PROGRAM SPECIFIC OUTCOMES (PSO's)* for **M. Sc. Physics**

At the time of graduation they would be able to:

PSO #	Statement	Mapped with PO#
PSO 1	Understand the principles of Classical Mechanics, Classical Electrodynamics, Statistical Mechanics and Quantum Mechanics. Apply the above to understand and analyse Atomic, Molecular, Nuclear, Particle & Condensed Matter systems and able to relate to various applications.	PO1, PO2
PSO 2	Use Mathematical methods in modeling of systems occurring in fundamental Physics as well as in Applied Sciences. Understand the Physical properties and characterization of solids & materials of technological interest	PO1, PO2, PO3, PO4
PSO 3	Design & perform simple experiments, analyse data, relate to Physical theory and able to conceive technological applications. Analyse functioning of semiconductor devices, design and study analog and digital circuits Use Microprocessors, embedded microcontrollers for various applications	PO3, PO4, PO5
PSO 4	Pursue research in pure and applied Physics as well as in areas outside Physics, where the fundamental concepts, methodology, tools and problem-solving skills learnt can be applied.	PO7

*Minimum 3 Maximum 5.

Curriculum Overview Table for M.Sc Physics		
Componenets	Credits	Hours / Cycle
Major Course (Including Practicals & project work)	75	(spread over 4 semesters)
Electives	15	(spread over 4 semesters)
Soft skill programme	8	4 (spread over 2 semesters)
Internship	2	(to be undertaken during summer vacation after 1st year)
Total	100	

Curriculum Template of M.Sc Physics Programme
– with PART I(Core) & Part II Courses

Semester		Course Code	Course title	Instruction hours per Cycle	Duration of exam	Marks			Credits
						ICA	ESE	Total	
I		082PY1M01	Classical Mechanics and Statistical Mechanics	6	3	50	50	100	**5**
I		082PY1M02	Electronics (Special) – I: Semiconductor Devices and Integrated Circuits	6	3	50	50	100	**5**
I		082PY1M03	Mathematical Physics - I	6	3	50	50	100	**5**
I & II			General Physics Practical I	6					---
I & II			Electronics Practical I	6					---
II		082PY2M01	Quantum Mechanics	6	3	50	50	100	**5**
II		082PY2M02	Electromagnetic Theory and Relativity	6	3	50	50	100	**5**
II		082PY2M03	Mathematical Physics - II	6	3	50	50	100	**5**
I & II		082PY2M04	General Physics Practical I	5	4	50	50	100	**4**
I & II		082PY2M05	Electronics Practical I	5	4	50	50	100	**4**
II&III			Soft Skill Programme	2	3	50	50	100	---
III		082PY3M01	Advanced Quantum Mechanics	6	3	50	50	100	**5**
III	EC	082PY3M02	Special Electronics I	6	3	50	50	100	**5**
III		082PY3M03	Solid State Physics	6	3	50	50	100	**5**
III		082PY3M04	Nuclear and Particle Physics	6	3	50	50	100	**5**
III&IV			General Physics Practical II	3					---
III&IV			Electronics Practical II	3					---
II&III	Part	082PC3C01	**Soft Skill Programme**	2					8
IV		082PY4M01	Molecular and Spin Resonance Spectroscopy	6	3	50	50	100	5
IV	EC	082PY4M02	Special Electronics II	6	3	50	50	100	5
IV	**Opt**	082PY4E01	Nuclear Reactor Physics*	6	3	50	50	100	**5***
		082PY4E02	Materials Science*						
III&IV		082PY4M03	General Physics Practical II	6	4	50	50	100	**4**
III&IV		082PY4M04	Electronics Practical II	6	4	50	50	100	**4**
III&IV		082PY4M05	Project	**outside class hours**		50	50	100	**5**
III&IV		082PY4M0	Viva Voce	---		50	50	100	**4**

		6							
		Part-II	Internship	during vacation					2
					Total No. of credits				**100**

***Optional_**Nuclear Reactor Physics **OR** Materials Science

Core-Course title: **CLASSICAL AND STATISTICAL MECHANICS**

Course Code*	**082PY1M01**			
Credits	**4**			
Hours / Cycle	**6**			
Category	**Part III** **Core/** Theory			
Semester	**I**			
Year of Implementation	**From the academic year 2023-'24 onwards**			
Course Structure	Theory	Tutorial	Practical	Total Hours
	90		---	90
Course Objectives	On completion of the course, the student will be able to			

