SUGGESTED BOOKS AND REFERENCES

1. Artin, Algebra, M. Prentice Hall of India, 1994
2. Dummit, D. S. and Foote, R. M., Abstract Algebra, McGraw-Hill, 1986

3. Lang, S., Algebra (3rd Ed.) Springer, 2002
4. Hungerford, Algebra, Graduate Texts in Mathematics 73, Springer Verlag, 1974
5. Nathan Jacobson, Basic Algebra I & II, Dover, 2009
6. Nathan Jacobson, Lectures in Abstract Algebra I, II & III, Graduate Text in Mathematics, Springer Verlag, 1951

MA 219 (3:1): Linear Algebra

Prerequisite course: UM 102/UMA 102

Instructor: Apoorva Khare

Vector spaces: Definition, Basis and dimension, Direct sums. Linear transformations: Definition, Rank-nullity theorem, Algebra of linear transformations, Dual spaces, Matrices.

Systems of linear equations: Elementary theory of š Œ u] v v š • U rules Œ Eigenvalues and eigenvectors, the characteristic polynomial, the Cayley-Hamilton Theorem, the minimal polynomial, algebraic and geometric multiplicities, Diagonalization, The Jordan canonical form. Symmetry: Group of motions of the plane, Discrete groups of motion, Finite groups of (30). Bilinear forms: Symmetric, skew symmetric and Hermitian forms, ^ Ç o À • š Œ [• o Á } ( ] v Œ š] U ^ ‰ š Œ o š Z } Œ u (} Œ š Z , Œ u] š] v v v } spaces.

SUGGESTED BOOKS AND REFERENCES

1. Artin, M., Algebra, Prentice Hall of India, 1994
2. Halmos, P., Finite dimensional vector spaces, Springer-Verlag (UTM), 1987
3. Hoffman, K. and Kunze, R., Linear Algebra (2nd Ed.) Prentice Hall of India, 1992

MA 231 (3:1): Topology

Instructor: Siddhartha Gadgil

Open and closed sets, continuous functions, Metric topology, Product topology, Connectedness and path connectedness, Compactness, Countability axioms, Separation axioms, Complete metric spaces, Quotient š } ‰ } o } P Ç U d } ‰ } o } P] o P Œ } µ ‰ • U K Œ] š • ‰, Baire Category theorem. Tietze Extension theorem. o u u U D š

SUGGESTED BOOKS

1. Armstrong, M. A., Basic Topology, Springer (India), 2004
2. Munkres, J. R., Topology, Pearson Education, 2005
3. Viro, O.Ya., Ivanov, O.A., Netsvetaev, N., and Kharlamov, V.M., Elementary Topology: Problem Textbook, AMS, 2008

Note: The course MA 231 can be deferred to VII semester, with the approval of the subject coordinator.

SEMESTER 6 (JANUARY)

MA 213 (3:1): Algebra II

Prerequisite course: MA 212

INSTRUCTOR: Venkatesh

Part A: Field theory

1. Theory of symmetric polynomials t E Á š } the theorem
2. Basic theory of field extensions
3. Algebraic and transcendental extensions (and transcendence degree)
4. Construction with straight edge and compass, Gauss-Wantzel theorem
5. Algebraic closure t ^ š] v] the theorem
6. Splitting fields, normal extensions
7. Separable extensions
8. Finite fields: construction, subfields, Frobenius
9. Primitive element theorem
10. Dedekind-Artin linear independence of (semi) group characters

Part B: Galois theory

1. Fundamental theorem of Galois theory (including Normal Basis Theorem)
2. Composite extensions and Galois group
3. Galois group of cyclotomic extensions, finite fields
4. Galois groups of polynomials, Fundamental theorem of Algebra
5. Solvable and radical extensions, insolvability of a quintic

SUGGESTED BOOKS AND REFERENCES

1. Artin, M., Algebra, Prentice-Hall of India, 1994
2. Dummit, D. S. and Foote, R. M., Abstract Algebra, McGraw-Hill, 1986
3. Lang, S., Algebra (3rd Ed.), Springer, 2002
4. Jonathan Alperin and Rowen Bell, Groups and Representations, Graduate Texts in Mathematics 162, Springer Verlag, 1995
5. Hungerford, Algebra, Graduate Texts in Mathematics 73, Springer-Verlag, 1974
6. Galois Theory, Artin, E., University of Notre Dame Press, 1944
7. Nathan Jacobson, Basic Algebra I & II, Dover, 2009
8. Nathan Jacobson, Lectures in Abstract Algebra I, II & III, Graduate Text in Mathematics, Springer-Verlag, 1951

MA 222 (3:1): Measure & Integration

Prerequisite course: UM 204

INSTRUCTOR: Harish Seshadri

Construction of Lebesgue measure, Measurable functions, Lebesgue integration, Abstract measure and abstract] v š P Œ š] } v U D } v } š } v } v À Œ P v š Z } Œ u U } u] v š } v À Œ P v š Z } Œ Riemann integration and Lebesgue integration, Product sigma algebras, Product measures, Sections of u • µ Œ o (µ v š] } v • U & µ] v] [• š Z } Œ u U ^] Radon-Nikodym u the orem Œ, L-spaces, Z } v Characterization of continuous linear functionals on L-spaces, Change of variables, Complex measures, Riesz representation theorem.

SUGGESTED BOOKS AND REFERENCES:

1. Royden, H. L., Real Analysis, Macmillan, 1988
2. Folland, G. B., Real Analysis Modern Techniques and their Applications (2nd Ed.), Wiley
3. Hewitt, E. and Stromberg, K., Real and Abstract Analysis, Springer, 1969

MA 224 (3:1): Complex Analysis

Prerequisite course: UM 204

Instructor: Gautam Bharali

Complex numbers, holomorphic and analytic functions, Cauchy u v v ‹ µ š] } v • U µ Z Ç [•] v š P Œ >] } µ À] o o [• š Z } Œ u v ‰ Œ } } (} ((µ v u v š o š Z } Œ u v Z } Œ u v (µ v u v š o š Z } Œ u v Z singularities, residue theorem, Argument Principle. Mobius transformations, conformal mappings, Schwarz lemma, automorphisms of the disc and complex plane. Normal families and D } v š theorem. The Riemann mapping theorem. If time permits - analytic continuation and/or W] Œ theorem.

SUGGESTED BOOKS AND REFERENCES

1. Ahlfors, L. V., Complex Analysis, McGraw-Hill, 1979
2. Conway, J. B., Functions of One Complex Variable, Springer-Verlag, 1978
3. Stein, E. M, and Shakarchi, R., Complex Analysis, Princeton University Press, 2003

MA 241 (3:1): Ordinary Differential Equations

Prerequisite course: UM 204

Instructor: Vamsi Pritham Pingali

Basics concepts: Introduction and examples through physical models, First and second order equations, general and particular solutions, linear and nonlinear systems, linear independence, solution techniques. Existence and h v] ‹ µ v • • d Z } Œ u • W] W Œ v } [• • š Z } Œ u • W] W Œ v } [• • š Z } Œ u • U ' Œ } Á v Á o o [•] v ‹ µ o] š Ç U ‰ v and associated flows. Linear system: The fundamental matrix, stability of equilibrium points, Phase plane analysis, Sturm-Liouville š Z } Œ Ç X E } v o] v Œ • Ç • š u v š Z] Œ • š] o] š Ç W > Ç Perturbation of linear systems, Periodic solutions and Poincare-Bendixson theorem.

SUGGESTED BOOKS AND REFERENCES

1. Hartman, Ordinary Differential Equations, P. Birkhaeuser, 1982
2. Coddington E. A. and Levinson N., Theory of Ordinary Differential Equations, Tata McGraw-Hill, 1972
3. Perko, L., Differential Equations and Dynamical Systems, Springer-Verlag, 1991

SEMESTER 7 (AUGUST)

The coursework for this semester comprises electives. Refer the table above for the list of electives offered by the Department of Mathematics.

SEMESTER 8 (JANUARY)

UM 400 (0:13) Project: Mathematics

Mandatory project for undergraduate Mathematics Majors in their fourth year, second semester.

Master of Science

Following mandatory courses to be fulfilled:

MA 389A (1:0): Seminar on topics in mathematics I (AUG)
MA 389B (1:0): Seminar on topics in mathematics II (JAN)
MA 213 (3:1): Algebra II (JAN)
MA 222 (3:1): Analysis II (JAN)

Soft core courses requirement: Any 3 courses from the list below

MA 223 (3:0): Functional Analysis
MA 232 (3:0): Introduction to Algebraic Topology
MA 242 (3:0): Partial Differential Equations
MA 361 (3:0): Probability Theory
MA 235 (3:0): Introduction to Differentiable Manifolds
MA 220 (3:0): Representation Theory of Finite Groups
MA 312 (3:0): Commutative Algebra
MA 313 (3:0): Algebraic Number Theory
MA 262 (3:0): Introduction to Stochastic Processes
MA 321 (3:0): Analysis III

The remaining 13 credits could be comprised of the following D • š Œ [projects A & B and courses offered by any department or a combination thereof.

Courses offered in August Semester

UM 501 (0:6): Masters Project A
Optional reading project.

Courses offered in January Semester

UM 502 (0:6): Masters Project B
Optional reading project.

