीय विश्वविद्यालय
बाँसवाड़ा (राजस्थान)

12. To determine the Verdet constant of a given optically active rod using the method of Faraday rotation.
13. To study variation in internal resistance of a material with temperature.
14. To study the Hall effect using a given semiconductor probe to find the Hall Voltage and Hall Coefficient, Charge Carriers, Hall angle and mobility of material.
15. To determine the coefficient of thermal conductivity of given material by Angstrom's method.
16. To study arc spectra by constant deviation spectrometer.
17. To demonstrate the discrete excited states of Argon atom and find the ionization potential using Frank-Hertz experiment.
18. To study the dissociation limit of iodine.
19. To determine e/m of electron using Millikan's oil drop method.

Text Books:

1. Advanced Practical Physics for Students, B.L. Worsnop and H.T. Flint Methuen & Co. Ltd., 36 Essex Street W.C., London (UK) (1931).
2. Advanced Practical Physics VOL. I by S.P. Singh, Pragati Prakashan, Meerut (2017).
3. Advanced Practical Physics VOL. II by S.P. Singh, Pragati Prakashan, Meerut (2014).

Reference Book:

E-book downloadable from https://www.scribd.com/document/72270640/Advanced-Practical-Physics-Worsnop-and-Flint

Suggested e-resources:

1. https://ocw.mit.edu/courses/8-13-14-experimental-physics-i-ii-junior-lab-fall-2016-spring-2017/afdfff9f8bbe067239af19c8b178a764_MIT8_13-14F16-S17exp7.pdf
2. https://www.youtube.com/watch?v=kgBLF6yJGK4
3. Implications of real-gas behavior on refractive index calculations for optical diagnostics of fuel–air mixing at high pressures by C. T. Wanstall, A. K. Agrawal and J. A. Bittle, Combustion and Flame, **214** 47-56 (2020).
4. https://doi.org/10.1016/j.combustflame.2019.12.023

End of Semester Exam

The duration of the examination shall be Five hours wherein the student has to perform any one experiment. The marks distribution shall be the following:

1. One experiment: 50
   (Formula(e)-8, Figure(s)- 7, Observations-15, Calculations-10, Result(s)-5, Precautions-5)
2. Viva Voce : 20
3. Evaluation of the record book of experiments performed in the semester: 10

Internal Evaluation : 20