Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY210a (Modular)

Course title: Thermal Physics

Pre-requisite(s):

Credits: 3-1-0-0-[6]

Semester: Even

Department/IDP: Physics

Instructor(s): A. Dutta

Course contents:

A phenomenological introduction to Thermodynamics as a macroscopic physics, Intensive and extensive variables, Concepts of equilibrium, Laws of Thermodynamics, Entropy and Energy representation, Euler equation, Gibbs-Duhem relation, Thermodynamics of ideal and van der Waals gases and ideal magnetic systems, Reversible processes, Maximum work theorem, Carnot cycles: Engine and Refrigerator, Different thermodynamic potentials, Enthalpy and Joule-Thomson Effect, Stability of thermodynamic systems and ideas of phase transitions, Elementary kinetic theory, Maxwell Velocity Distribution, Viscosity, Thermal conductivity and Diffusion.

Recommended books:

H. B. Callen*, Thermodynamics and an introduction to Thermostatics* (Wiley)

M. W. Zemansky and Richard H. Dittman, *Heat and Thermodynamics* (Tata McGraw-Hill Education)

F. Reif, *Fundamental of Statistical and Thermal Physics* (Levant Books)

D. Chowdhury and D. Stauffer, *Principles of equilibrium statistical Mechanics* (Wiley)

Estimated student enrolment: 50

Departments to which the proposed course will be of interest: MSE, ME, AE, CHE

Other faculty members interested in teaching the proposed course: D. Chowdhury, S. Mukherjee

V. Subrahmanyam, Anjan K. Gupta, Krishnacharya

Any other remarks: This is a compulsory (modular) course for the Physics (BS) students.

Dated:_____ Proposer: A. Dutta

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY224

Course title: Optics

Pre-requisite(s):

Credits: 2-0-0-2-[12]

Semester: Odd

Department/IDP: Physics

Instructor(s): R. Vijaya

Course contents:

Review of Maxwell's equations, Wave equation, Fresnel's equations, States of polarization and index ellipsoid, Two- and multiple- beam interference, Michelson interferometer, Fabry-Pérot interferometer, Multilayer thin films for anti- and high-reflection, Fraunhofer diffraction and diffraction grating, Coherence properties of light.

List of experiments:
1. Preparation lab –I, II
2. Verification of Fresnel's equations
3. General polarimetry
4. Birefringence
5. 2-slit and N-slit interference
6. Michelson interferometer
7. Fabry-Perot interferometer
8. Diffraction - single-slit, wire and Babinet principle
9. Diffraction grating
10. Spatial / temporal coherence
11. Individual appreciation experiment in Optics (One experiment to be designed and performed by each student anytime during the semester (eg: holography, spectroscopy, wedge plate, Fresnel lens (zone plate), Arago spot, fiber optics etc.)

Recommended books:

M. Born and E. Wolf*, Principles of Optics* (Cambridge Univ Press)

J. B. Peatross and M. Ware, *Physics of Light and Optics*

F. L. Pedrotti, L. M. Pedrotti and L. S. Pedrotti: *Introduction to Optics* (Pearson International Edition)

A. Ghatak*, Optics* (Tata McGraw-Hill)

E. Hecht*, Optics (*Addison-Wesley*)*

K. K. Sharma, *Optics: Principles* and *Applications* (Academic Press)

Estimated student enrolment: 30

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: S. A. Ramakrishnan, H. Wanare, A. Pradhan, R. Gupta

Any other remarks: This is a compulsory course for the Physics (BS) students.

Dated:_____ Proposer: R. Vijaya

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY226b (Modular)

Course title: Relativity

Pre-requisite(s):

Credits: 3-1-0-0-[6]

Semester: Even

Department/IDP: Physics

Instructor(s): T. Sarkar

Course contents:

Special Relativity, Empirical evidence for the constancy of c, Frames of reference, Lorentz transformations, Relativity of simultaneity, Twin and other paradoxes, Space-time diagrams Transformation laws for velocity, Momentum, energy, mass-energy equivalence, 4-vectors, Force equations, Kinematics of decays and collisions Maxwell's equations in covariant form.