Note: 1) The student must complete MA 213 (Algebra 2) and MA 222 (Analysis 2) in the BS programme
} Œ] v š Z ( ] (š Z Ç Œ] ve. D • š Œ [• ‰ Œ } P Œ u
2) Three courses must be taken from the softcore pool of 10 courses. If 'n' number of courses out of these 3 softcore courses have been completed in the BS programme, then the remaining '3-n' courses must be credited in the fifth year.
3) Master's projects A and B are optional, but if credited in the fifth year, will count towards the 32 credits.
4) If the student has completed MA 213 - Algebra II, MA 222 - Analysis II, and 3 softcore courses in the BS programme, then the 30 credits in the fifth year can potentially be taken from any department (subject to the approval of the mathematics coordinator)

Note: For credit carry over from BS (Research) to MS please refer to Chapter, section - 2.3

****

PHYSICS

Curriculum applicable From Batch 2022 onwards

Basic Core Courses (for Physics Major and Minor)

Sl.No.	Code	Title	Credits	Semester
1	UPH101T	Introductory Physics I Mechanics, Oscillations and Waves	3:0	I
2	UPH101L	Introductory Physics I Mechanics, Oscillations and Waves (Lab)	0:1	I
3	UPH102T	Introductory Physics II (Electricity, Magnetism and Optics)	3:0	II
4	UPH102L	Introductory Physics II (Electricity, Magnetism and Optics) (Lab)	0:1	II
5	UPH201T	Introductory Physics III (Thermal and Modern Physics)	3:0	III
6	UPH201L	Introductory Physics III (Thermal and Modern Physics) (Lab)	0:1	III

Curriculum applicable until Batch 2021

Basic core courses for Physics Major

Sl.No.	Code	Title	Credits	Semester
1	UP101T	Introductory Physics I Mechanics, Oscillations and Waves	2:0	I
2	UP101L	Introductory Physics I Mechanics, Oscillations and Waves (Lab)	0:1	I
3	UP102T	Introductory Physics II (Electricity, Magnetism and Optics)	2:0	II
4	UP102L	Introductory Physics II (Electricity, Magnetism and Optics) (Lab)	0:1	II
5	UP201T	Introductory Physics III (Thermal and Modern Physics)	2:0	III
6	UP201L	Introductory Physics III (Thermal and Modern Physics) (Lab)	0:1	III

Courses offered from the 4th semester onwards (All batches)

[Core, elective courses for Physics Major/Minor]

Sl. No.	Code	Title	Credits	Semester	Course Type
1	UP202T	Intermediate Mechanics, Oscillations and Waves	2:0	IV	Major- Core Minor- Elective
2	UP202L	Intermediate Mechanics, Oscillations and Waves (Lab)	0:1	IV	Major- Core Minor- Elective
3	UP203T	Intermediate Electromagnetism and the Quantum Physics of Radiation	2:0	IV	Major- Core Minor- Elective
4	UP203L	Intermediate Electromagnetism and the Quantum Physics of Radiation (Lab)	0:1	IV	Major- Core Minor- Elective
5	UP204T	Intermediate Thermal Physics and the Physics of Materials	2:0	IV	Major- Core Minor- Core
6	UP204L	Intermediate Thermal Physics and the Physics of Materials (Lab)	0:1	IV	Major- Core Minor- Core
7	PH201	Classical Mechanics	3:0	V	Major- Core Minor- Elective
8	PH203	Quantum Mechanics I	3:0	V	Major- Core Minor- Elective
9	PH205	Mathematical methods of Physics	3:0	V	Major- Core Minor- Elective
10	PH211	General Physics Laboratory	0:3	V	Major- Core Minor- Elective
11	PH202	Statistical Mechanics	3:0	VI	Major- Core Minor- Elective
12	PH204	Quantum Mechanics II	3:0	VI	Major- Core Minor- Elective
13	UP 400 UPH 400*	Project: Physics	0:16 0:15	VIII	Z o } Project
14	UP500	Project: Physics	0:20	X	D • š Project

Note: i) Effective from the Batch of 2022

ii) Electives for Physics Major and Minor

Any courses offered by Centre for High Energy Physics (CHEP) / Instrumentation and Applied Physics (IAP) / Physics departments will be considered towards Major and Minor electives with the consent of the course instructor.

Credit Requirements for Physics Major

Course Type	Basic Courses (Sem 1-3)	Engg (Sem 1-3)	Humanities (Sem 1-3)	Core (Sem 4-6)	Major Electives	Project	Assortment/ Institute Elective	Total
Until Batch 2021	36	19	9	27	9	16	15	131
Batch 2022 onwards	40	6	9	27	9	15	25	131

Course Details

Coordinator: Victor Suvisesha Muthu and Prasad Hegde
Instructors UG: Haritha Pamuluri, Nandha Gopal P and Jesla P K
Teaching Assistants: Rashmi R K, Tyby Monachan, Pavithra P, Nilaneena P K and Aria Kutty

SEMESTER 1 (AUGUST)

UP 101T (2:0) / UPH 101T (3:0): Introductory Physics I: Mechanics, Oscillations and Waves

Instructor: Sebabrata Mukherjee

Kinetics, laws of motion. Circular motion, work. Kinetic and potential energy. Line integrals. Conservative forces. Friction, terminal velocity in air. Systems of particles. Conservation of linear momentum. Scattering in one and two dimensions. Angular momentum. Moment of inertia. Rotation about one axis. Precession of gyroscope. Central force. Reduction of two-body problem to one-body problem and effective one-body potential. Planetary motion v < ‰ o Œ [• o Á • X ^] u ‰ o ‰ v µ o µ u u ‰ v (} Œ U Œ • } v v X } µ oscillations. Transverse waves on a string. Linear superposition, interference, beats. Fourier series. Sound waves in air. Doppler effect.

SUGGESTED BOOKS:

1. Kittel, C., Knight, W.D., Ruderman, M.A., Helmholz, A.C. and Moyer, B.J. 2011. Mechanics, Berkeley Physics Course: Volume 1, 2nd edition
2. Kleppner, D and Kolenkow, R.J. 2007. An Introduction To Mechanics (Special Indian Edition)
3. David Halliday, Robert Resnick, Jear Walker: Fundamentals of Physics
4. Raymond A. Serway and John W. Jewett: Physics for Scientists and Engineers with Modern Physics
5. Hugh D. Young and Roger A. Freedman: University Physics with Modern Physics
6. Vector Analysis (Schaum's Series) by M. R. Spiegel
7. Classical Mechanics By N. C. Rana & P. S. Joag

UP 101L (0:1) / UPH 101L (0:1): Introductory Physics I: Mechanics, Oscillations and Waves (Lab)

Instructors: K. Ramesh, Animesh Kuley and Binita Tongbram

SEMESTER 2 (JANUARY)

UP 102T (2:0) / UPH 102T (3:0): Introductory Physics II: Electricity, Magnetism and Optics

Instructor: Gaurav Narain

Introduction, review of vector algebra, vector calculus: gradient, divergence, curl, ' µ • • theorem and ^ š } l • [š Z } Œ u U > ‰ o] v š X } µ o } u [• o Á U o š Œ] ( ] o U o š Œ } • š š] % capacitance, method of images, bound charges and dipole moment density, energy stored in electric fields. Magnetostatics: electric currents, Biot-• À Œ š o Á U u ‰ Œ [• o Á U u P v š] ( ] o • } (• š and infinite solenoids, vector potential, magnetic dipole moment and bound currents. Lorentz force and & Œ Ç [• law, inductance, energy stored in a magnetic field. Linear dielectric and magnetic materials, bound current, magnetism, Z Œ P } v • Œ À š] } v U] • ‰ o u v š µ Œ Œ v š U D Æ Á o o [• ‹ µ š] } v

SUGGESTED BOOKS:

1. Purcell, E.M. 2011 Electricity and Magnetism, Berkeley Physics Course Volume 2, 2nd edition, Tata Mc Graw Hill
2. Griffiths, D.J. 2003. Introduction to Electrodynamics, 3rd edition, Prentice Hall of India. SICS

UP 102L (0:1) / UPH 102L (0:1) Introductory Physics II: Electricity, Magnetism and Optics (Lab)

Instructors: Ramesh Mallik and Sai Siva

SEMESTER 3 (AUGUST)

UP 201T (2:0) / UPH 201T (3:0) Introductory Physics III: Thermal and Modern Physics

Instructors: Prerna Sharma

Temperature, The First Law of Thermodynamics, Kinetic Theory of Gases and Maxwell-Boltzmann Statistics, Heat Engines, Entropy and the Second Law of Thermodynamics, Relativity, Introduction to Quantum Physics, Basics of Quantum Mechanics, Atomic, Molecular and Solid state physics, Nuclear Physics, Particle Physics and Cosmology.

SUGGESTED BOOKS

1. Serway and Jewett, Physics for Scientists and Engineers (7th Edition)
2. Young and Freedman, University Physics (12th Edition)
3. Halliday, Resnick and Walker, Fundamentals of Physics, Extended (8th Edition)
4. Harris Benson, University Physics, Revised Edition
5. Kenneth Krane, Modern Physics, Second Edition
6. Resnick - introduction to special theory of relativity
7. Beiser - Modern Physics

UP 201L (0:1) / UPH 201L (0:1) Introductory Physics III: Thermal and Modern Physics (Lab)

Instructors: Subroto Mukerjee, Manish Jain and Banibrata Mukhopadhyay

SEMESTER 4 (JANUARY)

UP 202T (2:0) Intermediate Mechanics, Oscillations and Waves

Instructor: Nirmal Raj

Special theory of relativity. Lorentz transformations. Energy-momentum relation. Lorentz four-vectors. Motion in non-inertial frames. Fictitious forces. Coriolis force. Foucault pendulum. Basic scattering theory. Vibrations of particles on a circle and a line. Orthonormal basis. Wave equation. Fourier transform Phase space. Hamiltonian equations, fixed points and stability. Nonlinear equations. Chaos. Logistics map and period doubling. Fluid mechanics Euler equation. Œ v } µ equation. Waves in fluids. Gravity waves. Viscosity. Navier-Stokes equation. Basic ideas about turbulence. Elasticity. Strain and stress tensor. Elastic moduli. Bending of rods. Waves in solids.

