CURRICULUM AND SYLLABI

B. Tech.

in

ENGINEERING PHYSICS

COURSES

(I to VIII Semesters)

(Applicable to 2017 admission onwards)

DEPARTMENT OF PHYSICS

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

CALICUT - 673601

KERALA, INDIA

The Program Educational Objectives (PEOs) of B. Tech. in Engineering Physics

PEO1	To understand and appreciate the many aspects of fundamental Physics and its applications to natural phenomena.
PEO2	The graduates will develop a sound scientific and mathematical foundation and practical laboratory experience leading to a career in research basic/ applied physics and related industry.
PEO3	The graduates will acquire competitive edge, communication skills and interpersonal team spirit necessary to take up challenging research projects in future advanced education and career.
PEO4	The graduates will develop technical and entrepreneur skills, and confidence necessary for contributing to the field of indigenous research and industry development.

The Programme Outcomes (POs) of B. Tech. in Engineering Physics

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CURRICULUM

The total credit for completing the B.Tech. Programmes in Engineering Physics is 160

MINIMUM CREDIT REQUIREMENT FOR THE VARIOUS COURSE CATEGORIES

The structure of B.Tech.programmes shall have the following Course categories:

Sl. No	Course Category	Number of courses	Credit as per Curriculum
1	Mathematics (MA)	4	12
2	Science (BS)	5	10
3	Humanities (HL)	3	9
4	Basic Engineering(BE)	6	15
5	Professional Core (PC)	27	84
6	Open Electives (OE)	2	6
7	Departmental Electives (DE)	6	18
8	Other Courses (OT)	4	6
	Total	57	160

DEPARTMENT OF PHYSICS

National Institute of Technology Calicut

Curriculum for Engineering Physics B. Tech. Degree Programme (2017)

Semester I

Sl. No	Code	Title	L	T	P	C	Category
01	MA1001D	Mathematics I	3	1	0	3	MA
02	PH1001D/CY1001D	Physics / Chemistry	3	0	0	3	BS
03	MS1001D/ZZ1001D	Professional Communication / Basic Electrical Sciences	3	0	0	3	HL/BE
04	ZZ1001D/ZZ1002D	Engineering Mechanics / Engineering Graphics	3/2	0	0/2	3	BE/BE
05	ZZ1004D/BT1001D	Computer Programming /Introduction to Life Science	2	0	0	2	BE/BS
06	PH1091D/CY1091D	Physics Lab./ Chemistry Lab.	0	0	2	1	BS
07	ZZ1091D/ZZ1092D	Workshop I / Workshop II	0	0	3	2	BE
08	ZZ1093D/ZZ1094D/ ZZ1095D	OT(Physical Education, Value Education, NSS)	-	-	-	3*	OT
		Total	14/13	1	5/7	17+3*	

Note:***

Semester II

Sl. No	Code	Title	L	T	P	C	Category
01	MA1002D	Mathematics-II	3	1	0	3	MA
02	CY1001D/PH1001D	Chemistry / Physics	3	0	0	3	BS
03	ZZ1001D/MS1001D	Basic Electrical Sciences/ Professional Communication	3	0	0	3	BE/HL
04	ZZ1002D/ZZ1001D	Engineering Graphics/ Engineering Mechanics	2/3	0	2/0	3	BE/BE
05	BT1001D/ZZ1004D	Introduction to Life Science/ Computer Programming	2	0	0	2	BS/BE
06	CY1094D/PH1091D	Chemistry Lab./ Physics Lab	0	0	2	1	BS
07	ZZ1092D/ZZ1091D	Workshop II / Workshop I	0	0	3	2	BE
		Total	13/14	1	7/5	17	

Semester III

Sl. No	Code	Title	L	T	P	C	Category
01	MA2001D	Mathematics-III	3	0	0	3	MA
02	PH2001D	Classical Mechanics	4	0	0	4	PC
03	PH2002D	Thermodynamics	3	0	0	3	PC
04	PH2003D	Analog Electronics	3	0	0	3	PC
05	PH2004D	Electromagnetics - I	4	0	0	4	PC
06	CY2001D	Physical Chemistry	3	0	0	3	PC
07	PH2091D	General Physics Lab	0	0	3	2	PC
08	PH2092D	Analog Electronics Lab	0	0	3	2	PC
		Total	20	0	6	24	

Semester IV

Sl. No	Code	Title	L	T	P	C	Category
01	MA2002D	Mathematics-IV	3	0	0	3	MA
02	PH2005D	Quantum Mechanics	4	0	0	4	PC
03	PH2006D	Optics	3	0	0	3	PC
04	PH2007D	Digital Electronics	3	0	0	3	PC
05	PH2008D	Electromagnetics - II	3	0	0	3	PC
06	PH2009D	Statistical Physics	4	0	0	4	PC
07	PH2093D	Digital Electronics Lab	0	0	3	2	PC
08	CY2091D	Physical Chemistry Lab	0	0	3	2	PC
		Total	20	0	6	24	

Semester V

Sl. No	Code	Title	L	T	P	C	Category
01	ME3104D	Principles of Management	3	0	0	3	HL
02	PH3001D	Applied Quantum Mechanics	4	0	0	4	PC
03	PH3002D	Condensed Matter Physics - I	3	0	0	3	PC
05	PH3003D	Atomic & Molecular Physics	3	0	0	3	PC
06		Elective - I	3	0	0	3	DE
07	PH3091D	Optics Lab	0	0	3	2	PC
08	PH3092D	Electromagnetics Lab	0	0	3	2	PC
		Total	16	0	6	20	

Semester VI

Sl. No	Code	Title	L	T	P	C	Category
01	MS3001D	Engineer Economics	3	0	0	3	HL
02	PH3004D	Condensed Matter Physics - II	3	0	0	3	PC
03	PH3005D	Computational Physics	3	0	0	3	PC
05		Elective - II	3	0	0	3	DE
06	PH3006D	Environmental Studies	3	0	0	3*	OT
07	PH3093D	Solid State Physics Lab	0	0	3	2	PC
08	PH3094D	Computational Lab	0	0	3	2	PC
		Total	15	0	6	16+3*	

Semester VII

Sl. No	Code	Title	L	T	P	C	Category
01	PH4001D	Laser Physics	3	0	0	3	PC
02	PH4002D	Nuclear and Particle Physics	3	0	0	3	PC
03		Elective - III	3	0	0	3	DE
04		Elective – IV	3	0	0	3	DE
05		Elective – V (Open Elective)	3	0	0	3	OE
06	PH4051D	Project: Part I	0	0	10	4	PC
		Total	15	0	10	19	

Semester VIII

Sl. No	Code	Title	L	T	P	C	Category
01		Elective – VI	3	0	0	3	DE
02		Elective -VII	3	0	0	3	DE
03		Elective – VIII (Open Elective)	3	0	0	3	OE
04	PH4052D	Project: Part II	0	0	20	8	PC
		Total	9	0	20	17	

Total Credit for the Course = 154+6OT = 160

LIST OF DEPARTMENT ELECTIVES (DE)

Sl. No	Code	Title	Credits
01	PH3021D	Fiber Optics	3
02	PH3022D	Atmospheric and Environmental Physics	3
03	PH3023D	Optical Engineering	3
04	PH3024D	Thin film technology	3
05	PH3025D	Modern Optics	3
06	PH3026D	Experimental Techniques in Physics	3
07	PH4021D	Unconventional Electronics	3
08	PH4022D	Introduction to Optoelectronics	3
09	PH4023D	Relativity and Gravitation	3
10	PH4024D	Nano Photonics	3
11	PH4025D	Light-Matter interaction in Resonators	3
12	PH4026D	Introduction to Critical phenomena	3
13	PH4027D	Microprocessors and Microcontrollers	3
14	PH4028D	Advanced Quantum Mechanics	3
15	PH4029D	Solid State Devices	3
16	PH4030D	Nuclear Engineering	3

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MA2001D MATHEMATICS III

Pre-requisites: NIL

L	T	P	C
3	1	0	3

Total hours: 39

Module 1: (15 Hours)

Probability distributions, Random variables,Expectation of a function of a random variable, Mean, Variance and Moment generating function of a probability distribution, Chebyshev's theorem, Binomial distribution, Poisson distribution, Geometric distribution, Hyper- geometric distribution, Normal Distribution, Uniform distribution, Gamma distribution, Beta distribution and Weibull distribution. Transformation of a random variable, Probability distribution of a function of a random variable, Jointly distributed random variables,Marginal and conditional distributions,Bi-variate Normal distribution, Joint probability distribution of functions of random variables.

Module 2: (14 hours)

Population and samples, The sampling distribution of the mean (σ known and σ unknown), Sampling distribution of the variance, Point estimation, Maximum likelihood estimation, Method of moments,Interval estimation, Point estimation and interval estimation of mean and variance. Tests of hypothesis, Hypothesis tests concerning one mean and two means. Hypothesis tests concerning one variance and two variances, Estimation of proportions, Hypothesis tests concerning one proportion and several proportions, Analysis of$r \times c$contingency tables, Chi – square test for goodness of fit.