Recommended books:

R. Resnick, *Introduction to Special Relativity* (Wiley)

D. Kleppner and R. Kolenkow, *An Introduction to Mechanics* (Tata McGraw-Hill Education)

Estimated student enrolment: 50

Departments to which the proposed course will be of interest: MSE, ME, AE, CHE

Other faculty members interested in teaching the proposed course: D. Chowdhury, D. Sahdev, H. C. Verma, Krishnacharya

Any other remarks: This is a compulsory (modular) course for the Physics (BS) students.

Dated:_____ Proposer: T. Sarkar

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY315

Course title: Modern Physics Lab

Pre-requisite(s):

Credits: 1-0-0-2-[7]

Semester: Odd

Department/IDP: Physics

Instructor(s): A. K. Gupta

Course contents:

The experiments determine some of the fundamental constants (Planck constant, e/m of electron, gravitational constant, Rydberg constant, Boltzmann constant) or quantitatively demonstrate some of the concepts (quantum analog, Single photon interference) and applications (Thermionic emission, Solar Cells) of quantum physics. Also there are experiments that illustrate applications of thermodynamics (Johnson Noise, thermoelectric effect and Peltier effect), and non-linear dynamics (chaos). The lectures consist of introduction to error analysis and essential tools of modern experiments (vacuum and low temperatures), discussion of experiments leading to quantum mechanics and a brief introduction to other experiments carried out in the lab.

Recommended books:

A.C. Melissinos and J. Napolitano, *Experiments in Modern Physics*, 2nd ed. (Academic Press)

D.W. Preston, *Experiments in Physics* (Wiley)

Resource Files on Experiments maintained in the Laboratory

P. R. Bevington, *Data Reduction and Error Analysis for Physical Sciences* (McGraw Hill)

Estimated student enrolment: 30

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: K. P. Rajeev, R. Gupta, S. Banerjee, Krishnacharya

Any other remarks: This is a compulsory course for the Physics (BS) students.

Dated:_____ Proposer: A. K. Gupta

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY401

Course title: Classical Mechanics

Pre-requisite(s):

Credits: 3-1-0-0-[11]

Semester: Odd

Department/IDP: Physics

Instructor(s): M. K. Verma

Course contents:

Review of Newtonian mechanics: basic assumption, Constraints, Principle of virtual work, D'Alembert's principle, Generalized coordinates, Calculus of variations, Principle of least action, Lagrange's equation, Symmetries and Noether's theorem, Hamilton's equations, Phase space & phase trajectories, Liuviulle's theorem, Small oscillations, Normal modes, Anharmonic and nonlinear oscillators, Nonlinear dynamics, Chaos (Hamiltonian systems in dissipative systems), Illustrations using Duffing oscillator, Double pendulum, Three body problem etc., Continuum mechanics, Waves in continuous media, Navier-Stokes Eqn., Pressure waves, Canonical transformations, Poisson brackets, Hamilton-Jacobi theory, Action-angle variables, Rigid body dynamics.

Recommended books:

L. D. Landau and E. M. Lisfsitz, *Mechanics, Courses of Theoretical Physics* (Pergamon)

H. Goldstein, C. P. Poole, and J. L. Safko, *Classical Mechanics* (Addison Wesley)

H. C. Corben and P. Stehle, *Classical Mechanics* (Dover)

T. W. B. Kibble, *Classical Mechanics* (Addison Wesley)

H. Strogatz, *Nonlinear Dynamics and Chaos* (Levant, Indian Ed.)

Software packages for chaos, Java for chaos: free for all platforms

Estimated student enrolment: 100

Departments to which the proposed course will be of interest: AE, ME

Other faculty members interested in teaching the proposed course: M. K. Harbola, H. C. Verma, A. Dutta, T. Sarkar

Any other remarks: This is a compulsory course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: M. K. Verma

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY412

Course title: Statistical Mechanics

Pre-requisite(s):

Credits: 3-1-0-0-[11]

Semester: Even

Department/IDP: Physics

Instructor(s): V. Subrahmanyam

Course contents:

Review of Thermodynamics, Probability Theory, Random Walk, Brownian Motion, Diffusion Equation, Idea of Langevin and Fokker-Planck Equations, Basic principles of Equilibrium Classical Statistical Mechanics, Micro Canonical, Canonical and Grand Canonical ensembles, Quantum Statistical Mechanics, Density Matrix, Ideal Quantum Gases and their properties, Bose-Einstein Condensation, Free Electron gas, Ising Model of Magnetism, Transfer Matrix method, Mean Field Theory, Phase Transitions, Curie-Weiss theory, Landau Theory, Scaling near a Critical Point.