Course Outcome(s)**	PSO Addressed	Bloom's Taxonomy Levels (K1 to K6)
CO 1 Define and remember fundamental terms, concepts and theories in Classical Mechanics and Statistical Mechanics	PSO 1	K1
CO 2 Explain and interpret Lagrangian, Hamiltonian and Hamilton-Jacobi equations. Understand Partition functions and Classical & Quantum Statistics.	PSO 1	K2
CO 3 Apply Lagrangian, Hamiltonian and Hamilton-Jacobi equations to solve scattering, rigid body and small oscillations problems. Using Partition functions to compute thermodynamic properties of matter. Apply Classical & Quantum statistics to a thermodynamic system.	PSO 1, PSO 2	K3
CO 4 Compare different formulations of Classical Mechanics and analyze the given mechanical system. Analyze Classical, Bosonic and fermionic distributions.	PSO 1, PSO 2, PSO 4	K4
CO 5 Evaluate the simplest formulation for the given classical mechanical system. Compare and choose the appropriate Statistics for a given thermodynamic system.	PSO 1, PSO 2, PSO 4	K5

* To be allotted by Examinations Office after the Approval of Academic Council

**Minimum 3 Maximum 5.

SYLLABUS: Classical and Statistical Mechanics

UNIT	CONTENT	Hours	COs	Bloom's Taxonomy Level
I	LAGRANGIAN FORMULATION Generalised coordinates – Constraints – D'Alembert's principle – Lagrange's equations of motion – Hamilton's variational principle and Lagrange's equation – Non-holonomic and non-conservative systems – Scattering in lab and centre of mass systems – Rutherford Scattering. Hamilton's Theory: Hamilton's equations – Cyclic variables – Principle of least action.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
II	CANONICAL TRANSFORMATIONS Equation of CT – Lagrange and Poisson brackets – Invariance – Equation of motion in Poisson bracket's notation – ICT.Hamilton Jacobi Theory: H-J equation for Hamilton's principle function – Hamilton's characteristic equation – Separation of variables in H-J equation – Action angle variables.	15	1,2,3,4 &5	K1, K2, K3, K4, K5

III	RIGID BODY DYNAMICS Moments and products of inertia – Euler's equations of motion – Euler's angles – uniformly rotating frames – Foucault's pendulum – Top motion. Small Oscillations: Theory – Normal coordinates – Normal modes – Linear triatomic molecules.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
IV	STATISTICAL MECHANICS Classical Statistics: Phase space – Ensembles – Liouville's theorem – M.B. distribution – Doppler broadening – Equipartition theorem – Entropy and probability.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
V	PARTITION FUNCTION Partition function – Calculation of thermodynamic quantities – Rotational, vibrational and translational partition functions – Diatomic ideal gas.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
VI	QUANTUM STATISTICS State function - Symmetry principles - Density matrix-B.E. distribution – Black body radiation – Planck's law – B.E. condensation – Degeneracy – F.D. distribution – Electron theory of metals – Qualitative comparison between classical and quantum statistics-Chandrasekhar limit – Pauli's spin paramagnetism – Debye's theory of specific heats of solids.	15	1,2,3,4 &5	K1, K2, K3, K4, K5

Prescribed Books/Text Books

1. H. Goldstein, Classical *Mechanics* 2nd edition, Narosa Publishing Co., (2001).
2. B. K. Agarwal and Melvin Eisner, *Statistical Mechanics*, 2nd edition New Age International Pvt. limited, Publishers (1989) New Delhi.
3. S.K. Sinha, *Statistical Mechanics Theory and Application*, TMH Publishing Co., (1990).

Reference Books

1. B. B. Laud , *Fundamentals of statistical mechanics*, New Age International pvt. Limited, Publishers (1998).
2. Federick Reif, *Fundamentals of statistical and thermal physics,20th printing*, McGraw Hill Publishing Co.,(1988) New York.

Suggested Reading

1. S. Lokanathan & R. S. Gambhir, Statistical and Thermal Physics, Printice-Hall India, New Delhi.

Web Resources

Course Articulation Matrix: Classical and statistical Mechanics

Course Outcomes	Programme Outcomes							Programme Specific Outcomes					Cognitive Level
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4	PS O5	
CO 1	3	3	1	1	-	-	3	3	3	-	3		K - 1
CO 2	3	3	1	1	-	-	3	3	3	-	3		K – 2
CO 3	3	3	1	1	-	-	3	3	3	-	3		K – 3
CO 4	3	3	1	1	-	-	3	3	3	-	3		K – 4
CO 5	3	3	1	1	-	-	3	3	3	-	3		K – 5
Wt. Avg.	3	3	1	1	--	--	3	3	3	--	3		
							2.2				3		
Overall Mapping of the Course													2.6

Core-Course title: **Semiconductor Devices and Integrated Circuits**

Course Code*	**082PY1M02**			
Credits	**4**			
Hours / Cycle	**6**			
Category	**Part III** **Core/** Theory			
Semester	**I**			
Year of Implementation	**From the academic year 2023-'24 onwards**			
Course Structure	Theory	Tutorial	Practical	Total Hours
	75	15		90
Course Objectives	On completion of the course, the student will be able to ▪ Know the physics and operating principle of basic and special semiconductor devices ▪ Understand IC fabrication technology ▪ Understand various wave shaping circuits of linear and non-linear types and memory storage devices.			