Module 3: (10 hours)

Analysis of variance, General principles, completely randomized designs, Randomized block design. Curve fitting, Method of least squares, Estimation of simple regression models and hypotheses concerning regression coefficients, Correlation coefficient- Estimation of correlation coefficient, Hypothesis concerning correlation coefficient. Estimation of curvilinear regression models.

References:

[1]. R. A. Johnson, Miller and Freund's Probability and Statistics for Engineers, 8th edition. PHI, New Delhi, 2011.

[2]. W. W. Hines, D. C. Montgomery, D. M. Goldsman and C. M. Borror, Probability and Statistics in Engineering, 4th edition, John Wiley & Sons, Inc., 2003

[3]. S.M. Ross, Introduction to Probability and statistics for Engineers and Scientists, 5rd edition, Academic Press (Elsevier), New Delhi, 2014

MA2001D MATHEMATICS III

Pre-requisites: NIL

L	T	P	C
3	1	0	3

Total hours: 39

Brief Syllabus:

Probability distributions, Random variables, Expectations, Mean, Variance and Moment generating function of a probability distribution,Chebyshev's theorem. Some important probability distributions, transformation of random variables, jointly distributed random variables. Introduction to statistical inference, sampling distributions, Maximum likelihood estimation, Point estimation and interval estimation of mean, variance and proportion, Hypothesis tests concerning one variance and two variances,one proportion and several proportions, Analysis of $r \times c$ contingency tables, chi – square test for goodness of fit.Analysis of variance, completely randomized designs, Randomized block design.Estimation of simple regression model and hypotheses tests concerning regression coefficients,Estimation of correlation coefficient, Hypothesis concerning correlation coefficient. Estimation of curvilinear regression models.

PH2001D CLASSICAL MECHANICS

Pre requisites: NIL

L	T	P	C
4	0	0	4

Total Hours: 52

Module 1 (12 hours)

Review of Newtonian formulation - free body diagrams, laws of motion, conservation laws, circular motion, calculus of variation, least action principle, generalized coordinates, Lagrange's equations, applications of Lagrangian formulation.

Module 2 (12 hours)

Central force problem - equations of motion, orbits, Virial theorem, Kepler problem, scattering in a central force field. Small oscillations - eigenvalue problem, frequencies of free vibrations and normal modes, forced vibrations, dissipation.

Module 3 (12 hours)

Rigid body motion: Orthogonal transformations, Euler angles, Corioliseffect, angular momentum and kinetic energy, inertia tensor, Euler equations, applications, rotating top.

Module 4 (16 hours)

Hamiltonian formulation - Legendre transformations, Hamilton equations, cyclic coordinates and conservation theorems, principle of least action, canonical transformations, Poisson brackets and Liouville's theorem, Hamilton-Jacobi theory, action-angle variables, classical field theory - Lagrangian and Hamiltonian formulation of continuous systems.

References:

[1]. Herbert Goldstein, Classical Mechanics, II Edition, Narosa Publishers
[2]. R. G. Takwale and P.S. Puranik, Introduction to Classical Mechanics, Tata McGraw Hill, 1979
[3]. Landau and Lifshitz, Mechanics, III Ed. Pergamon press, 1976
[4]. K. R. Symon, Mechanics, 3rd edition Addison-Wesley, 1971
[5]. Spiegl M. R.,Theoretical mechanics, Schaum Series, McGraw Hill, 1982

PH2001D CLASSICAL MECHANICS

Pre requisites: NIL

L	T	P	C
4	0	0	4

Total Hours: 52

Brief Syllabus

Equations of motion and integration, calculus of variations, Lagrange's equations, Kepler's problem, system of oscillators, rigid body motion, motion in non-inertial reference frames, scattering, Hamilton's equations, canonical transformations, Poisson bracket formulation, Hamilton-Jacobi equation, action-angle variables, Galilean transformation, Special theory of relativity

PH2002D THERMODYNAMICS

L	T	P	C
3	0	0	3

Pre-requisites: NIL

Total Hours: 39

Module 1 :(9 hours)
Spatial and temporal nature of macroscopic measurements, thermodynamic equilibrium, measurability of energy, quantitative definition of heat, equation of state: ideal gas, real gas, non-PVT systems, PVT surfaces, expansivity and compressibility, critical constants for Van der Waals gas,first law of thermodynamics, configuration and dissipative work, mechanical equivalent of heat, heat capacity, enthalpy, consequences of the first law of thermodynamics, energy equation, Gay-Lussac-Joule experiment, Joule Thomson experiment, reversible adiabatic processes, Carnot cycle.

Module 2: (12 hours)
Entropy and second law of thermodynamics, thermodynamic temperature, entropy changes in reversible and irreversible processes, temperature-entropy diagrams, principle of increase of entropy, Clausius and Kelvin-Planck statement of second law, combined first and second laws, TdS equations, properties of pure substances, ideal gas and Van der Waals gas, liquids or solids under hydrostatic pressure, Joule and Joule Thomson experiments

Module 3:(10 hours)
Helmholtz and Gibbs Function, thermodynamic potentials, Maxwell relations, stable and unstable equilibrium,Claussius-Clapeyron equation, third law of thermodynamics, chemical potential, phase equilibrium and phase rule, conditions of equilibrium, maximum work theorem, energy minimum principle, Legendre transformations, minimum principle for thermodynamic potentials, Massieu functions, maximum principle for the Massieu functions,

Module 4: (8 hours)
Intrinsic stability of thermodynamic systems, stability conditions for thermodynamic potentials, physical consequences of stability, Le Chatelier's principle, qualitative effect of fluctuations, first order phase transitions in single component systems, unstable isotherms and first order phase transitions, general attributes of first order transitions, first order phase transitions in multi component systems, thermodynamics in the neighborhood of the critical point

References

[1]. Zemansky, M.W and Dittman R. H., Heat and Thermodynamics, McGraw-Hill ,1987
[2]. Sears,F.W., and Sallinger,G.L.:Thermodynamics, Kinetic theory and Statistical Thermodynamics, Narosa, New Delhi, 1995
[3]. H. B. Callen, Thermodynamics and an Introduction to Thermostatics, Wiley student Ed., 1985
[4]. CengelA Y, and Boles A M, Thermodynamics: an engineering approach, 5th edition, TMH, 2006
[5]. Jones I. B, Dugan R. E., Engineering Thermodynamics, Prentice Hall, 1995

PH2002D THERMODYNAMICS

Prerequisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Brief Syllabus

Thermodynamics and macroscopic measurements, PVT and non-PVT systems, first law of thermodynamics and its consequences, second law of thermodynamics and its consequences, TdS equations, properties of ideal gas, Van der Waals gas, real gases and pure substances, thermodynamic potentials, conditions for equilibrium and thermodynamic stability of system, first order phase transitions

PH2003D ANALOG ELECTRONICS

Prerequisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Module 1 (6 Hours)

Voltage and current sources, circuit theorems - superposition theorem, Thevenin's theorem, thevenizing a circuit with two voltage sources, thevenizing a bridge circuit, Norton's theorem, Thevenin - Norton conversions, maximum power transfer theorem, star-delta transformations.

Module 2 (8 Hours)

Special diodes - schottky diode, LED, use of LED as a display,varactor diode, photodetectors- p-i-n and avalanche photodiode, phototransistor and photomultiplier tube, tunnel diode - their characteristics and applications, FET, MOSFET, diac, triac, and SCR.

Module 3 (12 Hours)

power supplies for integrated circuits, operational amplifier theory, equivalent circuit, open-loop operational amplifier configurations, feedback configurations- voltage series and voltage shunt feedback amplifiers, differential amplifiers- differential amplifier with one op-amp and two op-amps, current to voltage converter, input offset voltage, input bias current, input offset current, total output offset voltage, common mode rejection ratio, compensating networks, slew rate- causes of slew rate, slew rate equation, effect of slew rate in applications. .

Module 4 (13 Hours)

Summing, scaling, and averaging amplifiers, subtractor, integrator, differentiator, instrumentation amplifier, voltage to current converter, active filters- first order and second order low pass butterworth filters, first order and second order high pass butterworth filters, band pass filter, band reject filter, oscillators- basic principle of sinusoidal oscillator, phase shift, and Wein bridge oscillators, voltage controlled oscillator, comparators, peak detector, switched capacitor filter, the 555 timer, the 555 as a monostable, and as an astablemultivibrator, applications, Phase Locked Loop (PLL) - operating principles and applications, voltage regulators.

References

[1]. Malvino A.P., Electronic principles, Tata-McGraw Hill, (2017)
[2]. Sedra A.S. and Smith K.C., Microelectronics Circuits, Oxford University Press, (2017)
[3]. Gayakwad R.A., Op-amps and Linear Integrated Circuits, Prentice Hall of India, (2009)
Floyd T. L, and Buchla, Basic operational Amplifiers and Linear Integrated Circuits, Pearson Education Asia, (2003)
[4]. Kumar B. and Jain S.B., Electronic Devices and Circuits, Prentice Hall of India, (2007)

PH2003D ANALOG ELECTRONICS

L	T	P	C
3	0	0	3

Prerequisites: NIL

Total Hours: 39

Brief Syllabus

Circuit theorems, special diodes, FET, MOSFET, diac, triac, and SCR, operational amplifier theory, open-loop and, feedback configurations, differential amplifier with one op-amp and two op-amps, current to voltage converter, active butterworth filters, oscillators, voltage controlled oscillator, comparators, peak detector, switched capacitor filter, the 555 timer, phase Locked Loop (PLL), voltage regulators.