Recommended books:

F. Reif, *Fundamentals of Statistical and Thermal Physics* (Levant Books)

K. Huang, *Statistical Mechanics* (Wiley)

R. K. Pathria, *Statistical Mechanics* (Elsevier India Pvt. Ltd.)

L. D. Landau and E. M. Lisfsitz, *Statistical Physics* (Butterworth-Heinemann)

S. K. Ma, *Statistical Mechanics* (World Scientific Publishing Company)

D. Chowdhury and D. Stauffer, *Principles of Equilibrium Statistical Mechanics* (Wiley)

Estimated student enrolment: 100

Departments to which the proposed course will be of interest: MSE, CHE, CHM

Other faculty members interested in teaching the proposed course: D. Chowdhury, A. Dutta, S. Mukherjee

Any other remarks: This is a compulsory course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: V. Subrahmanyam

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY421

Course title: Mathematical Methods I

Pre-requisite(s):

Credits: 3-1-0-0-[11]

Semester: Odd

Department/IDP: Physics

Instructor(s): T. Sarkar

Course contents:

General introduction to Tensors, Transformation properties of covariant, Contravariant and mixed tensors, Raising and lowering of indices, The Kronecker delta and the Levi-Civita tensor, Functions of a complex variable, Differentiation and the Cauchy-Riemann conditions, Contour integrals and Cauchy's theorem, Cauchy's integral formula, Taylor and Laurent series, The residue theorem, Fourier transforms and the inversion theorem, Fourier transform of derivaties, Laplace transforms: simple examples, Use of Fourier and Laplace transforms in solving differential equations, Ordinary differential equations, Homogeneous and inhomogeneous cases, The Wronskian method, Singular points and solutions of ODEs in the vicinity of singular points and series solutions, Illustration with simple examples, Basic introduction to Sturn-Liouville theory, Classification of partial differential equations, General method of solution in two dimensions, Simple examples illustrating boundary conditions.

Recommended books:

S. D. Joglekar, *Mathematical Physics Vol I & II* (Universities Press)

Estimated student enrolment: 100

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: T. K. Ghosh, K. Bhattacharya, S. Mukherjee

Any other remarks: This is a compulsory course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: T. Sarkar

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY431

Course title: Quantum Mechanics

Pre-requisite(s):

Credits: 3-1-0-0-[11]

Semester: Odd

Department/IDP: Physics

Instructor(s): A. Singh

Course contents:

Origins of Quantum Theory, Schroedinger Equation, Application to One-Dimensional Problems, WKB Approximation, Central Potentials, Quantum Harmonic Oscillator, Hydrogen Atom, Hilbert Space Formalism for Quantum Mechanics, Symmetries in Quantum Mechanics, Angular Momentum, Addition of Angular Momenta, Identical Particles, Spin and Statistics, Pauli Exclusion Principle, Variational Method, Applications to Helium Atom and Hydrogen Molecule Ion**.**

Recommended books:

J. L. Powell and B. Crasemann, *Quantum Mechanics* (Narosa)

R. P. Feynman, *The Feynman Lectures on Physics vol. III* (Pearson)

E. Merzbacher, *Quantum Mechanics* (Wiley)

S. Gasiorowicz, *Quantum Physics* (Wiley)

L. I. Schiff, *Quantum Mechanics* (Tata McGraw-Hill)

J. J. Sakurai, *Modern Quantum Mechanics* (Pearson)

L. D. Landau and E. M. Lifshitz, *Quantum Mechanics* (Elsevier)

C. Cohen-Tannoudji, *Quantum Mechanics* (Wiley)

D. J. Griffiths, *Introduction to Quantum Mechanics* (Pearson)

Estimated student enrolment: 100

Departments to which the proposed course will be of interest: EE, MSE, CSE, CHM

Other faculty members interested in teaching the proposed course: K. Bhattacharya, D. Chakrabarti, A. Agrawal, T. K. Ghosh, Krishnacharya

Any other remarks: This is a compulsory course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: A. Singh

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY461

Course title: Experimental Physics I

Pre-requisite(s):

Credits: 0-0-0-2-[8]

Semester: Both

Department/IDP: Physics

Instructor(s): Y. N. Mohapatra

Course contents:

The laboratory will provide experimental set-up for more than approximately 40 different experiments (condensed matter physics, optical techniques, nuclear physics) of which at least six are compulsory for a student to complete. The list of experiments are provided in the regularly updated Laboratory Manual maintained by the Department of Physics. The experiments will be a judicious mix involving different techniques and specialties.