Course Outcome(s)**	PSO Addressed	Bloom's Taxonomy Levels (K1 to K6)
CO1: To remember and recall basics of semiconductor physics, IC technology, Op-Amp, timer, and storage devices	PSO1	K1
CO2: To understand the basic concepts underlying the working of semiconductor devices, principles involved in IC technology, digital gates, op-amp, timer, and memory devices	PSO1, PSO2	K2
CO3: To apply the physics of semiconductors to realize various processes and applications	PSO2, PSO3, PSO4	K3
CO4: To analyze the theoretical equations and experiments to apply to solve problems at different levels	PSO2, PSO3	K4
CO5: To evaluate concepts of semiconductor physics by learning the detailed theoretical background, processes, principles and working of devices	PSO2, PSO3	K5

* To be allotted by Examinations Office after the Approval of Academic Council

**Minimum 3 Maximum 5.

SYLLABUS: Semiconductor Devices and Integrated Circuits				
UNIT	**CONTENT**	**Hours**	**COs**	**Bloom's Taxonomy Level**
I	**Physics of Semiconductor Devices:** Energy band theory of semiconductors-Density of electrons in conduction band – Density of holes in valence band – Fermi levels in intrinsic and extrinsic semiconductors – Drift and diffusion currents – Recombination and life time of minority carriers – Einstein's relation – Poisson's equation – energy band diagram of a PN junction diode – continuity equation – Application of continuity equation to junction diodes and transistors.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
II	**Special Semiconductor Devices:** FET: Field effect transistor – Physical interpretation of the characteristic curve – theory of JFET – FET biasing – common source and common drain amplifiers at low frequency – FET as voltage variable resistor.	20	1,2,3,4 &5	K1, K2, K3, K4, K5

	MOSFET: Depletion and Enhancement modes – MOSFET as switch and resistors – Dual gate MOSFET. TUNNEL DIODE: Quantum mechanical tunneling – Characteristics on the basis of energy band diagrams – Theory of tunnel diode – Applications of tunnel diode as switch amplifier and oscillator. GUNN DIODE: RWH mechanism – Explanation of RWH mechanism on the basis of electron transfer – negative relaxation time – Gunn effect – Modes of operation of Gunn diode. THYRISTORS: PNPN Diodes – construction – operation – characteristics – SCR construction and operation – characteristics – SCR as half wave and full wave rectifiers – Diac and Triac.			
III	**IC Fabrication Technology** Monolithic IC Technology – Planar process – Fabrication of BJT, FET, and MOSFET – CMOS technology – monolithic diodes - Metal semiconductor contact – Integrated resistors, capacitors – Characteristics of IC components – VLSI – VHLD – Digital gates – MOSFET inverter, NOR, NAND gates – CMOS inverter, NOR, NAND gates.	10	1,2,3,4 &5	K1, K2, K3, K4, K5
IV	**Linear Analog Circuits** DC Analysis of IC Op-Amp – Instrumentation amplifier – Transducer bridge – Instrumentation amplifier – Applications – Temperature indicator, Fluxmeter, ECG and weighing machine – Analog integrator, differentiator – Design of analog circuits for the solution of differential equation and simultaneous equations using Op-Amps – Sample and hold system – Analog multiplexer.	15	1,2,3,4 ,5&6	K1, K2, K3, K4, K5
V	**Non-Linear Analog Circuits** Wave shaping circuits – Precision AC/DC converts – Precision rectifiers – Precision clamp – Fast half wave, full wave rectifier – Active average detector – Active peak detector – logarithmic & exponential amplifiers – Logarithmic multiplier – Analog squaring & square root circuits. Comparators – Zero crossing detectors – Time marker generator – Multivibrators – astable (Square wave), Monostable (Pulse generator), Bistable (Schmitt trigger) circuits – Triangle wave generator – Timer 555 – Internal architecture and working – Monostable and astable operation – Voltage control oscillator (VCO) IC 566 – Active Butterworth filter - PLL concept – Phase locked loop IC 565 – Application – Frequency multiplier, FSK modulator and demodulator.	20	1,2,3,4 &5	K1, K2, K3, K4, K5
VI	Memory Circuits and Systems Programming bipolar PROMs – AIM technique – Floating gate (FAMOS) – MOS static RAM cell – MOS dynamic RAM cell – Refreshing circuits – Charged coupled devices – Basic CCD operation – Two phase CCD – Magnetic bubble memory – Auxiliary memory storage – Magnetic disk, floppy disk and Wincester hard disk – CD – Laser R/W systems – Flash memory (memory stick)	10		K1, K2, K3, K4, K5