SUGGESTED BOOKS:

For Fluid Mechanics:

1. https://www.damtp.cam.ac.uk/user/tong/fluids.html
2. http://www.fluiddynamics.it
3. Elementary Fluid Dynamics by D. J. Acheson
4. Griffiths Electrodynamics for some parts of Special Relativity
5. For Classical Mechanics: `Classical Mechanics by Tom W. B. Kibble and Frank H. Birkshire.
6. For non-linear dynamics and Chaos: `Non-Linear Dynamics and Chaos by Steven H. Strogatz
7. Kleppner, D. and Kolenkow, R. J. 2007 An Introduction to Mechanics (Special Indian Edition)
8. https://www.amazon.com/Classical-Mechanics-John-R-Taylor/dp/189138922X
9. The Feynman Lectures on Physics https://www.feynmanlectures.caltech.edu/
10. Spacetime Physics by Taylor and Wheeler: https://www.amazon.in/Spacetime-Physics-Introduction-Special-Relativity/dp/0716723271

UP 202L (0:1) Intermediate Mechanics, Oscillations and Waves (Lab)

Instructors: R. Ganesan and D. S. Nadig

UP 203T (2:0) Intermediate Electromagnetism and the Quantum Physics of Radiation

Instructor: Ranjan Laha

Electromagnetic Waves: Wave equation from D Æ Á equations, polarization, energy and momentum in EM Á À • U ‰ Œ } ‰ P š] } v] v o] v Œ u] U Œ (o š] } v v Œ (Œ š] } v U ^ v o o and total internal reflection. EM waves in conductors, skin depth, simple theories for dispersion of EM waves. Wave guides and coaxial cables, optical fibers Geometrical optics: & Œ u principle, ^ v law, reflection and refraction at spherical surfaces, convex and concave mirrors and lenses, real and virtual images.

Physical Optics: Coherence, } µ v P [• š Á } • o] š Æ ‰ Œ] u v š U u µ o š] ‰ o • o] š • U] ((Œ v (Œ] v P À] •]] o] š Ç U E Á š } v [• Œ Plane P interfe U] Z ten • diffraction from rectangular and circular apertures, Airy disc and resolving power of microscopes.

Quantum optics: Photons, spontaneous and stimulated emission, Einstein A and B coefficients and relation to the Planck distribution, rate equations for absorption and emission, two level and three level systems, population inversion and light amplification, optical resonators and the basic working principle of a laser, examples of lasers: Ruby, HeNe, semiconductor etc.

SUGGESTED BOOKS:

1. Griffiths, D.J. 2003 Introduction to Electrodynamics, 3rd edition, Prentice Hall of India
2. Hecht, E. and Ganesan, A.R. 2008 Optics, 4th edition, Pearson
3. Ghatak, A. and Thyagarajan, K 1991 Optical Electronics, Cambridge University Press

UP 203L (0:1) Intermediate Electromagnetism and the Quantum Physics of Radiation (Lab)

Instructors: Victor S Muthu and Abha Misra

UP 204T (2:0) Intermediate Thermal Physics and the Physics of Materials

Instructor: Prabal Maiti

Review of kinetic theory and thermodynamics, Free energies, Phases and phase transitions, Van der Waals gas and the liquid gas transition, Thermodynamics of magnetic systems, Ensembles and rules of Statistical Mechanics, The Ideal Maxwell-Boltzmann Gas, The Ideal Fermi Gas, The Ideal Bose Gas, Crystal Structure, Lattice Vibrations, Ba theory of electrons in crystalline solids, Thermal properties of crystalline solids.

SUGGESTED BOOKS

1. Callen, H.B. Thermodynamics and Introduction to Thermostatics (2nd edition), Wiley Student Edition
2. Ken Dill and Sarina Bromberg, Molecular Driving forces, CRC Press
3. Kittel, C. Introduction to Solid State Physics, 5th/6th/7th edition, Wiley International
4. S.J. Blundell and K.M. Blundell, Concepts in thermal physics, Oxford University Press

UP 204L (0:1) Intermediate Thermal Physics and the Physics of Materials (Lab)

Instructors: Upendra Behera and Minakshi Nayak

SEMESTER 5 (AUGUST)

PH 201 (3:0) Classical Mechanics

Instructor: Baladitya Suri

E Á š } v laws generalized co-ordinates. > P Œ v principle of least action and equations. Conservation laws and symmetry. Integrable problems, elastic collisions and scattering. Small oscillations including systems with many degrees of freedom, free and forced oscillations, damped and undamped oscillations, normal modes, counting and density of states, parametric oscillations and Floquet's theorem, numerical computations in parametric } •] o o š] } v • X equations, Poisson brackets. Hamilton Jacobi theory. Canonical perturbation theory, chaos, elements of special relativity. Lorentz transformations, relativistic mechanics Nonlinear dynamics t nonlinear oscillator, critical points, flow, linearization, Lyapunov exponents, general Lyapunov stability. Introduction to Classical Field Theory
- Massive and massless scalar fields, Noether's theorem.

SUGGESTED BOOKS

1. Landau, L. D and Lifshitz, E. M. Mechanics, Third Edition, Butterworth- Heinemann
2. Goldstein H., Poole C., and Safko J Classical Mechanics, Third Edition (Pearson Education)
3. Rana, N. C. and Jog, P. S Classical Mechanics, Mc Graw-Hill Education, New Delhi
4. Strogatz Steven H., Nonlinear dynamics and Chaos CRC press, 2nd edition, Special Indian Edition
5. R Shankar, Principles of Quantum Mechanics, Second Edition, Springer (India), 2010
6. Kleppner D and Kolenkow R J, An Introduction to Mechanics (Special Indian Edition) (2021)

PH 203 (3:0) Quantum Mechanics I

Instructor: Banibrata Mukhopadhyay

Wavefunction for a single particle. Hamiltonian. Schrodinger equation. Probability current. Wavepackets. One-dimensional problems: particle in a box and on a circle, step, barrier and delta-function potentials. Tunneling, scattering and bound states. Energy bands in periodic potentials. Simple harmonic oscillator, operator approach.

Z Œ v (theorem. Particle in an electromagnetic field. Aharonov-Bohm effect. Uncertainty relations. Hermitian and unitary operators. Orthonormal basis. Postulates of quantum mechanics. Matrix formulation of quantum mechanics Three dimensional problems. Rotations, angular momentum operators, commutation relations.

Spherical harmonics. Hydrogen atom, its spectrum and wave functions. Spin angular momentum. Spin-1/2 and two- level systems. Addition of angular momentum. Spin-orbit and hyperfine interactions. Time-independent perturbation theory. Stark and Zeeman effects.

SUGGESTED BOOKS:

1. C. Cohen-Tannoudji, B Diu and F. Laloe, Quantum Mechanics, Vol. 1 and 2, John Wiley & Sons, 2005
2. D. J. Griffiths, Introduction to Quantum Mechanics, Pearson, 2005
3. L. D. Landau and Lifshitz, Quantum Mechanics (Vol. 3 of Course of Theoretical Physics), 1999
4. F. Schwabl, Quantum Mechanics, Springer, 1995
5. R. Shankar, Principles of Quantum Mechanics, Springer, 2010

PH 205 (3:0) Mathematical Methods of Physics

Instructor: Justin David

Linear vector spaces, linear operators and matrices, systems of linear equations. Eigen values and Eigenvectors,

classical orthogonal polynomials. Linear ordinary differential equations, exact and series methods of solution, special functions. Linear partial differential equations of physics, separation of variables method of solution. Complex variable theory; analytic functions. Taylor and Laurent expansions, classification of singularities, analytic continuation, contour integration, dispersion relations. Fourier and Laplace transforms.

SUGGESTED BOOKS

1. Arfken, G, Weber H. and Harris F., Mathematical methods for Physicists, 7th edition, Academic Press
2. Dennery, P. and Krzywicki, A. 1967 Mathematics for Physicists, Harper and Row
3. Riley, K. Hobson M., Bence, S. Mathematical Methods for Physics and Engineering, CUP, 1997

PH 211L (0:3) General Physics (Lab)

Instructors: T Das Gupta and Srimanta Middey

Identification of NaCl monocrystals (with X-ray unit). Gamma ray absorption with Multi Channel Analyzer (calibration & attenuation coefficient). NMR: Nuclear Magnetic Resonance (find the magnetogyric ratio of Hydrogen and Fluorine). Velocity of sound in liquids (Raman-Nath experiment). Normal modes in (3D) acoustic chamber. Solar cell (IV Characteristics). V-UVIS spectroscopy (Band gap of semiconductor, thickness measurement). X-ray fluorescence with Multi Channel Analyzer. Rutherford Scattering. Elastic Plastic Deformation.

SEMESTER 6 (JANUARY)

PH 202 (3:0) Statistical Mechanics

Instructor: Shibananda Das

Phenomena and experiments; thermodynamic entropy and the 0th, 1st and 2nd Laws; Free energies, Legendre transformations, Maxwell relations; Stability, equilibrium, van der Waals eqn of state & phase transitions; Elements of probability theory and the central limit theorem; The postulates of equilibrium classical statistical mechanics and their mechanical basis; the postulates of quantum statistical mechanics; the density matrix; the 3rd Law; Partition functions; ensembles and their equivalence; numerical methods; Noninteracting systems: ideal classical and quantum gases with examples; interacting systems: virial expansion, lattice gas, Ising model (1D and Bragg-Williams/Curie-Weiss); Random walks, Brownian motion, and the Langevin equation.