Recommended books:

A.C. Melissinos and J. Napolitano, *Experiments in Modern Physics, 2nd ed.* (Academic Press)

Resource Files on Experiments maintained in the Laboratory.

P. R. Bevington, *Data Reduction and Error Analysis for Physical Sciences* (McGraw Hill)

Estimated student enrolment: 80

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: Z. Hossain, A. Pradhan, R. Gupta, S. Banerjee, Krishnacharya

Any other remarks: This is a compulsory course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: Y. N. Mohapatra

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY473

Course title: Computational Methods and Numerical Analysis

Pre-requisite(s):

Credits: 2-0-0-1-[8] (Lab is of two-hour duration)

Semester: Odd

Department/IDP: Physics

Instructor(s): S. A. Ramakrishnan

Course contents:

Numerical errors, Error propagation, Time and complexity of programming, Solutions of linear systems of equations, Gauss elimination methods, Pivoting and LU decomposition, Eigenvalue problems, Power and inverse power methods, Jacobi rotations and Householder method, Interpolation methods, Finite differences, Spline interpolation, Gaussian quadratures and Orthogonal Polynomials Numerical differentiation and numerical integration using quadratures, Richardson extrapolation, Root solving for algebraic equations and polynomials, Bisection, Secant and Newton-Raphson methods, Integration of Ordinary Differential equations, Initial value problems, Runge-Kutta methods, Predictor corrector methods and Extrapolative methods, Two point boundary value problems, Shooting and relaxation methods, Introduction to numerical solution of partial differential equations with simple boundary conditions: Diffusion/ Laplace/ Schrödinger equations.

Recommended books:

A. Ralston and P. Rabinowitz, *First course on numerical analysis* (McGraw Hill)

W.H. Press, S.A. Teukolsky, W.T. Vetterling and B.P. Flannery, *Numerical recipes in FORTRAN /C /C++ : The art of Scientific computing* (Cambridge University Press, Indian Edition)

J. H. Ferziger and M. Peric, *Computational Methods for Fluid Dynamics* (Springer)

J.M. Thijssen, *Computational Physics* (Cambridge Univ. Press)

H. Gould, J. Tobochnik and W. Christian, *Introduction to Computer Simulation Methods* (Addison-Wesley)

Estimated student enrolment: 80

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: S. Bhattacharjee, M. K. Verma, D. Chakrabarti, R. Prasad, M. K. Harbola

Any other remarks: This is a compulsory course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: S. A. Ramakrishnan

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY552

Course title: Classical Electrodynamics I

Pre-requisite(s):

Credits: 3-1-0-0-[11]

Semester: Odd

Department/IDP: Physics

Instructor(s): P. Jain

Course contents:

Electrostatics, Laplace and Poisson equations and their solutions, Uniqueness theorem, Multipole expansion Magnetostatics: Boundary-value problems involving dielectrics and magnetic materials, Maxwell's equations, Electromagnetic waves in medium, Poynting's theorem, Momentum and angular momentum of electromagnetic fields, Electromagnetic radiation, Retarded potentials, Lorentz and Coulomb gauge (relativistic transformation of electric and magnetic fields)

Recommended books:

R. W. Christy, J. R. Reitz, F. J. Milford, *Foundations of electromagnetic theory* (Pearson)

D. J. Griffiths, *Introduction to Electrodynamics* (PHI Learning)

J. D. Jackson, *Classical Electrodynamics* (Wiley)

Estimated student enrolment: 100

Departments to which the proposed course will be of interest: EE

Other faculty members interested in teaching the proposed course: M. K. Harbola, R. Vijaya, S. Bhattacharjee

Any other remarks: This is a compulsory course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: P. Jain

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY555,PHY556,PHY557,PHY558

Course title: BS Projects

Pre-requisite(s):

Credits: 3-1-0-0-[09]

9 credit for each of the course.