PH2004D ELECTROMAGNETICS-I

Prerequisites: NIL

L	T	P	C
4	0	0	4

Total hours: 52

Module 1 (16 hours)
Cartesian coordinate system, cylindrical and spherical coordinate systems, scalar and vector fields, complex numbers and phasor technique, Coulomb's law, flux of the electric field and Gauss law, divergence of electric field, energy and potential of a moving point charge in an electric field, the line integral, potential and potential difference, potential due to system of point charges, potential gradient, energy density in the electric field, electric dipole, dielectrics, Poisson's and Laplace's equations-solutions in simple cases.

Module 2 (14 hours)
Steady magnetic field, Biot-Savart law, Amperes circuital theorem, curl of magnetic field, Stokes theorem, steady state equations for electric and magnetic field, scalar and vector magnetic potentials, force on a moving charge, force between differential current elements, magnetic dipole moment due to a current loop, inductance and mutual inductance

Module 3 (12 hours)
Time varying field and Maxwell's equations, Faraday's law, displacement current, Maxwell's equations, plane wave propagation in free space, wave propagation in dielectrics, wave propagation good conductors, power flow in electromagnetic field-Poynting's theorem

Module 4 (10 hours)
Plane waves in a dielectric medium, Plane waves in conducting media, Reflection and refraction at dielectric interfaces, Complex Fresnel coefficients, Optical dispersion in materials, dielectric constant.

References:

[1].D.J. Griffiths, Introduction to Electrodynamics. 4th Edition, PHI Learning, New Delhi. (2012).
[2].J.D. Jackson, Classical Electrodynamics. 3rd Edition, Wiley India. (1998).
[3].John R. Reitz, Frederic J. Milford and Robert W. Christy, Foundations of Electromagnetic Theory, 3rd Edition, Narosa Publishing House, New Delhi. (2012).
[4]. Jordan E.C. and Balmain K. G., Electromagnetic Waves and Radiating Systems, 2nd Edition, Prentice Hall (2001).
[5]. Matthew O. Sadiku, Elements of Electromagnetics, 4th edition, Oxford (2009)

PH2004D ELECTROMAGNETICS-I

L	T	P	C
4	0	0	4

Prerequisites: NIL

Total hours: 52

Brief Syllabus

Coulomb's law, Gauss law, potential and potential difference, energy density, electric dipole, dielectrics, Poisson's and Laplace's equations, Biot-Savart law, Ampere's circuital theorem, scalar and vector magnetic potentials, force on a moving charge, magnetic dipole moment, inductance, Faraday's law, displacement current, Maxwell's equations, plane electromagnetic waves, Poynting's theorem, dielectric and conducting media, reflection and refraction, optical dispersion.

CY2001DPHYSICAL CHEMISTRY

Pre-requisites: NIL
Total hours: 39

L	T	P	C
3	0	0	3

Module 1: (14 hours)
Concept of free energy and entropy – The Helmholtz and Gibbs energies – Criteria for spontaneity, Properties of the internal energy, The Maxwell relations, Properties of Helmoltz and Gibbs free energy– Variation of free energy with pressure and temperature-Gibbs Helmholtz equation- application in electrochemical cell, conditions for equilibrium – Derivation of Law of Chemical equilibrium from thermodynamics – Van't Hoff reaction isotherm, Relation between Kp, Kc and Kx, Ellingham diagrams and extraction of metals, Thermodynamics of solutions – Partial molar quantities, Chemical potential, Colligative properties- Van't Hoff Factor.
Gibbs Phase Rule– Conditions for equilibrium between phases, Clapeyron- Clausius equation, One component system – Water- metastable equilibrium, triple point, Two component system- simple eutectic systems, cooling curves, (eg. Pb-Ag),Three component solid-liquid systems.

Module 2: **(13 hours)**
Rate of reaction, order and molecularity, rate laws and rate constants– integration of rate expression of first, second and n^{th} order reactions, Half life time of a reaction, The temperature dependence of reaction rates. Theories of reaction rates – Collision theory and Activated complex theory of bimolecular gaseous reactions.TheLindemann – Hinshelwood mechanism of unimolecular reactions. Kinetics of opposing, consecutive, parallel reactions (first order examples) – Steady state approximation, Chain reactions:H_2–Cl_2, H_2–Br_2 and H_2–O_2 reaction, Polymerization kinetics – Stepwise polymerization, Chain polymerization.Electrocatalysis - mechanism, Kinetics of electrode reactions- Butler – Volmer and Tafel equations.

Module 3: (12 hours)
Consequences of light Absorption, Laws of Photochemistry–Grotthus-Draper Law, Stark–Einstein law of Photochemical equivalence, Quantum Yield- determination, Photochemical rate law, Photosensitization, Quenching of Fluorescence, Chemiluminescence. Principles of Raman Spectroscopy, NMR Spectroscopy–^{1}H NMR, Electron spin resonance spectroscopy.

References:
[1]. P.W.Atkins and J.D.Paula, *Atkins' Physical Chemistry* (Eighth Edition). New York: Oxford University Press, 2006.
[2]. I. N. Levine, *Physical Chemistry* (Sixth Edition). New Delhi: Tata McGraw-Hill, 2009.
[3]. K. J. Laidler, *Chemical Kinetics* (Third Edition). New Delhi: Pearson Education, 2004.
[4]. G. K. Vemulapalli, *Physical Chemistry.* New Delhi: Prentice Hall, 2004.
[5]. B.R. Puri, L.R.Sharma, M.S. Pathania, *Principles Physical Chemistry* (46^{th} edition). New Delhi: Vishal Publishing Co., 2015.
[6]. J.O'M. Bockris and A. K. N. Reddy, *Modern Electrochemistry 2A*, New York: Kluwer Academic Publishers, 1998.
[8]. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, (4^{th} edition), New Delhi: Tata McGraw Hill, New Delhi, 2010

CY2001D PHYSICAL CHEMISTRY

Pre-requisites: NIL

L	T	P	C
3	0	0	3

Total hours: 39

Brief Syllabus

Rate of reaction, temperature dependence, Theories of reaction rates, Kinetics of opposing, consecutive, parallel reactions (first order examples),Chain reactions, Polymerization kinetics, Kinetics of electrode reactions, chemical thermodynamic concepts, applications, Ellingham diagrams and extraction of metals, Thermodynamics of solutions, Gibbs Phase Rule and applications, photochemistry and principles ofRaman Spectroscopy, ^{1}H NMR and Electron spin resonance spectroscopy.

PH2091D GENERAL PHYSICS LAB

L	T	P	C
0	0	3	2

Pre-requisite: NIL

Total Hours: 39

Measurement of elastic modulus of materials by various methods, measurement of moment of inertia, thermal conductivity, surface tension and viscosity of liquidsetc.
A total of 8 experiments to be done.

References:

[1]. A.C. Melissinos, J. Napolitano, Experiments in Modern Physics, Academic Press, 2003

[2]. R. A. Dunlop, Experimental Physics, Oxford Univ. Press, 1988

PH2092D ANALOG ELECTRONICS LAB

Prerequisites: NIL

L	T	P	C
0	0	3	2

Total Hours: 39

To design ,set up ,and draw the frequency response characteristics of basic operational amplifier circuits such as inverting and non-inverting amplifiers ,to design and set up operational amplifier based circuits to perform mathematical operations such as addition ,subtraction ,integration, and differentiation ,to design and set up a Schmitt trigger circuit using operational amplifier for various LTP and UTP ,to design and set up an astablemultivibrator using operational amplifier for a desired pulse width , to set up and study half wave and full wave rectifiers using operational amplifier , to design and set up RC phase shift oscillator using operational amplifier for desired frequency, to set up and study a triangular wave generator using operational amplifier for a desired frequency , to design and set up active filters for a desired cutoff frequency and pass band gain , to design and set up a voltage controlled oscillator for a desired output frequency ,and design and set up a phase locked loop for a desired free-running frequency ,lock range and capture range.

References:

[1]. Zbar, Albert P. Malvino and Michael A. Miller, Basic Electronics A Text Lab Manual Part B, Tata Mc-Graw-Hill Publishing Company Ltd., New Delhi, 2001

[2]. Albert Malvino, David J Bates, Electronic Principles, Tata Mc-Graw-Hill Publishing Company Ltd., New Delhi, 2017

MA2002D MATHEMATICS IV

Pre-requisites: MA 1001 Mathematics I, MA 1002 Mathematics II

Total hours: 39

L	T	P	C
3	1	0	3

Module 1: Series Solutions and Special Functions (11 Hours)
Power series solutions of differential equations, Theory of power series method, Legendre Equation, Legendre Polynomials, Frobenius Method, Bessel's Equation, Bessel functions, Bessel functions of the second kind, Sturm- Liouville's Problems, Orthogonal eigenfunction expansions.