SUGGESTED BOOKS:

1. Kardar, M. 2007: Statistical Physics of Particles, Cambridge University Press
2. Mazenko G. F 2000: Equilibrium statistical mechanics, Wiley, New York
3. Reif, F. 2010: Fundamentals of Statistical and Thermal Physics, Sarat Book Distributors
4. Bhattacharjee, J. K 1996: Statistical Physics Equilibrium and Nonequilibrium Aspects, Allied, New Delhi
5. Landau L. D. and Lifshitz, E. M. 1980 Statistical Physics, Pergamon
6. Statistical Mechanics, R K Pathria
7. Reif, F. 2010: Fundamentals of Statistical and Thermal Physics, Sarat Book Distributors
8. Concepts in Thermal Physics, Blundell and Blundell

PH 204 (3:0) Quantum Mechanics II

Instructor: Biplob Bhattacharjee

Recap of quantum mechanics I, WKB approximation and variational methods, Density Matrices, Time dependent perturbation theory, Fermi golden rule, Transitions caused by a periodic external field, Dipole transitions and selection rules, Decay of an unstable state, Born cross section for weak potential scattering, Adiabatic and sudden approximations, Berry phase and the Aharonov-Bohm effect, Scattering theory: partial wave analysis, low energy scattering, scattering length, Born approximation, optical theorem, Wigner-Eckart theorem, Quantization of the radiation field. One out of the following topics: Entanglement, the Dirac equation and Hartree-Fock theory.

SUGGESTED BOOKS

1. Landau, L.D. and Lifshitz, E.M. 1974. Quantum Mechanics, Pergamon, NY
2. Cohen-Tannoudji, C., Diu, B. and Laloe, F. 1977. Quantum Mechanics (2 Vols.), John Wiley
3. Modern Quantum Mechanics by Sakurai and Napolitano
4. Quantum Mechanics by Schwabl
5. Quantum Mechanics by Schiff
6. The Principles of Quantum Mechanics by Dirac

UP 400 (0:16) / UPH 400 (0:15): Project: Physics

Coordinator: Victor S Muthu and Prasad Hegde

This is a 15/16 credit project course of six months duration and is compulsory for the completion of the BSc Research course. The student can choose any faculty of his or her choice from any of the three departments: Physics, Centre for High Energy Physics (CHEP), Instrumentation and Applied Physics (IAP) with mutual consent and take up an advanced topic of research either in the experimental or theoretical stream. At the end of the term, the student will submit a soft copy and hard copy of the report with proper binding. The viva voce examination will be conducted with two examiners and evaluated accordingly.

Master of Science

The following courses are mandatory for the 5th year UG (MS) students and 20 credits from the project:

PH 206 (3:0): Electromagnetic Theory
PH 208 (3:0): Condensed Matter Physics 1 or IN 232 (3:0): Concepts in Solid State Physics
PH 217 (3:0): Fundamentals of Astrophysics
PH/HE 215 (3:0): Nuclear and Particle Physics

The students have to complete 12-credit blackboard courses during the 5th year.

In case none of the above-mentioned mandatory courses are completed by the students during the first 4 years (Bachelor of Science), they have to credit all of them in the 5th year.

In case the students already completed all of the above-mentioned mandatory courses during the first 4 years (Bachelor of Science), to fulfill the 12-credit requirement, they can take any other course(s) (200 or 300 level) from any department, with the consent of their respective advisor, Instructor, and UG coordinator.

In case the students completed part of the above-mentioned mandatory courses during the 1st Four-Years (BS), they have to complete the remaining mandatory courses and, to fulfill the 12-credit requirement, any other course(s) (200 or 300 level) from any department, with the consent of their respective advisor, Instructor and UG coordinator.

UP 500 (0:20): Project: Physics

Coordinator: Victor S Muthu and Prasad Hegde

This is a 20-credit project course of six months duration and is compulsory for the completion of the MSc course. The student can choose any faculty of his or her choice from any of the departments: Physics, Centre for High Energy Physics (CHEP), Instrumentation and Applied Physics (IAP) with mutual consent and take up an advanced topic of research either in the experimental or theoretical stream. At the end of the term, the student will submit a soft copy of the report to the coordinator. The viva-voce examination will be conducted with two examiners and evaluated accordingly.

Note: For credit carry over from BS (Research) to MS please refer to Chapter, section- 2.3

****

BIOENGINEERING

Minor in Bioengineering for IISc Undergraduates

Bioengineering is a thriving interdisciplinary field in academic research and industrial practice today. On the one hand, Bioengineering is the engineering counterpart to life sciences, just as aerospace, chemical, civil, electrical, material, and mechanical engineering disciplines are engineering extensions of physics and chemistry. On the other hand, bioengineering is much more expansive. At one end of its broad spectrum, it deals with quantitative aspects and design principles of biomolecules, cells, tissues, organs and systems. The development of novel diagnostic and therapeutic devices, orthotics, human assistive devices, etc., lies at the other end of the spectrum of bioengineering. In a nutshell, bioengineering is the engineering of biology, for biology, and with biology.

Using engineering principles and techniques to understand biology at the fundamental level is a hallmark of bioengineering. Biomaterials, cell and tissue engineering, immunoengineering, and regenerative medicine are pursued within bioengineering towards developing novel drug delivery techniques, implants, prosthetics, and artificial organs. Neuroengineering interfaces neuroscience to not only understand how the brain works but also to study neurological diseases and their treatment. Emerging areas of systems and synthetic biology, which use computational methods and even the new trends in artificial intelligence, are also within the ambit of bioengineering.

Biosensors and implantable prostheses that involve various micro and nano technologies, image processing, signal processing, bioelectronics, medical imaging, etc., also come within the purview of bioengineering. The spectrum of bioengineering ranges from developing novel biochemical assays and apparatus such as microscopes to designing new biomedical instruments that are crucial for medical diagnosis and treatment.

Working with clinicians and clinical researchers is another important aspect of bioengineering, or its extension called biomedical engineering. Familiarity with physiology and anatomy empowers engineers to work on the unmet needs of clinical practice and explore careers in the biomedical industry. Bioengineering also has organic links to the thriving biopharma industry.

IISc undergraduates who opt for a minor in bioengineering will become familiar with the basics of bioengineering and touch upon its multiple facets. This minor program is administered by the Department of Bioengineering (BE) (earlier known as BioSystems Science and Engineering (BSSE)), a full-fledged academic department in IISc. BSSE was founded in 2015 based on the rapidly growing activities in this domain that became evident due to the Interdisciplinary PhD program in Bioengineering, which started in 2012. BSSE changed its name to BE in 2023. It is an inclusive department that works with several other departments as well as its numerous clinical partners. BE is a place of confluence of biologists, clinicians, designers, and engineers. It has a primary faculty of its own, associate faculty, adjunct faculty, research staff, and Ph.D. and M.Tech. students. Its thematic common laboratories support research and teaching.

BE has a well-thought-out and growing curriculum to train and nurture students with different backgrounds to become bioengineers with expertise and appreciation for biology and engineering. It also prepares them for pursuing careers in academia, research organizations, and the industry.

A few courses are selected from [• µ Œ Œ] µ o µ u š } • Œ À • } Œ v o š] À } µ Œ to fulfil 15 credits required for the minor in the undergraduate program of IISc. The core courses provide basics of traditional and emerging areas of biomaterials, biosensors, biomechanics, and systems biology. The electives

provide an opportunity to study these topics in depth, depending on the interests of the students after taking the core courses. It may be noted that the core courses are offered by BE, while the elective are taught by BE and other departments in IISc. While most courses are lecture oriented, some have hands on laboratories.

Coordinator: Mohit Kumar Jolly

Total credits required for the Minor subject option: 15

Core courses (4 credits):

BE 213 (2:0) Fundamentals of Bioengineering 1 (AUG)
BE 214 (2:0) Fundamentals of Bioengineering 2 (JAN)

Elective (11 credits): To be selected from the following:

BE 210 (3:0) Drug Delivery: Principles and Applications (AUG)
BE 211 (3:0) Cell Mechanics (JAN)
BE 216 (3:0) Dynamical Systems Biology (JAN)
BE 222 (3:0) Stem Cell Technology (JAN)
BE 224 (3:0) Diagnostics and Devices (JAN)
MT 271 (3:0) Introduction to Biomaterials (AUG)
ME 251 (3:0) Biomechanics (JAN)
NE 231 (3:0) Microfluidics (AUG)
CH 248 (3:0) Molecular Systems Biology (JAN)
EC 303 (2:1) Stochastic and spatial dynamics in Biology (AUG)
NS 201 (2:0) Systems Neuroscience (AUG)
DS 201 (2:0) Bioinformatics (AUG)
BC 302 (3:0) Current Trends in Drug Discovery (JAN)

****

QUANTUM TECHNOLOGY

Inclusion of Quantum Technology as a Minor in the UG Program

Coordinator: Arindam Ghosh and Baladitya Suri

Total credits required for the Minor subject option: 15

Core courses (12 credits):

QT207 (3:0) Introduction to Quantum Computation (AUG)
QT209 (3:0) Introduction to Quantum Communications and Cryptography (AUG)
QT 202 (3:0) Introduction to Quantum Measurement and Sensing (JAN)
QT204 (3:0) Introduction to Materials for Quantum Technologies (JAN)