Semester: Both

Department/IDP: Physics

Instructor(s): A. Singh

Course contents:

Student has to carry out work on a well formulated and open-ended problem with physics content to serve as initiation to research. The projects can be experimental, theoretical, computational, or a suitable combination thereof.

Recommended books:

Estimated student enrolment: 10

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: Any faculty member of the department can float a project appropriate to for a BS students.

Any other remarks: This is an elective course for the Physics (BS) students.

Dated:_____ Proposer: A. Singh

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY206

Course title: Order and Chaos

Pre-requisite(s):

Credits: 3-0-0-0-[9]

Semester: Even

Department/IDP: Physics

Instructor(s): M. K. Verma

Course contents:

Dynamical systems, Importance of nonlinearity, Nonlinear dynamics of flows (in 1, 2 and 3 dimensions) and maps (in 1, 2 dimensions) in phase space (equilibrium, periodicity, bifurcation, catastrophe, deterministic chaos, strange attractor), Routes to chaos (period doubling, quasiperiodicity/intermittency, universality, renormalization), Measurement of chaos (Poincaré section, Lyapunov index, entropy), Fractal geometry and fractal dimension, Examples from physical sciences, engineering and biology.

Recommended books:

H. Strogatz, *Nonlinear Dynamics and Chaos* (Levant Books)

J. Argyris, G. Faust, M. Hasse, *An Exploration of Chaos* (Elsevier)

Estimated student enrolment: 100

Departments to which the proposed course will be of interest: ME,AE

Other faculty members interested in teaching the proposed course: S. Chakraborty, P. Wahi (ME), S. Das (ME), K. Srihari (CHM)

Any other remarks: This is an elective course for the Physics (BS) students. This course is an open elective

for students of the other departments.

Dated:_____ Proposer:

M. K. Verma

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY407

Course title: General Relativity

Pre-requisite(s): PHY226b or equivalent

Credits: 3-0-0-0-[9]

Semester: Odd

Department/IDP: Physics

Instructor(s): T. Sarkar

Course contents:

Review of Special Relativity, Representations of the Lorentz group and SL(2,C), 4-vectors & 4-tensors, Introduction to General Relativity, Principle of Equivalence, Mach's principle, Riemannian geometry, Metric tensors, Christoffel symbols, Covariant differentiation, The curvature and stress-energy tensors, Conservation laws in curved space-time, The gravitational field equations, Geodesics and particle trajectories, The Schwarzchild solution, Black hole & horizon, The classic experimental tests of GR, Basic cosmology, FRW metric, Cosmological expansion, Cosmic microwave background, Helium abundance, Anisotropies in the CMBR.

Recommended books:

L. D. Landau and E. M. Lifshitz, *The Classical Theory of Fields* (Butterworth-Heinemann)

J. V. Narlikar, *General Relativity and Cosmology* (Macmillan)

S. Carroll, *Space and Geometry: An Introduction to General Relativity* (Addison-Wesley)

Estimated student enrolment: 50

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: G. Sengupta, K. Bhattacharya, D. Sehdev

Any other remarks: This is an elective course for the Physics (BS) students.

Elective course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: T. Sarkar

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY422

Course title: Mathematical Methods II

Pre-requisite(s): PHY421

Credits: 3-1-0-0-[11]

Semester: Even

Department/IDP: Physics

Instructor(s): T. Sarkar

Course contents:

Groups and their representations, Discrete and Lie Groups, Theory of Partial differential equations, Special functions, Green's functions, Function spaces, Hilbert spaces, Orthogonal expansions, Operators in infinite dimensional spaces.

Recommended books:

S. D. Joglekar, *Mathematical Physics Vol I & II* (Universities Press)

Estimated student enrolment: 80

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: D. Chakrabarty, H. Wanare, M. K. Verma, K. Bhattacharya, R. Prasad

Any other remarks: This is an elective course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and elective for M.Sc-PhD dual degree students.

Dated:_____ Proposer: T. Sarkar

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY432

Course title: Quantum Mechanics II

Pre-requisite(s): PHY431

Credits: 3-1-0-0-[11]

Semester: Even

Department/IDP: Physics

Instructor(s): A. Singh

Course contents:

Bound State Perturbation Theory, Time-Dependent Perturbation Theory, Semiclassical Treatment of Radiation, Scattering Theory, Relativistic Wave Equations, Foundational Issues in Quantum Mechanics, Quantum Computation.