Prescribed Books/Text Books

1. S.M.Sze, Semiconductor devices Physics and Technology, John Wiley & Sons, (1985) New York.
2. Jacob Millman and Christos.C.Halkias, Integrated Electronics,TMH,(2005) NewDelhi.
3. Ramakant .A.Gayakwad, Op Amps and integrated circuits,4th Edition, EEE, (1994).
4. Taub and Shilling, Digital Integrated Electronics, Mc Graw-Hill, (1983) New Delhi,.

Reference Books

1. R.F.Coughin and F.F.Driscol, Opamp and linear integrated circuits, Prentice Hall Of India, (1996) New Delhi.
2. M.S.Tyagi, Introduction to semiconductor devices, John Wiley & Sons, New York.
3. P.Bhattacharya, Semiconductor Optoelectronic devices, 2nd edition, Prentice hall of India, (2002) New

Delhi.
4. B.Somnath Nair, Digital electronics and Logic design, Prentice Hall Of India, (2002) New Delhi.

Suggested Reading

1. Malvino and Leach, Digital Principle and application 5th edition, TMH (2002) New Delhi.
2. R.L.Boylestad and L.Nashelsky, Electronic devices and circuit theory, 8th edition, Pearson Education (2003) New Delhi.

Web Resources

https://www.ti.com/seclit/ml/ssqu016/ssqu016.pdf

Semiconductor devices & Integrated circuits - Course Articulation Matrix

Course Outcomes	Programme Outcomes								Programme Specific Outcomes					Cognitive Level
	PO1	PO2	PO3	PO4	PO5	PO6	PO7		PSO1	PSO2	PSO3	PSO4		
CO 1	3	1	1	--	--	--	1		3	3	1	1		K1
CO 2	3	2	1	--	--	--	2		3	3	2	2		K2
CO 3	3	3	3	--	--	--	3		--	--	3	3		K3
CO 4	3	3	3	--	--	--	3		--	--	3	3		K4
CO 5	3	3	3	--	--	--	3		--	--	3	3		K5
Wt. Avg.	3	2.4	2.2	--	--	--	2.4		3	3	2.4	2.4		
							2.5					2.7		
Overall Mapping of the Course														**2.6**

CORE-Course title: **MATHEMATICAL PHYSICS – 1**

Course Code*	**082PY1M03**			
Credits	**4**			
Hours / Cycle	**6 hours/week**			
Category	**Part III** **Core – Theory**			
Semester	**I**			
Year of Implementation of CO's	**From the academic year June 2023 onwards**			
Course Structure	**Theory**	**Tutorial**	**Practical**	**Total Hours**
	85	5	-	90
Course Objectives	By completing this course, the student will be able to 1. Recall and understand the properties of mathematical tools that are vital for the study of physical systems such as differential equations, vector analysis and matrix algebra. 2. Analyse and examine the model equations and their properties – such as second order differential equations that warrant series solutions, vector calculus equations, and matrix equations as well as special functions and tensor analysis – that arise in various branches of theoretical physics such as classical mechanics, quantum mechanics, and relativity. 3. Determine and evaluate the solutions to ordinary and partial differential equations, vector integrals, applied matrices and tensor equations.			

Course Outcome(s)**	PSO Addressed	Bloom's Taxonomy Levels (K1 to K6)
CO1 : Define and remember the basic terms and concepts underlying Infinite Series, Second order differential equations and related Special functions, Wave equation, co-ordinate systems, vector algebra, vector calculus, Matrices. To know the applications of eigenvalues and eigenvectors of matrices and Tensors.	**PSO1**	**K1**
CO2 : Understand and interpret the concepts involved in Infinite Series and their convergence, various 2nd order differential equations, their power series solution and wave equation, different special functions and their applications, Vector Calculus, Matrices and Tensors.	**PSO2**	**K2**
CO3: To construct and develop power series solutions to second order differential equations and solve partial differential equations with boundary values. ii) To model and solve conservation equations using vector calculus. iii) To build matrix equations and solve for eigenvalues and eigen vectors.	**PSO1, PSO2**	**K3**
CO4 : i) To classify and examine the special functions being the solutions of special differential equations and inspect their properties. ii) To analyse matrix operations and distinguish quadratic forms. iii) To compare and classify contravariant and covariant tensors.	**PSO1, PSO2**	**K4**
CO5: i) To deduce and determine the solutions to PDEs of vibrating strings, membranes, and cavities. ii) To Evaluate and deduce the Stokes's theorem, Gauss's theorem and the Green's theorem. iii) To judge and interpret the simultaneous reduction of two quadratic forms. iv) To assess and explain Christoffel's symbols in various orthogonal coordinate systems.	**PSO1, PSO2**	**K5**