Elective (3 credits): To be selected from the following:

QT306 (3:0) Advanced Quantum Computation and Information (JAN)
E0 213 (3:0) Quantum-safe Cryptography (JAN)
E2210 (3:0) Quantum Error-correcting Codes (JAN)
E2 270 (3:0) Quantum Information Theory (AUG)
E7 211 (2:1) Photonics Integrated Circuits (AUG)
NE203 (3:0) Advanced Micro and Nanofabrication Technology and Process (AUG)
NE 222 (3:0) MEMS Modelling, Design and Implementation (AUG)
NE310 (3:0) Photonics Technology Materials and Devices (AUG)
NE320 (3:0) Quantum Optics (JAN)
PH 359 (3:0) Physics at the Nanoscale (JAN)
NE312 (3:0) Nonlinear and Ultrafast Photonics (AUG)
IN 332 (3:0) 2D Materials (JAN)

****

CHAPTER 18

SCHEME OF INSTRUCTIONS (SOI)

BACHELOR OF TECHNOLOGY (MATHEMATICS AND COMPUTING) PROGRAM

Core Courses: Mathematics and Computing

Sl. No.	Code	Title	Credits	Semester
1	UENG101T	Algorithms and Programming	3:0	I
2	UENG101L	Algorithms and Programming (Lab)	0:1	I
3	UMA101	Analysis and Linear Algebra - I	4:0	I
4	UENG102T	Electrical and Electronics Engineering	3:0	II
5	UENG102L	Electrical and Electronics Engineering (Lab)	0:1	II
6	UMA102	Analysis and Linear Algebra - II	4:0	II
7	UMC102	Computer Systems	3:0	II
8	UMC103	Discrete Mathematics	2:0	II
	UMC 103A*		3:0	
9	UMA201	Probability and Statistics	4:0	III
10	UMC201	Data Structures & Algorithms	3:1	III
11	UMC202	Numerical Methods	3:1	III
12	UM 204	Introduction to Basic Analysis	3:1	IV
13	UM 205	Introduction To Algebraic Structures	3:1	IV
14	UMC203	Introduction to Artificial Intelligence and Machine Learning	3:1	IV
15	UMC205	Automata and Computability	3:1	IV

Note: * Effective from the Batch of 2025

Humanities

Refer to Humanities section of Chapter 17 for details

Breadth Soft Core Courses

Sl.No.	Code	Title	Credits	Semester
1	UBL101T	Introductory Biology I	3:0	I
2	UBL101L	Introductory Biology I (Lab)	0:1	I
3	UCY101T	Introductory Chemistry I	3:0	I
4	UCY101L	Introductory Chemistry I (Lab)	0:1	I
5	UPH101T	Introductory Physics I	3:0	I
6	UPH101L	Introductory Physics I (Lab)	0:1	I
7	UBL102T	Introductory Biology II	3:0	II

8	UBL102L	Introductory Biology II (Lab)	0:1	II
9	UCY102T	Introductory Chemistry II	3:0	II
10	UCY102L	Introductory Chemistry II (Lab)	0:1	II
11	UENG103	Introduction to Earth and its Environment	3:0	II
12	UPH102T	Introductory Physics II	3:0	II
13	UPH102L	Introductory Physics II (Lab)	0:1	II
14	UBL201T	Introductory Biology III	3:0	III
15	UBL201L	Introductory Biology III (Lab)	0:1	III
16	UCY201T	Introductory Chemistry III	3:0	III
17	UCY201L	Introductory Chemistry III (Lab)	0:1	III
18	UENG201	Introduction to Materials Science	3:0	III
19	UPH201T	Introductory Physics III	3:0	III
20	UPH201L	Introductory Physics III (Lab)	0:1	III

Project

Sl.No.	Code	Title	Credits	Semester
1	UMC401	Independent Study Project I (ISP I)	6	VII
2	UMC402	Independent Study Project II (ISP II)	6	VIII
3	UMC403	Project	12	VIII

Note: Refer to Section 3.6 for detailed rules regarding projects.

Soft Core: Mathematics

Sl.No.	Code	Title	Credits
1	E0220	Graph Theory	3:1
2	E0228	Combinatorics	3:1
3	E0265	Convex Optimization and Applications	3:1
4	E0298	Linear Algebra and its Applications	3:1
5	E0 350	Advanced Convex Optimization	3:1
6	E1222	Stochastic Models and Applications	3:0
7	E1251	Linear and Nonlinear Optimization	3:0
8	E2202	Random Processes	3:0
9	E2212	Matrix Theory	3:0
10	MA 200	Multivariable Calculus	3:1
11	MA 212	Algebra I	3:0
12	MA 216	Introduction to Graph Theory	3:0
13	MA 218	Number Theory	3:0
14	MA 219	Linear Algebra	3:1
15	MA 222	Analysis II	3:1
16	MA 223	Functional Analysis	3:0
17	MA 224	Complex Analysis	3:1
18	MA 231	Topology	3:1
19	MA 232	Introduction to Algebraic Topology	3:0
20	MA 235	Introduction to Differentiable Manifolds	3:0
21	MA 241	Ordinary Differential Equations	3:1
22	MA 242	Partial Differential Equations	3:0
23	MA 262	Introduction to Stochastic Processes	3:0
24	MA 278	Introduction to Dynamical Systems Theory	3:0
25	MA 347A	Topics in Finite Element Methods	3:1
26	MA 361	Probability Theory	3:0
27	PH205	Mathematical Methods of Physics	3:0

Note:

1. Among E1222, E2202 and MA 262, only one can be chosen
2. Between E2212, E0 298 and MA 219, only one can be chosen
3. Between E0220 and MA 216, only one can be chosen

Soft Core: Computing

Sl.No.	Code	Title	Credits
1	UMC301	Applied Data Science and Artificial Intelligence	3:1
2	DS 207	Introduction to Natural Language Processi	3:1
3	DS211	Numerical Optimization	3:0
4	DS221	Introduction to Scalable Systems	3:1
5	DS250	Multigrid Methods	3:1
6	DS 252	Introduction to Cloud Computing	3:1
7	DS256	Scalable Systems for Data Science	3:1
8	DS284	Numerical Linear Algebra	2:1
9	DS289	Numerical Solution of Differential Equations	3:1
10	DS291	Finite Elements: Theory and Algorithms	3:1
11	DS294	Data Analysis and Visualization	3:0
12	DS295	Parallel Programming	3:1
13	DS301	Bioinformatics	2:0
14	E0205	Mathematical Logic and Theorem Proving	3:1
15	E0206	d Z } ŒT]•o3k[t•	3:1
16	E0208	Computational Geometry	3:1
17	E0209	Principles of Distributed Software	3:1
18	E0224	Computational Complexity Theory	3:1
19	E0225	Design and Analysis of Algorithms	3:1
20	E0227	Program Analysis and Verification	3:1
21	E0230	Computational Methods of Optimization	3:1
22	E0 234	Introduction to Randomized Algorithms	3:1
23	E0235	Cryptography	3:1
24	E0240	Modelling and Simulation	3:1
25	E0244	Computational Geometry and Topology	3:1
26	E0248	Theoretical Foundations of Cryptography	3:1
27	E0 249	Approximation Algorithms	3:1
28	E0 255	Compiler Design	3:1
29	E0259	Data Analytics	3:1
30	E0267	Soft Computing	3:1
31	E0270	Machine Learning	3:1
32	E0272	Formal Methods in Software Engineering	3:1
33	E1213	Pattern Recognition and Neural Networks	3:1
34	E1244	Detection and Estimation Theory	3:0
35	E1254	Game Theory	3:1
36	E1277	Reinforcement Learning	3:1

37	E2201	Information Theory	3:0
38	E2230	Network Science and Modelling	3:0
39	E2232	TCP/IP Networking	2:1
40	QT207	Introduction to Quantum Computation	3:0
41	BE218	Computational Epidemiology	3:1
42	MA208	Proofs and Programs	3:1

Suggested Institute Electives

Sl.No.	Code	Title	Credits
1	MG 201	Managerial Economics	3:0
2	MG 265	Data Mining	3:0
3	MG 221	Applied Probability and Statistics	2:1
4	MG 226	Time Series Analysis and Forecasting	3:0
5	MG 258	Financial Instruments and Risk Management Strategies	3:0
6	PH 202	Statistical Mechanics	3:0
7	PH 204	Quantum Mechanics II	3:0
8	PH 206	Electromagnetic Theory	3:0
9	BC 302	Current Trends in Drug Discovery	3:0
10	MA 253	Numerical Methods for Partial Differential Equations	3:0
11	EC 201	Theoretical and Mathematical Ecology	2:1
12	EC 303	Spatial dynamic in Biology	2:1
13	NE 101	Entrepreneurship, Ethics and Societal Impact	1:0
14	E1396	Stochastic Approximation Algorithms	3:1
15	MA 331	Topology and Geometry	3:0
16	E0259	Data Analytics	3:1
17	BE 218	Computational Epidemiology	3:1
18	CP 214	Foundations of Robotics	3:1
19	PH 354	Computational Physics	3:0
20	E2270	Quantum Information Theory	3:0
21	DS 301	Bioinformatics	2:0
22	E0207	Computational Topology	3:1

STUDY TRACKS

The program structure encourages interested students to pursue a study track should they wish to do so. Here is an indicative list of study tracks.