Recommended books:

J. L. Powell and B. Crasemann, *Quantum Mechanics* (Narosa)

R. P. Feynman, *The Feynman Lectures on Physics vol. III* (Pearson)

E. Merzbacher, *Quantum Mechanics* (Wiley)

S. Gasiorowicz, *Quantum Physics* (Wiley)

L. I. Schiff, *Quantum Mechanics* (Tata McGraw-Hill)

J. J. Sakurai, *Modern Quantum Mechanics* (Pearson)

L. D. Landau and E. M. Lifshitz, *Quantum Mechanics* (Elsevier)

C. Cohen-Tannoudji, *Quantum Mechanics* (Wiley)

D. J. Griffiths, *Introduction to Quantum Mechanics* (Pearson)

Estimated student enrolment: 80

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: K. Bhattacharya, D. Chakrabarti, V. Subrahmanyam

Any other remarks: This is an elective course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: A. Singh

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY441

Course title: Electronics

Pre-requisite(s):

Credits: 2-1-0-1-[11]

Semester: Odd

Department/IDP: Physics

Instructor(s): K. P. Rajeev

Course contents:

Review of network theorems and network analysis. Opamp characteristics & limitations. Negative feedback and applications of opamps such as amplifiers, current sources, filters. Extending the capability of opamps by combining them with discrete devices and other IC's. Voltage regulators, Positive feedback, Schmitt triggers and oscillators. Gates, Flip-flops, Counters, Timers: applications such as water level sensors, Oscillators. Microcontrollers: Assembly Language Programming and a few illustrative applications such as controlling Diwali lights, stepper motors etc.

List of experiments:

1. Basics and introduction to the lab
2. OpAmps I: (amplifier & negative feedback)
3. OpAmps II: (limitations & applications)
4. Interfacing OpAmps with diodes: (clamp, rectifier, power supply)
5. Interfacing OpAmps with transistors I: (amplifiers)
6. Interfacing OpAmps with transistors II: (Schmitt trigger, oscillator, MOSFET)
7. Digital electronics I (logic gates)
8. Digital electronics 2 (flip-flops)
9. Microcontroller I: (basic feature)
10. Microcontroller II: (applications)
11. Microcontroller III: (stepper motor controller)

Recommended books:

"The art of electronics" by P. Horowitz and W. Hill

"Student Manual for The Art of Electronics" by T. C. Hayes and P. Horowitz

"Op-Amps and linear integrated circuits" by R.A. Gayakwad "Digital fundamentals" by T. L. Floyd

"Digital computer electronics" by A.P. Malvino and J.A. Brown

"The 8051 Microcontroller: architecture, programming and applications" by K. J. Ayala

Estimated student enrolment: 70

Departments to which the proposed course will be of interest: EE, LTP

Other faculty members interested in teaching the proposed course: Krishnacharya, H. C. Verma, S. Bhattacharjee, A. K. Gupta

Any other remarks: This is an elective course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: K. P. Rajeev

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY462

Course title: Experimental Physics II

Pre-requisite(s):

Credits: 0-0-0-2-[8]

Semester: Both

Department/IDP: Physics

Instructor(s): Y. N. Mohapatra

Course contents:

The laboratory will provide experimental set-up for more than approximately 40 different experiments (condensed matter physics, optical techniques, nuclear physics) of which at least six are compulsory for a student to complete. The list of experiments are provided in the regularly updated Laboratory Manual maintained by the Department of Physics. The experiments will be a judicious mix involving different techniques and specialties.

Recommended books:

A.C. Melissinos and J. Napolitano, *Experiments in Modern Physics, 2nd ed.* (Academic Press)

Resource Files on Experiments maintained in the Laboratory.