SYLLABUS: **MATHEMATICAL PHYSICS - 1**				
Unit	**CONTENT**	**Hours**	**COs**	**Bloom's Taxonomy Level**
I	**Infinite Series** Series of positive terms - Alternate series - Tests for convergence - Comparison test, De Alembert's ratio test, Cauchy's root test, Raabe's test, logarithmic and integral test - Power series - Radius of convergence - Test for uniform convergence.	**13**	**1,2,3,4,5**	**K1, K2, K3, K4, K5**
II	**Differential Equation of Second Order With Variable Coefficients** Solution by power series method (Frobenius method) - Root of indicial equation unequal but not differing by an integer - Root of indicial equation unequal but differing by an integer - Bessel's equations of the zeroth order, of order n (n is not an integer), of order n (where n is an integer positive), Legendre's equation - Hermite's equation - Laguerre's equation - Associated Laguerre's differential equation - Hypergeometric and confluent hypergeometric differential equation. Laplacian operator in Cartesian and polar (cylindrical and spherical) coordinates in two and three dimensions – Partial differential equation and wave equation – Solution by the method of separation of variables - Application to wave propagation - Normal modes of strings, membranes (square and circular) - waves in cavities.	**17**	**1,2,3,4,5**	**K1, K2, K3, K4, K5**
III	**Special Functions** Bessel's function of I kind and II kind – Legendre polynomials - Associated Legendre functions - Hermites polynomials - Hypergeometric and confluent hypergeometric functions and their properties - Gamma and beta functions - Their applications.	**15**	**1,2,3,4,5**	**K1, K2, K3, K4, K5**
IV	**Vector Analysis** Vector field - Scalar product and orthonormal basis - Differentiation of vectors -gradient, divergence, curl, Laplacian – Orthogonal curvilinear coordinates - Cylindrical and spherical coordinates - Expression for gradient, divergence, curl and Laplacian in these coordinates - Integration of vectors - Line, surface and volume integrals of vectors - Problems and applications of Stokes' theorem, Gauss's theorems, Green's theorem in the plane.	**15**	**1,2,3,4,5**	**K1, K2, K3, K4, K5**
V	**Matrices** Basic concepts of matrix algebra - Characteristics equation – Eigen values and Eigen vectors - Cayley Hamilton's theorem – Diagonalisation of special types of matrices - Matrices as operators - Trace of a matrix and theorems on trace of matrices - Quadratic forms - Reduction of a quadratic form into a sum of squares (conic sections) - Simultaneous reduction of two quadratic forms into sum of squares - Function of matrix.	**15**	**1,2,3,4,5**	**K1, K2, K3, K4, K5**
VI	**Tensor Analysis:** Definition of scalars, contravariant and covariant vectors – Einstein's summation convention - Definition of covariant, contravariant and mixed tensors - Symmetric and anti-symmetric tensors - Fundamental operations with tensors: addition, subtraction, outer multiplication, contraction and inner multiplication of tensors - Quotient theorem - Christoffel's symbols of I kind and II kinds - Christoffel's symbols in orthogonal systems like Cartesian, cylindrical and spherical coordinates - Covariant derivatives of tensors.	**15**	**2,3,4,5**	**K2, K3,K4,K5**
Prescribed Books/Text Books				

1. Riley, Hobson and Bence, *Mathematical Methods for Physics and Engineering*, Cambridge University Press, 2016.
2. M. Boaz, *Mathematical Methods in the Physical Sciences*, 3rd Ed Indian Adaptation, Wiley, 2023.
3. Arfken, Weber and Harris, *Mathematical Methods for Physicists*, 7th Ed., Elsevier, 2012.
4. E.Kreyszig, Advanced *engineering Mathematics*, 8th edition, John Wiley & Sons, (2002) New York.
5. C. Harper, An Introduction to Mathematical Physics, Prentice Hall, 1978,

Reference Books

1. Sokolnikoff I.S and Sokolnikoff F.S, *Higher mathematics for engineers and physicists*, Mc Graw Hill (1941) New York.
2. *Advanced calculus* 2nd edition A.E. Taylor
3. Rainville. E.D (Macmillan), *Infinite series*
4. Sen .B *Special functions*, (Allied pub., New Delhi)
5. Bell (Van Nostrand), *Special functions for scientists and engineers*
6. Morse. P.M, *Vibration and sound*, Mc Graw hill
7. Slater J. C and Frank N. H *Electromagnetism*, Mc Graw hill
8. M. D. Greenberg, *Advanced engineering Mathematics*, second edition, Pearson Education, (2002) New Delhi.