A. MATHEMATICS

- ¾ Linear Algebra, Multivariable calculus
- ¾ Algebra: Algebra I, Algebra II, Number theory, Graph theory, Cryptography
- ¾ Analysis Measure and Integration, Functional Analysis, ODE, PDE, Convex Optimization, Numerical solutions to Differential Equations
- ¾ Geometry/Topology: Topology, Differentiable Manifolds, Algebraic Topology, Graph theory, Computational Geometry and Topology
- ¾ Probability: Measure and Integration, Probability Theory, Random Processes, Stochastic Processes, Percolation and Random Graphs, Random Matrix Theory

B. INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- Random Processes
- Applied Data Science and Artificial Intelligence
- Computational Methods of Optimization
- Machine Learning, Game Theory
- Data Mining
- Soft Computing
- Reinforcement Learning
- Scalable Systems for Data Science
- Foundations of Robotics
- Data Analysis and Visualization

C. COMPUTATIONAL SCIENCE

- Numerical Optimization
- Multigrid Methods
- Numerical Solution of Differential Equations
- Finite Element Methods, Bioinformatics

D. THEORETICAL COMPUTER SCIENCE

- Algorithms and Complexity: Design and Analysis of Algorithms, d Z } CE]o3[t, Computational Complexity Theory, Introduction to Randomized Algorithms, Approximation Algorithms
- Combinatorics and Geometry: Computational Geometry, Computational Topology, Combinatorics, Graph Theory
- Cryptography and Security: Theoretical Foundations of Cryptography, Cryptography, Network and Distributed Systems Security, Foundations of Secure Computation
- Logic and Verification: Mathematical Logic and Theorem Proving, Formal Methods in Software Engineering, Program Analysis and Verification, Proofs and Programs

E. QUANTUM COMPUTING

- Mechanics
- Electricity, Magnetism and Optics
- Quantum Mechanics I
- Physics/Engineering foundations of Quantum Technologies
- Introduction to Quantum Computation
- Introduction to Quantum Communication & Cryptography
- Advanced Quantum Computing & Information

F. COMPUTATIONAL BIOLOGY

- Biology for Engineers
- Fundamentals of Bio Engineering I, II
- Theoretical and Mathematical Ecology
- Dynamical Systems in Biology
- Introduction to Molecular Simulation
- Current Trends in Drug Discovery
- Digital Epidemiology
- Neural Signal Processing
- Theoretical and Computational Neuroscience
- Algorithmic foundations of Big Data Biology

G. SIGNAL PROCESSING

- ¾ Detection and estimation theory
- ¾ Random processes
- ¾ Linear and non-linear optimization
- ¾ Matrix theory or Computational linear algebra
- ¾ Pattern recognition and neural networks
- ¾ Signal processing in practice
- ¾ Digital Signal Processing
- ¾ Digital Image Processing
- ¾ Neural Signal Processing

H. MATHEMATICAL FINANCE

- ¾ Probability Theory
- ¾ Stochastic Finance
- ¾ Random Processes
- ¾ Detection and Estimation
- ¾ Data Analysis
- ¾ Financial Instruments and Risk Management
- ¾ Statistics
- ¾ Time Series Analysis
- ¾ Numerical Solutions to Differential Equations

SEMESTER 1 (AUGUST)

Core Courses:

UENG 101T (3:0:3) Algorithms and Programming
UENG 101L (0:1:2) Algorithms and Programming (Lab)

Instructors: L. Sunil Chandran and Viraj Kumar

The emphasis of this course is on translating algorithms (either implicitly known or taught during the course as pseudocode) into both a high-level programming language (Python) and a systems-level high-performance programming language (C). This course is broadly divided into three parts.

Part 1: Introduction to Python
Implementation, testing and debugging of elementary algorithms in Python involving operators and expressions, basic data types (integers, floats, Booleans, strings, lists), variables (references vs. objects), assignments, conditionals, iteration, functions, recursion, and modules.

Part 2: Basic Algorithms and Data Structures
Implementation of iterative algorithms (linear and binary search, string matching, iterative sorting algorithms, etc.) and recursive algorithms (exponentiation, recursive sorting, etc.). Introduction to asymptotic analysis. Big O notation. Recursive relations. Arrays versus Linked lists. Improving running times of algorithms using appropriate data structures such as hash tables, binary search trees, heaps, etc. Simple graph algorithms (shortest path, minimal spanning tree).

Part 3: Introduction to C
Differences between C and Python with respect to syntax and semantics (basic data types: integers, C arrays vs. Python lists, and strings; passing arguments to functions). Pointers and managing dynamic memory in C. Comparing the runtime performance of Python and C implementations of algorithms.

SUGGESTED BOOKS

1. How to Think Like a Computer Scientist: Interactive Edition, based on the book by Allan Downy and Jeff Elkner (https://runestone.academy/ns/books/published/thinkcspy/index.html)
2. How to Solve it by Computer by R.G. Dromey, Pearson Education, 2007
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India, 2009
4. Introduction to Programming in Python by Robert Sedgewick, Kevin Wayne, and Robert Dondero, 1st edition, 2015 (https://introcs.cs.princeton.edu/python/home/)
5. A Byte of Python by Swaroop CH (https://python.swaroopch.com/)
6. CPython implementation of binary heaps (https://github.com/python/cpython/blob/3.10/Lib/heapq.py)
7. Graphs and Graph Algorithms (https://runestone.academy/ns/books/published/pythonds3/Graphs/toctree.html)
8. An Introduction to Programming through C++ by Abhiram Ranade McGraw Hill, 1st edition, 2017
9. C for Python Programmers (https://realpython.com/c-for-python-programmers/)

Humanities (Mandatory)

Refer to Chapter 17 for details

UMA 101 (4:0): Analysis and Linear Algebra

Refer to Chapter 17 for the syllabus

Breadth Soft Core Courses:

UBL 101T (3:0): Introductory Biology I
UBL 101L (0:1): Introductory Biology I (Lab)

Refer to Chapter 17 for the syllabus

UCY 101T (3:0): Introductory Chemistry - I
UCY 101L (0:1): Introductory Chemistry - I

Refer to Chapter 17 for the syllabus

UPH 101T (3:0): Introductory Physics I
UPH101L(0:1): Introductory Physics I (Lab)

Refer Chapter-17 for the syllabus

SEMESTER 2 (JANUARY)

Core Courses:

UENG 102T (3:0): Introduction to Electrical and Electronics Engineering
UENG 102L (0:1): Introduction to Electrical and Electronics Engineering (Lab)

Instructor: Kaushik Basu

Circuit analysis: KVL, KCL, dependent voltage/current sources, series and parallel equivalent, mesh and nodal analysis, Norton and d Z À v]vq[v equivalent, network theorems (superposition, maximum power transfer, Tellegen, Millman etc.), Laplace transform, first and second order RLC circuit transient analysis, RLC circuit analysis in sinusoidal steady state using phasors, idea of complex impedance, active and reactive power, Fourier series, Bode plots and passive filters. P-N junction theory. Ideal diode, Zener diodes, rectifier, clipper and clamper circuits, Zener-based power supply. MOSFET device theory and derivation of circuit model. MOSFET DC biasing and large signal analysis, small signal analysis CE, CG, CC amplifiers, differential amplifier and source coupled pair, a three-stage differential amplifier. Biasing with MOSFETs, current mirror, cascode, source degeneration. Amplifiers at high frequency. Two stage CMOS Operational Amplifier. Ideal Op-Amp. Op-Amp nonidealities, gain bandwidth product. Op-Amp with negative feedback and applications such as instrumentation amplifier, active filters, and analog computers. Operational Amplifier with positive feedback and applications such as Schmidt trigger, multivibrator, Wein-Bridge oscillator. Sample and Hold, ADC, DAC circuits. Combinational logic functions and its implementation using Boolean algebra (AND/OR/NOT), sum of products, product of sums, reduction with Karnaugh maps. Binary arithmetic, ripple carry adder and multiplier circuits. Multiplexer, demultiplexer, decoder, encoders, and tri-state buffer. Logical sufficiency of NAND/NOR gates and their implementation with CMOS. Digital circuit design considerations: noise margin, propagation delay, fan-out, power loss. Sequential circuits with RS latch, D-, JK flipflops and metastability. Asynchronous and synchronous counters. Finite state machines and its implementation. Introduction to computer organization: microprocessors and microcontrollers.
Software: SPICE and Verilog/VHDL.

SUGGESTED BOOKS:

1. Electrical Engineering Principles and Applications, Allan R Hambley
2. Microelectronic Circuits: Theory And Applications, Sedra, Smith and Chandorkar
3. Fundamentals of digital logic with Verilog design, Stephen Brown and Jovonko Vranesic

Humanities

Refer to Chapter 17 for details

UMA 102 (4:0): Analysis and Linear Algebra II

Refer to Chapter 17 for the syllabus

UMC 102 (3:0): Introduction to Computer Systems

Instructor: Vinod Ganapathy and Sanchari Sen

Computer Programs as Instructions and Data; Instruction Execution; Representation of Data: Signed Integers, Reals; Program Execution: Function Call and Return, Memory Layout, Exceptions; Overview of System Software; Memory Hierarchy and Locality; Operating System Concepts: Process, Virtual Memory, Concurrency and Parallelism.

SUGGESTED BOOKS:

1. Computer Systems: A W Œ } P Œ Perspective, by Randal E Bryant and David R.K [, o o Pearson, 2015

UMC 103 (2:0)/UMC 103A (3:0): Discrete Mathematics

Instructor: C. Pandu Rangan

Mathematical Logic: Propositional logic: connectives, tautologies, and contradictions, logical equivalences, normal forms and applications. Predicates and quantifiers, interpretation and validity, proving validity, rules of inference.