P. R. Bevington, *Data Reduction and Error Analysis for Physical Sciences* (McGraw Hill)

Estimated student enrolment: 70

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: Z. Hossain, A. Pradhan, R. Gupta, S. Banerjee, Krishnacharya

Any other remarks: This is an elective course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: Y. N. Mohapatra

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY524

Course title: Atomic, Molecular and Optical Physics

Pre-requisite(s): PHY432

Credits: 3-1-0-0-[11]

Semester: Even

Department/IDP: Physics

Instructor(s): T. K. Ghosh

Course contents:

Atomic structure: Review of one-electron atoms, Fine structure and Hyperfine structure, Spectral consequences of fine structure, Stark and Zeeman shifts, Interaction of One-electron atoms with EM Radiation**,** Transition rates, Dipole approximation, The Einstein coefficients, Selection rules and spectrum of one-electron atoms, Line intensities and lifetime of the excited states, Line shapes and widths, Photoelectric effect, Atom-light Hamiltonian, Density matrix, Optical Bloch equations, Electromagnetically Induced Transparency (EIT) and three-level effects, Many-electron Atoms: Electron-electron interactions, Helium energy levels, Exchange interaction, Thomas-Fermi model, Hartree-Fock method, Coupled angular momentum, Molecular structure: Van der Waals and Covalance Bond, Rotational and Vibrational spectroscopy, Molecular electronic spectra, Experimental probes Raman and Infrared spectroscopy, Selection rules, Molecular symmetries and their consequences. Special Topic: (one of the topics will be discussed) Atomic Bose-Einstein condensate/Non-linear optics/Nanomaterials/Quantum Dots and quantum Wells/Carbon cluster

Recommended books:

G. K. Woodgate, *Elementary atomic structure* (Claredon Press).

B. H. Bransden and C. J. Joachain, *Physics of Atoms and Molecules* (Pearson)

M. Karplus, *Atoms and Molecules* (Benjamin-Cumming Pub. Co.)

Estimated student enrolment: 80

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: H. Wanare, M. K. Harbola, H. C. Verma, S. Ghosh

Any other remarks: This is an elective course for the Physics (BS) students.

Elective course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: T. K. Ghosh

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY526

Course title: Nuclear and Particle Physics

Pre-requisite(s): PHY432

Credits: 3-1-0-0-[11]

Semester: Even

Department/IDP: Physics

Instructor(s): P. Jain

Course contents:

Nuclear Physics: General properties of nuclei, Nuclear two body problem, Nuclear force and nuclear models, Nuclear decay, Nuclear reaction kinematics, Scattering and reaction cross section, Optical Model, Classification of nuclear reactions (compound nuclear, direct etc), Breit-Wigner resonance formula, Nuclear fission and fusion. Particle Physics: Natural Units, Evidence for four fundamental interactions, Leptons and hadrons, Historical introduction to the particle zoo, Introduction to cross sections and decay rates, Particle accelerators and detectors, Invariance principles and conservation laws, Experimental tests of parity, Charge conjugation, Time reversal and CP, Isospin, Strangeness.

Recommended books:

I. Kaplan, *Nuclear Physics* (Narosa)

K. S. Krane, *Introduction to Nuclear Physics* (Wiley)

D. H. Perkins, *Introduction to High Energy Physics* (Cambridge University Press)

Estimated student enrolment: 80

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: D. Sahdev, D. Chakrabarty, K. Bhattacharjee, H. C. Verma

Any other remarks: This is an elective course for the Physics (BS) students.

Elective course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: P. Jain

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY543

Course title: Condensed Matter Physics

Pre-requisite(s): PHY432

Credits: 3-1-0-0-[11]

Semester: Odd

Department/IDP: Physics

Instructor(s): R. Prasad

Course contents:

Free electron theory, Heat capacity, Transport properties, Hall effect, Elementary concepts of quantum Hall effect, Quantization of conductance in a metallic nanowire, Structure and scattering, Crystalline solids, Liquids and liquid crystals, Nanostructures, Buckyballs, Energy band theory, Bloch's theorem, Nearly-free electron model, Tight-binding model, Application to graphene and nanotubes, Semi-classical dynamics, Notion of an electron in a DC electric field, Effective mass, Holes, Crystal binding, Types of solids, van der Waals solids, Ionic and covalent solids, Metals, Phonons and heat capacity, Lattice vibrations, Adiabatic & harmonic approximations, Vibrations of mono and diatomic lattices, Lattice heat capacity, Einstein and Debye models, Semiconductors: intrinsic & extrinsic semiconductors, Laws of mass action, Electron & hole mobilities, Impurity levels, p-n junctions, Superconductivity: experimental survey, Meissner effect, London's equation, BCS theory, Ginzburg- Landau theory, Flux quantization, Magnetism: exchange interaction, Diamagnetism, Paramagnetism, Ferromagnetism & anti-ferromagnetism, Hund's rules, Pauli paramagnetism, Heisenberg model, Mean field theory, Spin waves, RKKY interaction, Giant and colossal magnetoresistance.