Suggested Reading

Web Resources

1.

Mathematical Physics - Course Articulation Matrix

Course Outcomes	Programme Outcomes								Programme Specific Outcomes					Cognitive Level
	PO1	PO2	PO3	PO4	PO5	PO6	PO7		PSO1	PSO2	PSO3	PSO4		
CO 1	-	3	1	1	2	1	2		3	3	2	1		K1
CO 2	-	3	1	1	2	1	2		3	3	2	1		K2
CO 3	-	3	1	1	2	1	2		3	3	2	1		K3
CO 4	-	3	1	1	2	1	2		3	3	2	1		K4
CO 5	-	3	1	1	2	1	2		3	3	2	1		K5
Wt. Avg.	-	3	1	1	2	1	2		3	3	2	1		
							1.7					2.25		
Overall Mapping of the Course														1.97

Core-Course title: **QUANTUM MECHANICS**

Course Code*	**082PY2M01**			
Credits	**4**			
Hours / Cycle	**6**			
Category	**Part III** **Core/** Theory			
Semester	**II**			
Year of Implementation	**From the academic year 2023-'24 onwards**			
Course Structure	Theory	Tutorial	Practical	Total Hours
	75	15	---	90
Course Objectives	On completion of the course, the student will be able to ▪			

Course Outcome(s)**	PSO Addressed	Bloom's Taxonomy Levels (K1 to K6)
CO1: To remember and recall the history and basics of Quantum mechanics, representation theory, Time evolution process, Angular momenta, approximation theories and Identical particle system	PSO1, PSO2	K1
CO2: To understand the basic concepts underlying general formalism of Quantum mechanics, representation theory, Time evolution process, Angular momenta, approximation theories and Identical particle system	PSO1, PSO2	K2
CO3: To apply the basic theories and concepts learnt to realize various processes and applications	PSO2, PSO3, PSO4	K3
CO4: To analyse, interpret the theoretical equations for solving problems at different levels	PSO2, PSO3, PSO4	K4
CO5: To evaluate concepts of Quantum Mechanics by learning the theories in detail and derive equations	PSO2, PSO3	K5

* To be allotted by Examinations Office after the Approval of Academic Council

**Minimum 3 Maximum 5.

Syllabus**: QUANTUM MECHANICS**

UNIT	CONTENT	Hours	COs	Bloom's Taxonomy Level
I	**FORMALISM OF QUANTUM MECHANICS** The Schrödinger's equation – Interpretation and conditions on the wave functions – Ehrenfest's theorem – Stationery states – Operator formalism – Eigenvalues and Eigen functions of observables – Orthonormality – The DIRAC delta function – completeness of set of Eigen functions – Simultaneous measurability – Proof of uncertainty principle – Commutability and compatibility.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
II	**REPRESENTATION THEORY** Basis in function space – Momentum and configuration representations – Linear vector spaces – Dirac's ket and bra vector notation – State space – Matrix representation – Operators.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
III	**QUANTUM DYNAMICS** Equation of motion – Schrödinger picture [A] – Heisenberg picture [B] – The interaction picture – Linear harmonic oscillator by [A],[B]	15	1,2,3,4 &5	K1, K2, K3, K4, K5

	and Dirac's method.– Particle in a central potential – Hydrogen atom – Reduction of two body Hamiltonian – Hydrogenic Eigen functions and spectra.			
IV	**ANGULAR MOMENTUM** Commutation rules for angular momentum operators – Eigenvalue spectrum – Raising and lowering operators – Matrix representation of angular momentum – Spin matrices and wave function – Combinations of two angular momenta – Clebsh-Gordon coefficients.	15	1,2,3,4 ,5&6	K1, K2, K3, K4, K5
V	**APPROXIMATE METHODS** Perturbation theory in non-degenerate cases – Applications to ground state of Helium atom, anharmonic oscillator - STARK effect in Hydrogen – Variation method – Application to the ground state of the Helium atom – WKB approximation.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
VI	**IDENTICAL PARTICLE SYSTEM** Symmetric and antisymmetric wave functions – Bosons and Fermions – The exclusion principle – Second quantization – Occupation number representation – Ensembles of identical systems – The density matrix.	15	1,2,3,4 &5	K1, K2, K3, K4, K5

Prescribed Books/Text Books

1. V. K. Thankappan, *Quantum Mechanics*, New Age Intl. (2004) New Delhi.
2. P.M. Mathews and K. Venkatesan, *Textbook of Quantum Mechanics*, TMH (1977) New Delhi.
3. A. Ghatak and Loganatnan S, *Quantum mechanics, theory and applications*, Macmillan Ltd, (2004), New Delhi.