Module 2: Partial differential Equations (10 Hours)
Basic Concepts, Cauchy's problem for first order equations, Linear Equations of the first order, Nonlinear Partial Differential Equations of the first order, Charpit's Method, Special Types of first order equations, Classification of second order partial differential equations, Modeling: Vibrating String, Wave equation, Separation of variables, Use of Fourier Series, D'Alembert's Solution of the wave equation, Heat equation: Solution by Fourier series, Heat equation: solution by Fourier Integrals and transforms, Laplace equation, Solution of a Partial Differential Equations by Laplace transforms.

Module 3: Complex Numbers and Functions (9 Hours)
Complex functions, Derivative , Analytic function, Cauchy- Reimann equations, Laplace's equation, Geometry of Analytic functions: Conformal mapping, Linear fractional Transformations, Schwarz - Christoffel transformation, Transformation by other functions.

Module 4: Complex Integration (9 Hours)
Line integral in the Complex plane, Cauchy's Integral Theorem, Cauchy's Integral formula, Derivatives of analytic functions.Power series, Functions given by power series, Taylor series and Maclaurin's series. Laurent's series, Singularities and Zeros, Residue integration method, Evaluation of real Integrals.

References:
[1]. Kreyszig E, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons, New York, 1999.

[2]. I.N. Sneddon, Elements of Partial Differential Equations, Dover Publications, 2006.

[3]. Wylie C. R. &Barret L. C., Advanced Engineering Mathematics, 6th Edition, McGraw Hill, NewYork,1995.

[4]. Donald W. Trim, Applied Partial Differential Equations, PWS – KENT publishing company, 1994.

MA2002D MATHEMATICS IV

Pre-requisites: MA 1001 Mathematics I, MA 1002 Mathematics II

L	T	P	C
3	1	0	3

Total hours: 39

Brief Syllabus

Series Solutions and Special Functions: Power series solutions of differential equations, Theory of power series method, Legendre Equation, Legendre Polynomials, Frobenius Method, Bessel's Equation, Bessel functions, Sturm- Liouville's Problems, Orthogonal eigenfunction expansions. Partial differential Equations: Cauchy's problem for first order equations, Linear Equations of the first order, Nonlinear Partial Differential Equations of the first order, Charpit's Method, Special Types of first order equations, Classification of second order partial differential equations, Wave equation, Heat equation, Laplace equation, Solution of a Partial Differential Equations by Laplace transforms. Complex functions, Derivative , Analytic function, Cauchy- Reimann equations, Laplace's equation, Geometry of Analytic functions: Conformal mapping, Linear fractional Transformations, Schwarz - Christoffel transformation, Transformation by other functions, Line integral in the Complex plane, Cauchy's Integral Theorem, Cauchy's Integral formula, Derivatives of analytic functions.Power series, Functions given by power series, Taylor series and Maclaurin's series. Laurent's series, Singularities and Zeros, Residue integration method, Evaluation of real Integrals.

PH2005D QUANTUM MECHANICS

Pre-requisites:NIL

L	T	P	C
4	0	0	4

Total Hours: 52

Module 1:(16 hours)

Origins of quantum theory, wave function, probability interpretation, Dirac formalism – bra-ket notation, operators, Hermitian operators, eigenvalues and eigenvectors, basis transformations and unitary operators, commutation relations, measurement theory, Born interpretation, expectation values, uncertainty principle, position and momentum representation, time evolution, Hamiltonian operator, Schrödinger, Heisenberg and interaction pictures, Schrödinger equation

Module 2: (16 hours)

One dimensional potential problem, potential wells and barriers, charged particle in external magnetic field, simple harmonic oscillator- operator formalism, raising and lowering operators, eigenvalues and eigenvectors, Schrödinger equation for the oscillator.

Module 3:(12 hours)

Angular momentum: Infinitesimal rotations, rotation operator, angular momentum operators, commutation relations, eigenvalues, matrix representation, orbital and spin angular momentum, central field problems, hydrogen atom, orbitals

Module 4:(8 hours)

Symmetry, conservation laws, degeneracy, density matrix, pure and mixed states, connection to partition functions.

References:

[1]. J. J. Sakurai, Modern Quantum Mechanics, Addison Wesley, (1999)
[2]. R. Shankar, Principles of Quantum Mechanics (II Ed.), Springer (1994)
[3]. David. J. Griffiths, Introduction to Quantum Mechanics, (II Ed.) Pearson Education (2005)
[4]. NouredineZettili, Quantum Mechanics: Concepts and Applications, 2nd Ed. John-Wiley (2009)
[5]. L. I. Schiff, Quantum Mechanics, (III Ed.) McGraw Hill (1968)

PH2005D QUANTUM MECHANICS

L	T	P	C
4	0	0	4

Total Hours: 52

Pre-requisites: NIL

Brief Syllabus

Dirac formalism, Born interpretation, measurement theory, time evolution, Schrödinger equation, applications of quantum mechanics to simple systems, rotations, angular momentum, central field, hydrogen atom, symmetry, conservation laws, density matrix, partition function.

PH2006D OPTICS

Pre-requisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Module 1 (11 hours)

Electromagnetic radiation, visible spectrum, geometrical and physical optics, laws of reflection and refraction - Huygens principle, Fermat's principle, principle of reversibility, Stokes relations, reflection - external and internal, phase changes on reflection, matrix methods in paraxial optics, aberrations – classification and removal

Module 2 (11 hours)

Coherence - temporal and spatial, spectral bandwidth of source and coherence time, two beam interference, Young's double slit, Michelson interferometer, Fabry-Perot interferometer and etalon (description), Diffraction - Fresnel, Fraunhofer diffraction, single slit diffraction, beam spreading, rectangular and circular apertures, Rayleigh's criterion of resolution, multiple slits, diffraction grating, free spectral range, resolution and dispersion

Module 3 (11 hours)

Polarized and unpolarised light - matrix representation of polarized light, plane polarized, circularly polarized and elliptically polarized light, matrix representation of polarizers, production of polarized light-dichroism, birefringence, quarter wave plate and half wave plate, double refraction, Glan-air prism and Wollaston prism, reflection from dielectric surfaces, Brewster's law, optical activity

Module 4 (6 hours)

Light sources - incandescent, discharge and laser, fiber Optics, systems and applications, human eye, its capabilities and limitations, binocular vision, eye piece, microscope, telescope - properties and design considerations

References:

[1]. Pedrotti, F. L. and Pedrotti, L. S., Introduction to Optics, Prentice Hall, 1987
[2]. Ghatak, A., **O**ptics, Tata-McGraw-Hill, 1981
[3]. Hecht,E., Optics**,** Pearson Education, 2003
[4].Meyer-Arendt, J.R., Introduction to Classical and Modern Optics, II Edition, Prentice-Hall, 1988

PH2006D OPTICS

Pre-requisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Brief Syllabus

Maxwell's equations – Electromagnetic wave in different media, Mathematical description of polarization of light.Interference and Interferometer. Geometrical optics, Fermat's principle, Lens and resonators, Coherence of light, Fourier Optics and applications

PH2007D DIGITAL ELECTRONICS

L	T	P	C
3	0	0	3

Prerequisites: NIL

Total Hours: 39

Module 1 (10 Hours)
Number system and codes: decimal, binary, hexadecimal, octal, BCD, ASCII, excess 3 code, gray code, binary addition and subtraction, signed and unsigned numbers, 1's and 2's complement arithmetic, logic gates and Boolean algebra: OR, AND, NOT, XOR, XNOR, NOR and NAND gates, Boolean laws, De Morgan's theorems, sum of products and product of sums method, the map method- two, three, four, and five variable Karnaugh map, TTL and CMOS inverters – circuit description and operation, other TTL and CMOS gates.

Module 2 (6 Hours)
Combinational logic circuits - adders- half and full adders, subtractor- half and full subtractors, fast adder, encoders and decoders, seven segment decoders, parity generators and checkers, multiplexers, demultiplexers and their applications.

Module 3 (13 Hours)
Clock waveforms, pulse forming circuits- positive and negative edge triggered circuits, sequential logic circuits- flip flops: R-S, J-K, T, and D, master-slave flip flops, characteristic equations and excitation tables for R-S, J-K, T and D flip flops, conversion of flip flops, shift registers, types of registers- serial in-serial out, serial in parallel out, parallel in- serial out, parallel in- parallel out, applications of shift registers, counters - asynchronous counters, decoding gates, synchronous counters, digital- to-analog converters with binary weighted-resistors and R-2R resistors, analog- to- digital converter- successive-approximation A/D converter.

Module 4 (10 Hours)
Introduction of microprocessor and microcontroller, block diagrams, bus organization, pin details, diagrams, data and address deviation, microprocessor system design and programming, data communications and interfacing, memory – Read Only Memory (ROM), EPROM, flash, static and dynamic random access memories, programmable array logic.