Sets, Functions and Relations: Sets and cardinality, relations, functions, partial orders, total orders, linear orders, equivalence relations, partitions, n-ary relations.

Induction and Recursion: Induction, strong induction, well-ordering principle, recursive definitions and structural induction.

Basic Counting Principles: Pigeonhole principle, permutations and combinations, Binomial coefficients and identities, elementary applications to discrete probability, recurrence relations and equations, generating function techniques, principle of inclusion and exclusion and its applications.

Graph Theory: Graphs and graph models, basic notions and operations, matchings, Hall's marriage theorem, vertex and edge connectivity, Euler and Hamiltonian circuits, vertex coloring. Trees.

SUGGESTED BOOKS:

1. Kenneth H Rosen Discrete Mathematics and its Applications, McGraw-Hill (2012)
2. Winfield K Grassmann and Jean-Paul Tremblay: Logic and Discrete Mathematics: A Computer Science Perspective, Prentice-Hall (1996)
3. M. Ben-Ari: Mathematical Logic for Computer Science, 3rd edition, Springer (2012)
4. Eric Lehman, F Thomson Leighton, Albert R Meyer: Mathematics for Computer Science, (Open Edition 2013)

Breadth Soft Core Courses:

UBL 102T (3:0): Introductory Biology- II
UBL 102L (0:1): Introductory Biology- II (Lab)

Refer to Chapter 17 for the syllabus

UCY 102T (3:0): Introductory Chemistry- II
UCY 102L (0:1): Introductory Chemistry- II (Lab)

Refer to Chapter 17 for the syllabus

UENG 103 (3:0): Introduction to Earth and its Environment

Refer to Chapter 17 for the syllabus

UPH 102T (3:0): Introductory Physics II
UPH102L(0:1): Introductory Physics II (Lab)

Refer to Chapter 17 for the syllabus

SEMESTER 3 (AUGUST)

Core Courses:

Humanities
Refer to Chapter 17 for details

UMA 201 (4:0): Probability and Statistics
Refer to Chapter 17 for the syllabus

UMC 201 (3:1): Data Structures and Algorithms

Instructor: C. Pandu Rangan

Review of Basic Data Structures - Arrays, Linked Lists, Stacks, Queues. Asymptotic complexity functions. Standard Data Structures - Heaps, Balanced Search Trees. Algorithmic Paradigms - Divide and Conquer, Greedy, Dynamic Programming. Graph Algorithms - Traversals, Shortest Paths, Minimum Spanning Trees. Advanced Data Structures - Union Find, Hashing. Amortized analysis, Splay trees, Fibonacci trees.

SUGGESTED BOOKS:

1. Data Structures and Algorithm Analysis in C by Mark Allen Weiss, Second edition, 1997 (Pearson)
2. Algorithm Design by Kleinberg and Tardos, 2006 (Pearson)
3. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Fourth edition, 2022 (MIT Press)

UMC 202 (3:1): Introduction to Numerical Methods

Instructor: Ratikanta Behera

Numerical Solution of Algebraic and Transcendental Equations, Iterative Algorithms, Convergence, Newton Raphson Procedure, Solutions of Polynomial and Simultaneous Linear Equations, Gauss Method, Relaxation Procedure, Error Estimates, Numerical Integration, Euler-Maclaurin Formula. Newton-Cotes Formulae, Error Estimates, Gaussian Quadrature, Extensions to Multiple Integrals.

Numerical Integration of Ordinary Differential Equations Methods of Euler, Adams, Runge Kutta and Predictor Corrector Procedures, Stability of Solution. Solution of Stiff Equations.
Solution of Boundary Value Problems: Shooting Method with Least Square Convergence Criterion, Galerkin Method (Finite Element) Solution of Partial Differential Equations: Finite Difference Techniques, Stability and Convergence of the Solution, Finite Element Methods.

SUGGESTED BOOKS:

1. Richard L. Burden and J. Douglas Faires, Numerical Analysis: Theory and Applications, India Edition, Cengage Brooks Cole Publishers, 2010
2. Press, W. H., Teukolsky, S. A., Vetterling, W. T., and Flannery, B. P., Numerical Recipes in C/FORTRAN, Prentice Hall of India, New Delhi, 1994
3. Borse, G. J., Numerical Methods with MATLAB: A Resource for Scientists and Engineers, PWS Publishing Co., Boston, 1997
4. Conte, S.D. and Carl de Boor., Elementary Numerical Analysis, McGraw-Hill, 1980
5. Hildebrand, F. B., Introduction to Numerical Analysis, Tata McGraw-Hill, 1988
6. Froberg, C.E., Introduction to Numerical Analysis, Wiley, 1965

Breadth Soft Core Courses:

UBL 201T (3:0): Introductory Biology- III
UBL 201L (0:1): Introductory Biology- III (Lab)

Refer to Chapter 17 for the syllabus

UCY 201T (3:0): Introductory Chemistry- III
UCY 201L (0:1): Introductory Chemistry- III (Lab)

Refer to Chapter 17 for the syllabus

UENG 201 (3:0): Introduction to Materials Science

Refer to Chapter 17 for the syllabus

UPH201T (3:0): Introductory Physics- III
UPH201L(0:1): Introductory Physics- III (Lab)

Refer to Chapter 17 for the syllabus

SEMESTER 4 (JANUARY)

Core Courses:

Humanities

Refer to Chapter 17 for details

UM 204 (3:1): Introduction to Basic Analysis

Refer to Chapter 17 for the syllabus

UM 205 (3:1): Introduction to Algebraic Structures

Refer to Chapter 17 for the syllabus

UMC203 (3:1): Introduction to Artificial Intelligence and Machine Learning

Instructors: Aditya Gopalan and Shishir Kolathaya

Overview: Machine Learning Paradigms; Supervised, Unsupervised, and Reinforcement Learning. Supervised Learning: Bayes Classifier, Optimality; Risk Minimization; Generalisation Error Estimation. Perceptron, Logistic Regression, Least Squares, Regularization, Kernel Methods, SVMs, Multilayer Perceptrons, CNNs and Other Neural Network Models. Classifier Ensembles, Adaboost Algorithm. Unsupervised Learning: Generative Models, Parameter Estimation: Maximum Likelihood, Bayesian Methods; Latent Variables and EM Algorithm; Graphical Models, Deep Generative Models, Principal Component Analysis, Independent Component Analysis. Reinforcement Learning and Markov Decision Processes.

SUGGESTED BOOKS:

1. C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
2. S. Shalev-Shwartz and S. Ben-David, Understanding Machine Learning From Theory to Algorithms, Cambridge University Press, 2014
3. Kevin Murphy, Machine learning: A probabilistic perspective, 2012
4. T. Hastie, R. Tibshirani and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference and W Œ] Springer, 2009
5. A. Zhang, Z. C. Lipton, M. Li, A. J. Smola, Dive into Deep Learning, 2019 (free PDF available)
6. I. Goodfellow, Y. Bengio and A. Courville, Deep Learning, MIT Press, 2016

UMC 205 (3:1): Automata Theory and Computability

Instructor: ‰ l [^ } µ Ì

Finite-state automata: deterministic finite-state automata, pumping lemma, non-deterministc automata, regular expressions, Myhill-Nerode theorem, and ultimate periodicity.

Pushdown automata and context-free languages: Context-free grammars, Chomsky normal form, pumping lemma for CFLs, Parikh's semilinearity theorem, deterministic pushdown automata, equivalence of context free grammars and pushdown automata, pushdown systems and reachability, and complementing deterministic PDAs. Turing machines and undecidability: deterministic Turing machines, notion of computable functions using Turing machines, recursive and recursively enumerable languages, halting problem, reductions, Rice's theorems, undecidable problems related to context-free languages, and Godel's Incompleteness theorem.

Finite-State Automata, including the Myhill-E Œ } d Z } Œ u U h o š] u š W Œ] }]] š Ç U v Characterization. Pushdown Automata and Context-&t Œ > v P µ P • U / v o µ] v P š Œ u] v] • š] Theorem, and The Chomsky Z µ š Ì v Œ P Œ d Z } Œ u X d µ Œ] v P D Z] v • v h v] d Z } Œ u v ' } o [• / v } u ‰ o š v • • d Z } Œ u X

SUGGESTED BOOKS:

1. Dexter Kozen: Automata and Computability. Springer 1997.
2. Hopcroft J.E. and Ullman J.D.: Introduction to Automata, Languages and Computation. Addison Wesley, 1979.

SEMESTER 5 (AUGUST)

Core Courses:

Humanities

Refer to Chapter 7 for details

Soft Core/Electives Courses: 16 Credits (Please refer to the table of Soft Core courses)

UG Soft Core Courses:

UMC 301 (3:1) Applied Data Science and Artificial Intelligence

Instructor: Deepak Subramani

Data Science Fundamentals: Identifying and framing a data science problem in different fields; Different types of Analytics; Introduction to Machine Learning, Artificial Intelligence; Is MUAI the right tool for your problem?; Stakeholder Discussion Guidelines; End-to-end Problem Solving through a Step Data Science Process. Model selection for different data types. Assess the effectiveness of AI/ML models using A/B testing.

Exploratory Data Analysis: Visualizing data. Framing questions from data. Analyzing statistical relationships via Hypothesis Testing. How much data is sufficient data? Processing of data: Data Distributions, Imputation, Outlier handling.