Reference Books

1. E. Merzbacher, *Quantum Mechanics*, 2nd Edition, John Wiley & Sons, (1970) New York.
2. J.J. Sakurai, *Modern Quantum Mechanics*, Benjamin Cummings (1985).
3. R.P. Feynman, R.B. Leighton And M. Sands, *The Feynman Lectures on Physics, Vol.3*,Narosa Pub. House, (1992).
4. C. Cohen-Tannoudji, B.Diu, Franck L, *Quantum Mechanics, I & II*, John Wiley & Sons (1977) New York
5. V. Devanathan, *Quantum Mechanics*, Narosa Pub. House, (2005) Chennai.

Suggested Reading

G. Aruldhas, Quantum Mechanics2nd edition, PHI, NewDelhi

Web Resources

https://www.compadre.org/quantum/**?**

Quantum Mechanics - Course Articulation Matrix

Course Outcomes	Programme Outcomes								Programme Specific Outcomes					Cognitive Level
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	
CO 1	3	3	--	--	--	--	1		3	3	1	1		K1
CO 2	3	3	--	--	--	--	2		3	3	2	2		K2
CO 3	3	3	--	--	--	--	3		3	3	3	3		K3
CO 4	3	3	--	--	--	--	3		3	3	3	3		K4
CO 5	3	3	--	--	--	--	3		3	3	3	2		K5
Wt. Avg.	3	3	--	--	--	--	2.4		3	3	2.4	2.2		
							2.8					2.65		
Overall Mapping of the Course												**2.72**		

Core-Course title: **ELECTROMAGNETIC THEORY AND RELATIVITY**

Course Code*	**082PY2M02**			
Credits	**4**			
Hours / Cycle	**6**			
Category	**Part III** **Core/** Theory			
Semester	**II**			
Year of Implementation	**From the academic year 2023-'24 onwards**			
Course Structure	Theory	Tutorial	Practical	Total Hours
	90	-		90
Course Objectives	On completion of the course, the student will be able to			

Course Outcome(s)**	PSO Addressed	Bloom's Taxonomy Levels (K1 to K6)
CO 1: Define and remember fundamental terms, concepts and theories in Electromagnetic Theory and Relativity.	PSO1, PSO2, PSO3	K1
CO 2: Explain and interpret Maxwell's equations and Relativistic mechanics underlying Lorentz transformations and Relativistic Electrodynamics.	PSO1, PSO2, PSO3	K2
CO 3: Apply Maxwell's equations to solve electrostatic, magnetostatic and electromagnetic problems using various techniques. Apply Lorentz transformations to Electromagnetism and identify 4-scalars and 4-vectors.	PSO1, PSO2, PSO3	K3
CO 4: Analyze electric and magnetic properties of solids and their interactions with electromagnetic waves. Discover the relationship between Special Relativity & Electromagnetism.	PSO1, PSO2, PSO3	K4
CO 5: Evaluate Electromagnetic properties of matter and explain their behavior.	PSO1, PSO2, PSO3	K5

* To be allotted by Examinations Office after the Approval of Academic Council

**Minimum 3 Maximum 5.

SYLLABUS: Electromagnetic Theory and Relativity				
UNIT	**CONTENT**	**Hours**	**COs**	**Bloom's Taxonomy Level**
I	ELECTROSTATICS IN VACUUM AND DIELECTRICS Gauss' law – Electrostatic potential – Poisson's and Laplace's equations – Multipole expansion of potential and energy in an electric field for a charge distribution – Polarization – Electric displacement – Molecular polarisability and electric susceptibility – Clausius–Mossotti equation – Electrostatic energy in dielectric medium.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
II	BOUNDARY VALUE PROBLEMS IN ELECTROSTATICS Boundary conditions - First uniqueness theorem – Conductors and second uniqueness theorem - Formal solution of problems with Green's function - Method of images – Point charge in the presence of grounded conducting sphere – Conducting sphere in uniform electric field – Green's function for sphere – Dielectric sphere in a uniform electric field.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
III	MAGNETOSTATICS:	15	1,2,3,4	K1, K2, K3,