References:
[1]. Malvino, Leach and Saha, Digital Principles and applications, Tata Mc. Graw Hill, (2014)
[2]. Floyd T. L., Digital Fundamentals, VIII Edition, Pearson Education Asia, (2011)
[3]. Morris Mano M., Digital Logic and Computer Design, Pearson Education India, (2016)
[4]. Malvino, A.P, Digital computer electronics, Tata-McGraw Hill, (2017)
[5]. Taub and Schilling, Digital Integrated Electronics, McGraw Hill, (2017)
[6]. Tocci R. J., and Widmer N. S., Digital Systems: Principles and Applications, Pearson, (2009)
[7]. Anand Kumar A.,Fundamentals of Digital Circuits, Prentice- Hall of India, (2014)

PH2007D DIGITAL ELECTRONICS

L	T	P	C
3	0	0	3

Prerequisites: NIL

Total Hours: 39

Brief Syllabus

Review of digital principles- algebra for logic circuits, logic gates, TTL and CMOS inverters, combinational logic circuits- adders and subtractors, encoders and decoders, parity generators and checkers, multiplexers, dmultiplexers, and their applications, pulse forming circuits, sequential logic circuits- flip flops, characteristic equations and excitation tables, conversion of flip flops, shift registers, asynchronous and synchronous counters, A/D and D/A converters, introduction of microprocessor and microcontroller, memory- Read Only Memory (ROM), EPROM, Flash, static and dynamic random access memories**,** programmable array logic.

PH2008D ELECTROMAGNETICS-II

Prerequisites: Electromagnetic I (PH2004D)

L	T	P	C
3	0	0	3

Total hours: 39

Module 1: (9 hours)

Wave guides, propagation modes - TE, TM and TEM modes, dispersion and group velocity, parallel plate wave guide, rectangular, cylindrical wave guides and cavity resonator, Transmission lines and their applications.

Module 2: (9 hours)

Potentials and fields- Scalar and vector potentials, gauge transformation - Coulomb and Lorentz gauge, retarded potentials, Jefimenlo's equations. Lienard-Wiechert potentials, field of a moving point charge.

Module 3: (11hours)

Radiation from moving point charge, electric and magnetic dipole radiation, radiation from an arbitrary source, radiation reaction and its physical basis.
Antenna – fundamentals, directional properties of dipole antennas, travelling wave antennas.

Module 4: (10 hours)

Special theory of relativity, Lorentz transformation, relativistic mechanics and dynamics, four-vectors in electrodynamics, electromagnetic field tensor and Maxwell's equations, transformation of fields, fields of uniformly moving particles.

References:

[1]. D.J. Griffiths**,** Introduction to Electrodynamics. 4th Edition, PHI Learning, New Delhi.(2012).
[2]. J.D. Jackson, Classical Electrodynamics. 3rdEdition, Wiley India. (1998).
[3].N NarayanaRao, Elements of Engineering Electromagnetics, 5th edition, Prentice Hall of India, 2003
[4]. Jordan E.C. and Balmain K. G., Electromagnetic Waves and Radiating Systems, 2nd Edition, Prentice Hall (2001).
[5]. Matthew O. Sadiku, Elements of Electromagnetics,4th edition, Oxford (2009)

PH2008D ELECTROMAGNETICS-II

Prerequisites: NIL

L	T	P	C
3	0	0	3

Total hours: 39

Brief Syllabus

Wave guides, propagation modes, cavity, dispersion and group velocity, transmission lines, scalar and vector potentials, gauge transformation, retarded potentials, Lienard-Wiechert potentials, radiation from moving point charge, dipole radiation, radiation reaction, antenna, Lorentz transformation, relativistic mechanics and dynamics, electromagnetic field tensor.

PH2009D STATISTICAL PHYSICS

Pre-requisites: NIL

L	T	P	C
4	0	0	4

Total Hours: 52

Module 1 (12 hours)

Need for statistical physics, models of macroscopic systems, macro states and micro states, phase space, Liouville's theorem, energy quantization, fundamental postulate of equilibrium statistical mechanics, microcanonical ensemble, Gibbs paradox, enumeration of microstates, canonical ensemble, partition function, free energy, calculation of thermodynamic quantities, entropy, fluctuations, grand canonical ensemble

Module 2(14 hours)

Classical ideal gas, Maxwell-Boltzmann distribution, equipartition theorem, virial theorem, specific heat of gases, real gases, paramagnetism, Langevin and Brillouin functions, Curie's law, nuclear spins, ortho and para hydrogen, negative temperature concept, system of harmonic oscillators

Module 3(14 hours)

Systems of identical, indistinguishable particles, spin, symmetry of wavefunctions, bosons, fermions, Pauli's exclusion principle, Bose-Einstein and Fermi-Dirac distributions, degeneracy, ideal Fermi gas and ideal Bose gas, applications – free electron gas, liquid helium, radiation, specific heat of crystalline materials – Einstein and Debye theories

Module 4 (12 hours)

Introductory ideas on phase transitions and criticality, models for ferromagnetism – Ising and Heisenberg models, introduction to microscopic simulations – Monte Carlo and molecular dynamics

References:

[1]. E. Atlee Jackson, Equilibrium Statistical Mechanics, Prentice-Hall, 1968
[2]. R. K. Pathria Statistical Mechanics, 2nd Ed., Butterworth-Heinemann, 1996
[3]. F. Reif, Fundamentals of Statistical and Thermal Physics McGraw-Hill, 1985
[4]. Kerson Huang, Statistical Mechanics, 2nd Ed, John Wiley, 1987
[5]. Herbert B. Callen, Thermodynamics 2nd Ed., Wiley, 2005

PH2009D STATISTICAL PHYSICS

Pre-requisites: NIL

L	T	P	C
4	0	0	4

Total Hours: 52

Brief Syllabus

Models of macroscopic systems, macro states and micro states, phase space, Liouville's theorem, postulate of equilibrium statistical mechanics, Maxwell-Boltzmann distribution, applications of classical statistical mechanics, quantum statistics, systems of identical, indistinguishable particles, Bose-Einstein and Fermi-Dirac distributions, applications and examples of quantum statistics, phase transitions, Ising and Heisenberg models, microscopic simulations.

PH2093D DIGITAL ELECTRONICS LAB

L	T	P	C
0	0	3	2

Prerequisites: NIL

Total Hours: 39

Realization of basic gates using discrete components (resistor, diodes, and transistor) and verification of their truth tables ,realization of basic gates using universal gates (NAND and NOR gates),verification of De- Morgan's theorems for two variables ,realization of arithmetic circuits such as half and full adder ,half and full subtractor using gates ,and verification of their truth tables ,realization of combinational circuits such as multiplexer demultiplexer,seven segment decoder ,realization of sequential circuits- RS,JK,D and T flip- flopsusing gates and verification of the characteristic tables ,realization of shift registers ,realization of ring and Johnson counter ,experiments using 8085 and 8086 microprocessor trainer kits – write and executes assembly language program to performaddition,subtraction,multiplication,division and relocation of data ,assembly language program to generate a square wave on CRO.

References:

[1]. InderbirKaurand, GeetaMongia, Digital Electronics laboratory manual, Narosa Publishing House Pvt Ltd, 2016
[2]. M. Morris Mano, Digital Logic and Computer Design, Pearson Education India, 2016

CY2091D PHYSICAL CHEMISTRY LAB

Pre-requisites: Nil

L	T	P	C
0	0	3	2

Total hours: 39

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List of Experiments

1. Rate constant of the reaction having equal concentrations of reacting species.
2. Validation of order of chemical reactions
3. Partition coefficient of I_2 between CCl_4 and water.
4. Determination of added electrolyte on CST of phenol-water system
5. Adsorption of oxalic acid from aqueous solution by activated charcoal.
6. Verification of Nernst equation and the thermodynamic parameters.
7. Determination of temperature dependence of equilibrium constant of a reaction.
8. Application of Phase rule for a binary liquid system

References:

[1]. B .Viswanathan and P. S. Raghavan, Practical Physical Chemistry, Viva Books, 2010.
[2]. A. M. Halpern, and G. C. McBane,Experimental Physical Chemistry: A Laboratory Text Book, (Third Edition),W. H. Freeman, 2006.
[3]. J. Raveendran, L. Sreejith and S. Murugan, MicroscaleExperiments Manual, Proc. of FDP on Green Environment for Academic Campus, 2013.

ME4104D PRINCIPLES OF MANAGEMENT

Pre-requisites: NIL

Total hours: 39

L	T	P	C
3	0	0	3

Module 1: (14 hours)

Introduction to management functions, Characteristics of management, Systems approach to management, Task and responsibilities of a professional manager, Levels of managers and skill required. Management process – planning – mission – objectives – goals – strategy – policies – programmes – procedures. Organizing – principles of organizing – organization structures, Directing – delegation – span of control – leadership – motivation, Controlling, Sustainability issues.

Module 2: (10 hours)

Decision making process – decision making under certainty, risk and uncertainty, Project management – critical path method – crashing - programme evaluation and review technique.