Data Science for Tabular Data: CART Algorithm, Random Forest Models, Gradient Boosted Models (XGBoost, CatBoost, LightGBM), Feature Importance and Selection, Development Testing Paradigm. Cross Validation

Deep Learning for AI: A unified view of data-driven neural models for AI. From Linear Regression to Neural Networks, Basics of Stochastic Gradient Descent and Backpropagation, Hyperparameter Tuning, Different types of Layers, Neural models as data processing pipelines.

Computer Vision: Practical computer vision with Transfer Learning. Identifying key AI tasks in Computer Vision. Choosing the right model, applying it, and taking the models to production.

Natural Language Processing: Natural Language Processing with Bag of Words and sequence Transformer Models. BERT-class models for Natural Language Understanding tasks; GPT-class models for Natural Language Generation Tasks. LLMOps: Taking an NLP problem from scratch to production.

SUGGESTED BOOKS:

1. Aurelien Geron. Hands On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition. O'Reilly Media. / v 2022
2. F. Chollet. Deep Learning with Python. 2nd Edition. Manning 2021
3. Raschka, Sebastian, Yuxi Hayden Liu, Vahid Mirjalili, and Dmytro Dzhulgakov. Machine Learning with PyTorch and Scikit-Learn: Develop machine learning and deep learning models with P. Packt Publishing Ltd. 2022
4. Lakshmanan, Valliappa. Martin Gomer. and Ryan Gillard. Practical machine learning for computer vision. O'Reilly Media, / v 2021
5. Tunstall, Lewis, Leandro Von Werra. and Thomas Wolf. Natural language processing with transformers. O'Reilly Media, / v 2022

Note: For details of the other soft core and elective courses please refer to respective department websites.

SEMESTER 6 (JANUARY)

Core Courses:

Humanities

Refer to Chapter 7 for details

Soft Core/Electives Courses 16 Credits
(Please refer to the table of Soft Core/Electives courses)

SEMESTER 7 (AUGUST)

UMC401 ISP I (0:6)/ Soft Core/ Electives (6) + Soft Core/ Electives (6)

SEMESTER 8 (JANUARY)

- UMC402 ISP II (0:6)/ Soft Core/Electives Courses (6) + Electives (6) OR
- UMC403 Project (12)

Note: For Semesters 7 and 8 please refer to Section 3.6 for eligibility criteria for taking ISP I / ISP II / Project.

****

Abbreviations/Acronyms

Sl No.	Abbreviation	Full form
1	ADSER	Administrative Service Request
2	AI	Artificial Intelligence
3	B.Tech (M& C)	Bachelor of Technology (Mathematics and Computing)
4	BSc (Research)	Bachelor of Science (Research)
5	CGPA	Cumulative Grade Point Average
6	CMO	Chief Medical Officer
7	CoW	Council of Wardens
8	DBT	Direct Beneficiary Transfer
9	DCC	Departmental Curriculum Committee
10	DIGITS	Digital Campus and IT Services
11	DST	Department of Science and Technology
12	EntIISc	Entrepreneurship and Innovation at IISc'
13	EWS	Economically Weaker Section
14	ICASH	Internal Committee Against Sexual Harassment
15	ID Cards	Identification Document Cards
16	IIScP	Indian Institute of Science - Promotional Scheme
17	INR	Indian Rupee
18	INSPIRE (SHE)	Innovation in Science Pursuit for Inspired Research - Scholarship for Higher Education
19	M.Tech	Master of Technology
20	MSc	Master of Science
21	OBC	Other Backward Community
22	OCCaP	Office of Career Counselling and Placement
23	ODAA	Office of Development and Alumni Affairs
24	OIR	Office of International Relations
25	OoC	Office of Communications
26	PCC	Program Curriculum Committee
27	PDC	Provisional Degree Certificate
28	PwD	Persons with Disabilities
29	SAC	Student Affairs Committee
30	SAF	Students' Aid Fund
31	SAP	Systems Applications and Products in Data Processing
32	SC	Schedule Caste
33	SC	Students' Council
34	SCC	Senate Curriculum Committee
35	SERC	Supercomputing Education and Research Centre
36	SHCC	Sexual Harassment Complaint Committee
37	SLCM	Student Life Cycle Management
38	SOLMAN	SAP Solution Manager
39	ST	Schedule Tribe
40	TGPA	Term Grade Point Average
41	UG BoS	Undergraduate Programs Board of Studies Committee
42	UGSCC	Undergraduate Senate Curriculum Committee

INTERNSHIP/COLLABORATIVE RESEARCH/ CR WORK/ ISP/ PROJECT FORM OUTSIDE IISc FOR UNDERGRADUATE PROGRAMS

Name of the Student: S. R. No: Batch:	Mr/Ms.
Program: Discipline/Major:	☐B.Sc (Research) ☐Master of Science ☐B.Tech ☐M.Tech
Semester: Completed Credits :	CGPA : Pending credits for degree requirement :
Request for (Choose the appropriate option)	☐Internship ☐CR Work ☐ISP ☐Project
Name and Department of the Faculty Advisor/Project Guide(s) from IISc	
Details about the Internship / CR Work / ISP / Project Name of the University / Company: Name of the Laboratory: Place : Name of the guide/ collaborator from the visiting University : Period of Internship/Project (DD/MM/YYYY):	From: ____ /____ /_____ To: ____ / ____ / _____
Are you paid during the Internship period?	☐Yes ☐No (If yes, Amount_____)

Mandatory documents to be attached to the form as a single PDF file in the same order:

- ☐ The acceptance/Invitation from the sponsoring University
- ☐ Recommendation letter from the Research Mentor/ Advisor/ Guide(s)
- ☐ Recommendation letter from the discipline coordinator/ DPCC Chair

Undertaking

I understand that if I am selected for the internship/project, I will apply for internship on SAP and will commence the internship/project work only after the leave has been formally approved.

Declaration

I hereby declare that all entries in this form, as well as the information provided in the attac documents, are true to the best of my knowledge and belief.

Date: Signature of the Student

FOR OFFICE USE ONLY
Remarks by UG Office Name: Date: Signature of the caseworker
Remarks by the Associate Dean
Date: Signature of the Associate Dean
Approval of the Dean
Date: Signature of the Dean UG

Note: For Procedure refer Section 5.12 of Student Information Handbook.

(Refer Section 5.3)

LATE COURSE REGISTRATION FORM
FOR UNDERGRADUATE PROGRAMS

Date:

Name ofthe student:

SR No: Batch:

Program:

Major: Minor (If Applicable) :

Sl No	Course Code	Course title	Course Credits	Course Type	Name of the Course instructor	Instructor Signature

Signature of the student

Signature of the Project Advisor (if applicable)
Name of the project Advisor:

Department:

Signature of the Coordinator/PCC
Name of the Co Ordinator:

Department:

REQUEST FOR APPROVAL FOR NO OBJECTION CERTIFICATE/ FINANCIAL ASSISTANCE TO ATTEND CONFERENCE FOR UNDERGRADUATE PROGRAMS

1	Name of the Student: S. R. No: Batch:	Mr./Ms.
2	Program: Discipline/Major:	☐B.Sc (Research) ☐Master of Science ☐B.Tech ☐M.Tech
3	Semester: Total credits completed: CGPA:	☐7th ☐8th ☐9th ☐10th
4	Name of the Conference: Period of the Conference (DD/MM/YYYY): Place of the Conference:	From: ___ /___ /_____ To: ___ /___ /_____
5	Paper Presentation Details Title of Paper: Presentation: ☐Poster ☐Oral Are you the first author of the paper? ☐Yes ☐ No Name of the Authors (as mentioned in the paper):	
6	Name and Department of the Research Mentor/ Advisor/ Guide(s) from IISc	
7	Approval requested for (Choose the appropriate option or both)	☐No Objection Certificate (NOC): Leave from ___/___/_____ to___/___/_____ ☐Financial Assistance
8	If you have previously availed financial assista from any of the following sources, select t appropriate option(s)	☐ GARP ☐ ODAA ☐None of the above
9	If financial assistance is requested for t conference, please specify the source (Choose appropriate option or both)	☐ GARP ☐ ODAA Total estimated amount: Rs.
10	Are you availing financial assistance for this conference from any other source? If yes, plea provide source and amount details.	☐Yes ☐No
11	Check list of mandatory documents to be attached to the form as a single PDF file, in the following or ☐ Final Conference Program/Brochure. ☐ The acceptance/Invitation from the conference organisers. ☐ The full paper with all authors' names and affiliations. ☐ Recommendation letter from the Research Mentor/ Advisor/ Guide(s). ☐ Recommendation letter from the discipline coordinator/ PCC Chair.	

Undertaking: I hereby undertake that I shall apply for study/travel leave on SAP and shall commence the journ only upon receipt of formal approval.

Declaration: I hereby declare that all entries in this form, as well as the information provided in the attached documents, are true to the best of my knowledge and belief. I undertake to abide by the rules and regulations set forth by the Institute.

Date: Signature of the Student

FOR OFFICE USE ONLY

Remarks by UG Office

Name: Date: Signature of the casewo

Remarks by the Associate Dean

Date: Signature of the Associate Dean

Recommendation of the Dean

NOC : Approved Not Approved Not Applicable

Financial Assistance through

GARP: Recommended (up to Rs. 25,000) Not Recommended Not Applicable

ODAA Grant: Recommended (up to Rs.) Not Recommended Not Applica

Recommended ODAA Fund:

Remarks:

Date:	Signature of the Dean UG
Approval of the Dean (A & F) for Financial Assistance through GARP	
Date:	Signature of the Dean (A & F)

Note: For eligibility requirements, procedures, and regulations, please refer to Section 7.5 of the Student Information Handbook.