Recommended books:

C. Kittel, *Introduction to Solid State Physics* (Wiley)

N. W. Ashcroft and N. D. Mermin, *Solid State Physics* (Cengage Learning)

H. Ibach and H. Luth, *Solid State Physics* (Springer)

Estimated student enrolment: 80

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: A. Singh, S. Banerjee, M. K. Harbola, Y. N. Mohapatra, Krishnacharya

Any other remarks: This is an elective course for the Physics (BS) students.

Elective course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: R. Prasad

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PHY553

Course title: Classical Electrodynamics II

Pre-requisite(s): PHY552

Credits: 3-1-0-0-[11]

Semester: Even

Department/IDP: Physics

Instructor(s): P. Jain

Course contents:

Special relativity, Minkowski space and four vectors, Concept of four-velocity, Four acceleration and higher rank tensors, Relativistic formulation of electrodynamics, Maxwell equations in covariant form, Gauge invariance and four-potential, The action principle and electromagnetic energy momentum tensor, Liénard-Weichert potentials, Radiation from an accelerated charge, Larmor formula, Bremsstrahlung and synchrotron radiation, Multipole radiation, Dispersion theory, Radiative reaction, Radiative damping, Scattering by free charges: applications to wave-guides, fibres and plasmas.

Recommended books:

J. D. Jackson, *Classical Electrodynamics* (Wiley)

Estimated student enrolment: 80

Departments to which the proposed course will be of interest:

Other faculty members interested in teaching the proposed course: M. K. Harbola, R. Vijaya, S. Bhattacharjee, G. Sengupta

Any other remarks: This is an elective course for the Physics (BS) students.

Compulsory course for 2-year M.Sc and M.Sc-PhD dual degree students.

Dated:_____ Proposer: P. Jain

1Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____

Appendix 4

Indian Institute of Technology, Kanpur
Proposal for a New Course

Course No. : PSO201 (Science Option)

Course title: Quantum Physics

Pre-requisite(s):

Credits: 2-1-0-0-[8]

Semester: Even

Department/IDP: Physics

Instructor(s): M. K. Harbola

Course contents:

Foundations of quantum mechanics – Black body radiation, Photoelectric effect, Compton effect, de Broglie hypothesis and its experimental verification, Time-independent and time-dependent Schrodinger equation, Born interpretation, Expectation values, Free-particle wavefunctions and wavepackets, Uncertainty principle, Solution of stationary-state Schrodinger equation for particle in a box, Particle in a finite well, Reflection and transmission across a step potential, Application to phenomena like alpha-decay, One-dimensional harmonic oscillator, Solution of stationary-state Schrodinger equation for the ground-state of hydrogen, Discussion of excited-state, Explanation of the periodic table by introduction of electron spin and Pauli's exclusion principle, Stern-Gerlach experiment, Two level systems, Free particle wavefunctions and metals, Kronig-Penny model and formation of bands in one dimension, Variational principle for approximate solutions and simple applications, Ground-state energy of helium atom, Interaction of light with matter – Einstein's phenomenological theory, Lifetime of a state, LASERS

Recommended books:

Text book:

R. Eisberg and R. Resnick, *Quantum physics* (Wiley)

Reference books:

R. P. Feynman, *The Feynman Lectures on Physics -volume 3* (Pearson)

M. Jammer, *Conceptual development of quantum mechanics* (Tomash Publishers)

B.L. van der Waerden, *Sources of quantum mechanics* (Dover Publications)

E. Shroedinger, *Papers on wave mechanics*

R. Shankar, *Principles of quantum mechanics* (Springer)

Estimated student enrolment: 210

Departments to which the proposed course will be of interest: MSE (Compulsory), CSE, EE

Other faculty members interested in teaching the proposed course: A. K. Gupta, H. C. Verma, T. K. Ghosh, Krishnacharya, A. Singh, A. Dutta

Any other remarks: This is a compulsory course for the Physics (BS) students.

Dated:_____ Proposer: M. K. Harbola

Dated:_____ DUGC Convener:_____

The course is approved / not approved

Chairman, SUGC

Dated:_____