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Module 3: (15 hours)

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management – principles of double entry book keeping, financial statements, Sources of finance.
Entrepreneurial processes – analysis of new ventures/startups, creating new products/services and business plans, Intellectual property issues.

References

[1]. Koontz, H., and Weihrich, H., *Essentials of Management: An International Perspective*, 8th ed., McGraw Hill, 2009.
[2]. Griffin, R.W., *Management: Principles and Applications,*Cengage Learning, 2008.
[3]. Kotler, P., Keller K.L., Koshy, A., and Jha, M., *Marketing Management*, 13th ed., 2009.
[4]. Khan, M.Y., and Jain, P.K., *Financial Management*, Tata-McGraw Hill, 2008.
[5]. Hisrich R.D., and Peters M.P., Entrepreneurship: Strategy, Developing, and Managing a NewEnterprise, Irwin, Chicago, 1995.
[6]. Roberts E.B., Entrepreneurs in High Tech- Lessons from MIT and beyond, Oxford University Press,New York, 1991

ME4104D PRINCIPLES OF MANAGEMENT

Pre-requisites: NIL

L	T	P	C
3	0	0	3

Total hours: 39

Brief Syllabus

Introduction to management functions, Characteristics, Systems approach, Task responsibilities and skill required, Process of management, Planning, Organizing, Directing, Controlling, Sustainability issues, Decision making process, Project management, Overview of operations management, Human resources management, Marketing management, Financial management.Entrepreneurial processes, new ventures/startups, creating new products/services and business plans, Intellectual property issues.

PH3001D APPLIED QUANTUM MECHANICS

Total Hours: 52

L	T	P	C
4	0	0	4

Pre-requisites: PH2005D

Module 1:(12 hours)

Addition of angular momenta, Clebsch-Gordon coefficients, tensor operators, Wigner-Eckart theorem, identical particles, distinguishable and indistinguishable particles, symmetric and anti-symmetric wave functions, exchange degeneracy, bosons and fermions, Slater determinant, Pauli's exclusion principle; entangled states, locality principle and Bell's inequalities

Module 2: (18 hours)

Stationary perturbation theory, first and second order approximation to wave function and energy eigenvalue, degenerate perturbation theory, applications to- harmonic oscillator, Zeeman effect, Stark effect. Time dependent perturbation – method of variation of constants, transition rate, sudden and adiabatic approximations, Fermi golden rule, scattering theory, scattering cross section, Born approximation, partial wave analysis, variational method –application to ground state of He-atom, WKB method.

Module 3:(10 hours)

Interaction of atoms with electromagnetic radiation: Maxwell's equations, plane waves and perturbation theory, transition probability, absorption and emission, dipole transitions and selection rules, forbidden transitions, spontaneous emission, simulated emission, radiation field,

Module 4:(12 hours)

Relativistic effects, Klein-Gordon equation, Dirac equation, Dirac matrices, spinors, positive and negative energy solutions, physical interpretation, nonrelativistic limit of the Dirac equation

References:

[1]. J. J. Sakurai, Modern Quantum Mechanics, Addison Wesley, (1999)
[2]. R. Shankar, Principles of Quantum Mechanics (II Ed.), Springer (1994)
[3]. David. J. Griffiths, Introduction to Quantum Mechanics, (II Ed.) Pearson Education (2005)
[4]. NouredineZettili, Quantum Mechanics: Concepts and Applications, 2^{nd} Ed. John-Wiley (2009)
[5]. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, 2^{nd} Ed, McGraw Hill (2010)
[6]. L. I. Schiff, Quantum Mechanics, (III Ed.) McGraw Hill (1968)

PH3001D APPLIED QUANTUM MECHANICS

L	T	P	C
4	0	0	4

Total Hours: 52

Pre-requisites: PH2005D

Brief Syllabus

Addition of angular momenta, Clebsch-Gordon coefficients, Wigner-Eckart theorem, distinguishable and indistinguishable particles, bosons and fermions, Pauli's exclusion principle. Stationary perturbation theory, degenerate perturbation theory, Zeeman effect, Stark effect. Time dependent perturbation, Fermi golden rule, scattering theory, Born approximation, partial waves, variational method, WKB method. Interaction of atoms with electromagnetic radiation, absorption and emission, dipole transitions, Relativistic effects, Klein-Gordon equation, Dirac equation, positive and negative energy solutions.

PH3002D CONDENSED MATTER PHYSICS – I

Prerequisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Module 1: (12 hours)
Crystal Physics: Classification of condensed matter-crystalline and noncrystalline solids, Bonding in solids - Ionic, covalent and metallic solids, the van der Waals interaction, hydrogen bonding, crystal symmetry, point groups, space groups, lattices and basis, typical crystal structures, reciprocal lattice, Bragg's law of diffraction, X-ray, neutron, and electron diffraction, Brillouin zone, structure factor. Defects in Crystals: Point defects - Frenkel and Schottky defects; Dislocations - models of screw and edge dislocations, Burgers vector; Surface imperfections – grain boundaries, tilt boundaries, twin boundaries and stacking faults; Volume defects.

Module 2: (8 hours)
Lattice Vibrations and Thermal Properties: Monoatomic and diatomic lattices, normal modes of lattice vibration, phonons and density of states, dispersion curves, specific heat – classical, Einstein and Debye models.Thermal expansion, thermal conductivity, normal and Umklapp processes.

Module 3: (10 hours)
Free Electron theory: Dependence of electron energy on the wave vector, E-K diagram. Free electron theory of metals. Thermal and Electrical transport properties, Electronic specific heat. Fermi surface. Motion in a magnetic field: cyclotron resonance and Hall effect. Thermionic emission.Failures of free electron theory.

Module 4: (12 hours)
Energy Band Theory: Energy spectra of atoms, molecules and solids- formation of energy bands. Bloch theorem, Kronig-Penny Model, construction of Brillouin zones, extended, reduced and periodic zone schemes, effective mass of an electron, nearly free electron model, tight binding approximation, orthogonalized plane wave method, pseudo-potential method, insulators, conductors and semiconductors.

References:

[1]. KittelC.: Introduction to Solid State Physics, Wiley (2007)
[2]. Ashcroft and Mermin, Solid state Physics, Thomson (2007)
[3]. HaraldIbach and Hans Luth, Solid State Physics, Springer (2009)
[4]. Ali Omar, Elementary Solid State Physics, Addison-Wesley (2005)

[5]. M A Wahab, Solid State Physics-Structure and Properties of Materials, Narosa (2005)

PH3002D CONDENSED MATTER PHYSICS – I

Prerequisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Brief Syllabus

Crystalline and noncrystalline solids, bonding, crystal symmetry, lattices and basis, reciprocal lattice, Bragg's law of diffraction, Brillouin zone, lattice dynamics, normal modes of lattice vibration, phonons, specific heat, thermal expansion, thermal conductivity, free electron theory of metals, Hall effect, electronic specific heat, Fermi surface, formation of energy bands, Bloch theorem, Kronig-Penny Model, insulators, conductors and semiconductors, effective mass.

PH3003D ATOMIC AND MOLECULAR PHYSICS

Prerequisites: Quantum Mechanics

L	T	P	C
3	0	0	3

Total hours: 39

Module 1 :(11 hours)
Schrodinger equation for one-electron atoms, eigen functions of bound states, expectation values and virial theorem, extension to two-electron atoms, spin wave functions, level scheme, independent particle model, many electron atoms, central field approximation, spin orbitals, slater determinants, Thomas Fermi model of an atom,

Module 2 :(10 hours)
Charge particles in EM field, transition rates: absorption, stimulated emission, spontaneous emission, Dipole approximation, velocity and acceleration forms, schrodinger equation in length and velocity gauges, spontaneous emission from 2p level, Einstein coefficients, selection rules, spin of photon, Beth's experiment, spectrum of one electron atoms, line intensities and lifetimes of excited states, line shapes and width, pressure and Doppler broadening

Module 3: (9 hours)
Fine structure of hydrogenic atoms, fine structure splitting, Lamb shift, hyperfine structure and isotope shifts, magnetic dipole and electric quadrupole hyperfine structure

Module 4: (9 hours)
Interaction of one-electron atoms with external electric and magnetic fields: linear and quadratic stark effect, Zeeman effect, Paschen-Back effect, anomalous Zeeman effect, quadratic Zeeman effect

References:

[1]. B.H.Bransden and C.J. Joachain, Physics of Atoms and Molecules, (II Ed.), Pearson Education (2004)
[2]. R. Eisberg and R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles,John Wiley, New York(1974).
[3]. H. E. White, Introduction to Atomic Spectra,McGrawHill,Kogakusha, Tokyo (1934).
[4]. C.J. Foot, Atomic Physics, Oxford University Press (2005)
[5]. E. U. Condon and G. H. Shortley, The Theory of Atomic Spectra, Cambridge University Press (1935)

PH3003D ATOMIC AND MOLECULAR PHYSICS

Prerequisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Brief Syllabus

One electron atoms, two electron atoms, spin orbitals, many electron atoms, central field approximation, Thomas-Fermi model, interaction of one electron atom with external fields, selection rules, line shapes and width, fine structure, hyperfine structure, linear and quadratic Stark effect, Zeeman, anamolous Zeeman effect, Paschen-Back effect

PH3091 OPTICS LAB

.
Prerequisites: NIL

L	T	P	C
0	0	3	2

Total hours: 39

Principles of Physical Optics.
Experiments based on polarization, Reflection, Refraction, Diffraction, Interference and Coherence.

A total of 8 experiments to be done.

References:

[1]. M. Born and E. Wolf, Principles of Optics, (VI Edition),Pergamon, (1989)
[2]. A. Ghatak and K.Tyagarajan**,** Introduction to Optics, Cambridge University Press, (1999)
[3]. A. Yariv**,** Optical Electronics (1985)
[4]. A. Ghatak and K.Tyagarajan, Optical Electronics, Cambridge University Press, (1999)
[5]. J.W. Goodman, Introduction to Fourier Optics, McGraw Hill, (1968)
[6]. D.L. Clark and J.F.Grainger, Polarised light and Optical measurement, Pergamon Press, (1971)

PH3092D ELECTROMAGNETICS LAB

Prerequisites: NIL

L	T	P	C
0	0	3	2

Total Hours: 39

Study of characteristics of a Klystron tube, frequency and wavelength measurement, determination VSWR and reflection coefficient, impedance and phase shift measurement, study of multi-hole-directional couplers, magic tee, circulators, isolators and attenuators, measurement of dielectric constant of solids and liquids.
A total of 8 experiments to be done.

References:

[1]. R.S.Rao, Microwave engineering (2nd edition), Prentice Hall India (2015)

[2]. K.C.Gupta, Microwave, Wiley Eastern Ltd (1979)

MS4003D ECONOMICS

L	T	P	C
3	0	0	3

Pre-requisites:NIL

Total Hours: 39

Module 1: (9 hours)

General Foundations of Economics; Forms of organizations-Objectives of firms-Opportunity principle-Discounting, Marginalism versus Incrementalism-Production Possibility frontier-Central problems of an economy- Two sector, Three sector and Four sector circular flow of income. Demand analysis-Individual, Market and Firm demand, Determinants of demand and supply, Shifts and changes in demand and supply, Market equilibrium, Shortages versus surpluses, Price ceiling ,Price floor- Elasticity of demand and business decision making.

Module 2: (17 hours)

Production functions in the short and long run-Cost concepts- Short run and long run costs- economies and diseconomies of scale-economies and diseconomies of scope-Break even analysis-Vertical & horizontal integration-Product markets- Market structure-Competitive market-Imperfect competition (Monopoly, Monopolistic competition and Oligopoly) and barriers to entry; Pricing in different markets; Price discrimination-Dead weight loss-consumer's surplus ; Game Theory-Prisoner's Dilemma-Maximin, Minimax, Saddle point, Nash Equilibrium.

Module 3: (13 hours)

Macroeconomic Aggregates-Gross Domestic Product; Gross national product, net domestic product, Transfer payments, Depreciation, Economic Indicators; Models of measuring national income; Fiscal deficit, primary deficit, Inflation and deflation ; Fiscal and Monetary Policies ; Monetary system; Indian stock market; Development Banks; NBFIs, role of Reserve Bank of India, Money Market, Capital market; NIFTY,SENSEX,Financial ratios.

References

[1]. R.S. Pindyck, D.L.Rubinfield and P.L. Mehta,*Microeconomics*,Pearson Education, 9th Edition, 2018.
[2]. P. A. Samuelson and W.D. Nordhaus,*Economics*, Tata McGraw Hill,19thed., 2015.
[3]. N. G. Mankiw,*Principles of Microeconomics*, Cengage Publications,7th ed.,2014.
[4]. S. B. Gupta, *Monetary Economics: Institutions, Theory &Policy*,New Delhi: S. Chand & Company Ltd., 2013.
[5]. K. E. Case, R. C. Fair and S. Oster, *Principles of Economics*, Prentice Hall, 10th ed., 2011.

Note: Supplementary materials would be suggested / supplied for select topics on financial markets and Indian economy.

MS4003D ECONOMICS

Pre-requisites: NIL

L	T	P	C
3	0	0	3

Total hours: 39

Brief Syllabus

Micro Economics,Demand and Supply Forces, Elasticity concepts, Short run and long run costs, Market Structure, Pricing in different markets, Game theory, Macro Economic Aggregates-Gross Domestic Product, Inflation , Fiscal and Monetary Policies ; Monetary system; Money Market, Capital market; Indian stock market; Break even analysis.

PH3004D CONDENSED MATTER PHYSICS – II

Prerequisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Module 1: (10 hours)
Motion of electrons in bands and effective mass, Currents in bands, Scattering of electrons in bands, Intrinsic and extrinsic semiconductors, Charge carrier density in intrinsic semiconductors, Doping, Carrier densities in doped semiconductors, Conductivity of semiconductors,Cyclotron resonance in semiconductors, Hall effect in semiconductors.

Module 2: (10 hours)
Dielectric function, Absorption of electromagnetic radiation, Dielectric function for a harmonic oscillator, Longitudinal and Transverse Normal modes, Surface waves on a dielectric, Local field, Polarization catastrophe and Ferroelectrics, The free electron gas, Interband transitions, Excitons, Dielectric energy losses of electrons, Fano Resonances (qualitative).

Module 3: (12 hours)
Diamagnetism and paramagnetism, Exchange interaction, Exchange interaction between free electrons, The band model of Ferromagnetism, Temperature behaviour of a ferromagnet in the band model, Ferromagnetic coupling of localised electrons, Antiferromagnetism, Spin waves.
Superconductivity: Meissner effect, London equation, Type I and II superconductors, thermodynamics, superconducting band gap, Cooper pairs, flux quantization. BCS theory (qualitative). Josephson Effect, SQUIDS, high temperature superconductors.

Module 4: (10 hours)
Hall effect, Magnetoresistance, Anomalous Hall effect, Quantum Hall effect, Transport phenomena, Impurity scattering and localization, Mesoscopic systems, Transport phenomena in mesoscopic systems.

References
[1]. HaraldIbach and Hans Luth, Solid State Physics, Springer (2009)
[2]. Michael P. Marder, Condensed matter Physics, Wiley (2010)
[3]. Ashcroft and Mermin, Solid state Physics, Thomson (2007)
[4]. GuisseppeGrosso, Solid State Physics, Academic Press (2003)
[5]. Kittel C., Introduction to Solid State Physics, Wiley (2007)

PH3004D CONDENSED MATTER PHYSICS – II

Prerequisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Brief Syllabus

Semiconductor physics, energy bands, intrinsic and extrinsic semiconductors, charge carrier ststistics in semiconductors, Optical and dielectric properties of solids, Magnetic properties of solids, Basics of superconductivity, Magnetoresistance, Anomalous and Quantum Hall effects, Transport phenomena in solids.

PH3005D COMPUTATIONAL PHYSICS

Pre requisites: NIL

Total Hours: 39

L	T	P	C
3	0	0	3

Module 1: (6 hours)

Programming with MATLAB – basics, operators, controls – if-else and switch, loops – for and while, arrays and matrices, functions, basic symbolic calculations, plotting and graphics, good programming practices, testing and debugging

Module 2: (12 hours)

Errors in numerical calculations.Roots of non-linear functions: bisection, Newton-Raphson, secant and regula-falsi methods, convergence, applications to quantum mechanics - finite potential well, double well, etc. Systems of linear equations: Gauss- and Gauss-Jordan elimination, Gauss-Seidel methods, over- and under determined systems, matrix inversion, Simultaneous non-linear equations: Newton's method, applications in classical mechanics – small oscillations, nonlinear dynamics, MATLAB's equation(s) solver

Module 3: (12 hours)

Finite-differences, Interpolations: Newton's interpolation, Lagrange interpolation, the Airy pattern, Hermite interpolation, cubic spline interpolation, approximation of derivatives, MATLAB's interpolation routines. Regressions and curve fitting: general (weighted) least square fitting - linear and non-linear, continuous functions and orthogonal polynomials, MATLAB's routines for curve fitting

Module 4: (12 hours)

Numerical integration: quadrature methods – trapezoidal, Simpson's methods, etc., errors and corrections, Romberg integration, adaptive step sizes, MATLAB's integration routines. Ordinary differential equations - Euler's methods, Runge-Kutta methods, convergence, applications to classical and quantum mechanics, introduction to Monte Carlo and molecular dynamics methods

References:

[1]. Paul DeVries and Javier Hasbun: A First Course in Computational Physics, 2^{nd}ed, Jones and Bartlett, 2010
[2]. Tao Pang: An Introduction to Computational Physics, 2^{nd}ed, Cambridge University Press, 2006
[3]. S. S. Shastry: Introductory methods of numerical analysis, 3^{rd}ed, Prentice-Hall of India, 2003
[4]. Steven C. Chapra, Applied Numerical Methods, 3^{rd}ed, McGraw Hill, 2011

PH3005D COMPUTATIONAL PHYSICS

Pre requisites: NIL

L	T	P	C
3	0	0	3

Total Hours: 39

Brief Syllabus

Programming with MATLAB, good programming practices, testing and debugging roots of non-linear functions, systems of linear equations, simultaneous non-linear equations, Interpolations, regressions and curve fitting, numerical integration, ordinary differential equations, Monte Carlo and molecular dynamics

PH3007D ENVIRONMENTAL STUDIES

L	T	P	C
3	0	0	3

Prerequisites: Nil

Total Hours: 39

Module 1 (10 hours)

Scope and importance of environmental studies, renewable and non-renewable resources, natural resources - forest, water, mineral, food and energy and land resources, study of problems, role of individual in conservation, equitable use of resources and sustainable lifestyles

Module 2 (09 hours)

Eco systems - structure and function, producer, consumer and decomposer, energy flow, ecological succession, food chains, forest, grassland, desert and aquatic ecosystems, biodiversity and conservation

Module 3 (12 hours)

Environmental pollution, air, water, soil, marine, thermal, noise pollution, nuclear pollution - radiation hazards and environmental degradation, measurement of radioactivity, effects on human health, radiation protection, methods of prevention of pollution - waste management, disaster management, environmental ethics, sustainable development models, water conservation, climate change and global warming - ozone layer depletion, carbon dioxide accumulation, nuclear holocaust management, consumerism and waste products, nuclear waste products and management, plastic wastes and electronic waste

Module 4 (08 hours)

Human population and environment, family welfare, human health and environment, human rights

References:

[1]. Bharucha, E., Textbook of Environmental Studies, University Press, New Delhi, 2005

[2]. R RajagopalanEnvironmental Studies: From Crisis to Cure, Oxford University press 2015

PH3007D ENVIRONMENTAL STUDIES

Prerequisites: Nil

L	T	P	C
3	0	0	3

Total Hours: 39

Brief Syllabus

Scope and importance of environmental studies.Importance of ecosystem in environment, biodiversity and conservation.Environmental pollution, different types of pollutions. Global warming – reasons for global warming. Human population and environment.

PH3093D SOLID STATE PHYSICS LAB

Prerequisites: NIL

L	T	P	C
0	0	3	2

Total Hours: 39

Syllabus

Experiments based on measurement of Temperature coefficient of resistance, Magneto-resistance, Hall coefficient, Magnetic susceptibility, Energy band gap of a semiconductor, Specific heat capacity, Dielectric constant, Curie temperature, Thin film deposition and characterization etc.

References:

[1]. Dieter K. Schroder, Semiconductor Material and Device Characterization, 3rd Edition, Wiley (2008)
[2]. Kittel C, Introduction to Solid State Physics, Wiley (2007)
[3]. Milton Ohring, The Materials Science of Thin Films, Academic Press (1992)

PH3094D COMPUTATIONAL LAB

L	T	P	C
0	0	3	2

Pre requisites: NIL

Total Hours: 39

Programming with MATLAB/ C/ C++/ FORTRAN/ PYTHON (Choice of instructor/student) algorithms for root extraction, solving linear equations, interpolation and extrapolation, curve fitting, numerical integration and solving ordinary differential equations with applications to physics problems.

References:

[1]. Paul DeVries and Javier Hasbun: A First Course in Computational Physics, 2/e, Jones and Bartlett, 2010
[2]. Tao Pang: An Introduction to Computational Physics, 2/ed, Cambridge University Press, 2006
[3]. S. S. Shastry: Introductory methods of numerical analysis, 3/ed, Prentice-Hall of India, 2003

PH4001D LASER PHYSICS

Pre-requisites: Electromagnetics-II (PH2008D)

L	T	P	C
3	0	0	3

Total hours: 39

Module 1: (8 hours)

Introductory concepts of laser and properties of laser , beam profiles, Einstein coefficients and light amplification, line broadening mechanisms, laser rate equation – three level and four level systems

Module 2: (12 hours)

Optical resonators. modes of rectangular cavity – quality factor, ultimate line width of the laser – mode selection, Q – switching – different techniques, mode locking in lasers – techniques for mode locking, Pump-probe spectroscopy

Module 3: (10 hours)

Laser systems – Ruby laser, Neodymium based lasers, CO_2 laser and dye lasers, semiconductor lasers – junction lasers, LED, free electron lasers

Module 4: (9 hours)

Applications of lasers - laser in industry and medicine, laser in precision measurements, laser induced fusion, light wave communications, laser in science, spatial frequency filtering and holography, defense applications of lasers

References:

[1]. AjoyGhatak and K. Thyagarajan, Lasers theory and applications, 1st editionMcmillan India Ltd, 1984.
[2]. OrazioSvelto, Principles of laser, 4th Edition Plenum Publishing corporation New York, 1998.
[3]. A. Yariv, Quantum Electronics, John Wiley and sons 3rd edition, 1985.

PH4001D LASER PHYSICS

Pre-requisites: Electromagnetics-II (PH2008D)

L	T	P	C
3	0	0	3

Total hours: 39

Brief Syllabus

Einstein coefficients and light amplification, optical resonators, Q-switching, mode-locking, pump-probe spectroscopy, Ultimate line-width of laser, mode selection, Ruby laser, neodymium-based laser systems, CO_2 laser, dye laser, free electron lasers. Applications of lasers in medicine, industry and science.Defence applications of lasers.

PH4002D NUCLEAR AND PARTICLE PHYSICS

Pre-requisites: Quantum Mechanics (PH2005D)
Total hours: 39

L	T	P	C
3	0	0	3

Module 1: (10 hours)
Properties of nuclei: Nuclear radius, mass and binding energy, spin, parity, magnetic and electric moments. Nuclear Forces: charge symmetryandisospin invariance of nuclear forces.Properties of deuteron.Nuclear Models: Semi-empirical mass formula, stability, binding energy.Fermi gas model, Liquid drop model, Shell model, magic numbers.

Module 2: (10 hours)
Nuclear decays: General nuclear radioactive decay, alpha decay and barrier penetration, beta decay, Fermi'stheory of beta decay, Kurie plot, parity violation in beta decay.Gamma decay, energetic of gamma decay, angularmomentum and parity selection rules.Detection of nuclear radiation: Interaction of radiation with matters, gas-filled counters, scintillation detectors, semiconductor detectors.

Module 3: (09 hours)
Nuclear reaction: Different types of reactions, conservation laws and energetics. Breit-Wigner dispersion relation,Compound nucleus formation and break-up, Optical model, transfer reactions, nuclearfission, neutron physics, fusion reaction.

Module 4: (10 hours)
Elementary particles: Fundamental interactions and their relative strengths, Leptons, Mesons, Baryons.Symmetries and conservation laws in particle physics, parity, charge-conjugation and time reversalsymmetry.Neutralkaons and CP violation, CPT theorem. Eight-fold way and Quark Model: Isospin and SU(2), Gell-Mann's eight-fold way and SU(3) meson octet, SU(3) baryon octet and decuplet, GellMann-Nishijimaformula. Quark bound states, concept of colour charge and gluons.

References
[1]. Kenneth S. Krane, Introductory Nuclear Physics, John Wiely& Sons (1988)
[2]. K. Heyde,Basic Ideas and Concepts in Nuclear Physics: An Introductory Approach, IOP publishing (3rd Edition 2004)
[3]. W. N. Cottinghamand D. A. Greenwood An Introduction to Nuclear Physics, Cambridge University Press (2nd Edition, 2001)
[4]. D. J. Griffiths, Introduction to Elementary particles,John Wiley & Sons, (2nd Edition 2008).
[5]. D.H. Perkins, Introduction to High Energy Physics, Cambridge University Press (4th Edition, 2001)
[6]. Y. Ne'eman and Y.Kirsh, The Particle Hunters,Cambridge University Press (2nd Edition, 1996)
[7]. Francis Halzen and Alan D. Martin, Quarks & Leptons: An Introductory Course In Modern Particle Physics, John Wiely& Sons (1984)
[8]. B. Povh, K.Rith, C. Scholz and F. Zetsche Particles and NucleiAn Introduction to the Physical Concepts, Springer-Verlag (2006)

PH4002D NUCLEAR AND PARTICLE PHYSICS

Pre-requisites: Quantum Mechanics (PH2005D)

Total hours: 39

L	T	P	C
3	0	0	3

Brief Syllabus

Basic properties of nuclei and interactions,Nuclear binding energy, Nuclear Models, Fermi gas model, Liquid drop model, Shell model.Deuteronproblem.Radioactivedecay,Alpha,Beta and Gamma decay. Selection rules,Detection of radioactive decay, Nuclear reactions, Conservation laws and energetics, Fission and Fusion, Elementary particles, classifications, symmetries and conserved quantum numbers, Quark model and Eight-fold way.

PROJECT: Part I

Pre-requisites: NIL

L	T	P	C
0	0	10	4

Total hours:

The project work, started in the seventh semester, will continue in this semester. The students will complete the project work in this semester and present it before the assessments committee.

PROJECT: Part II

Pre-requisites: PH4051D

L	T	P	C
0	0	20	8

Total hours:

This project work can be a separate work or the continuation of the previous semester project work. The students will complete the project in this semester and present it before the assessment committee.