	Biot-Savart law – Divergence and curl of magnetic induction (B) – Magnetic vector potential – Current loops in external fields - magnetic dipole - Magnetic dipole in a non -uniform magnetic field - Vector potential and magnetic induction for a circular current loop –Magnetic moment, force and torque on a current distribution in external magnetic induction – Magnetostatic energy – Magnetic induction and magnetic field in macroscopic media – Boundary conditions – Uniformly magnetized sphere in an external magnetic field.		&5	K4, K5
IV	MAXWELL'S EQUATIONS: Maxwell's equations – Poynting's theorem - Vector and scalar potential – Gauge invariance – Coulomb and Lorentz gauges – retarded potentials – Lienard–Wiechert potentials - Fields and radiation of an oscillating dipole.	15	1,2,3,4 ,5&6	K1, K2, K3, K4, K5
V	PROPAGATION OF PLANE ELECTROMAGNETIC WAVES: Propagation of plane electromagnetic waves in free space – Non-conducting medium – Conducting medium and in low pressure ionized gases – Reflection and refraction of electromagnetic waves at a dielectric interface.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
VI	RELATIVITY AND RELATIVISTIC ELECTRODYNAMICS: Lorentz transformations and basic kinematic results of special theory of relativity – Addition of velocities – Relativistic momentum and energy of a particle, space time of special relativity, relativistic electrodynamics in vacuum – Invariance of charge, current density – Vector and scalar potentials in 4-vectors - Transformation equations for field vectors E and B – Covariance of Maxwell's equation in 4-vector form.	15	1,2,3,4 &5	K1, K2, K3, K4, K5

Prescribed Books/Text Books

1. Paul Lorrain and Dale R. Corson, *Electromagnetic field and waves* , 2nd edn, W.H.Freeman and Co., (1970).
2. B.B. Laud, Electrodynamics, Wiley Eastern Ltd., (1987).
3. D J Griffiths *Introduction to Electrodynamics*, 3rd edn, Prentice Hall of India, (2003).

Reference Books

1 J.D. Jackson , *Classical Electrodynamics* , 2nd edn., Wiley Eastern Ltd., (1975).
2. Feynmann, Leighton, R.B, and Mathew Sands, *Feynmann Lectures on Physics – Vol II*, Narosa Publishing House, (1964).

Suggested Reading

2. Andrew Zangwill, *Modern Electrodynamics*, Cambridge University Press (2012)
3. Akira Ishimaru, *Electromagnetic wave propagation, Radiation and Scattering, From fundamentals to Applications*, 2nd edn, IEEE Press, WILEY (2017)

Web Resources:

1. https://web.mit.edu/8.02t/www/802TEAL3D/visualizations/guidedtour/Tour.htm
2. https://ocw.mit.edu/courses/res-6-002-electromagnetic-field-theory-a-problem-solving-approach-spring-2008/pages/textbook-contents/

Course Articulation Matrix: Electromagnetic Theory and Relativity													
Course Outcomes	**Programme Outcomes**							**Programme Specific Outcomes**					**Cognitive Level**
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**		
CO 1	3	3	1	1	-	-	3	3	3	3	-		K - 1
CO 2	3	3	1	1	-	-	3	3	3	3	-		K – 2
CO 3	3	3	1	1	-	-	3	3	3	3	-		K – 3
CO 4	3	3	1	1	-	-	3	3	3	3	-		K – 4
CO 5	3	3	1	1	-	-	3	3	3	3	-		K – 5
Wt. Avg.	3	3	1	1	--	--	3	3	3	3	--		
							2.2				3		
Overall Mapping of the Course													2.6

MASTER OF SCIENCE (PHYSICS)

Core-Course title: **MATHEMATICAL PHYSICS II**

Course Code	**082PY2M03**			
Credits	**4**			
Hours / Cycle	**6**			
Category	**Core/** Theory			
Semester	**II**			
Year of Implementation	For students admitted from June 2008			
Course Structure	Theory	Tutorial	Practical	Total Hours
	80	10	0	90
Course Objectives	On completion of the course, the student will be able to • Understand concepts involved in complex analysis, conformal mapping, Sturm-Liouville Theory, Groups, integral transforms, vector space and probability • Solve problems in complex analysis, conformal mapping, Sturm-Liouville Theory, Groups, integral transforms, vector space and probability. • Evaluate concepts learnt in this course that are applied in 21st century science and technology.			

Course Outcome(s)**	**PSO Addressed**	**Bloom's Taxonomy Levels (K1 to K6)**
CO1: To recall and revise the basic concept of complex analysis, conformal mapping, Sturm-Liouville Theory, Groups, integral transforms, vector space and probability	PSO1	K1
CO2: To exemplify and discuss concepts involved in complex analysis, conformal mapping, Sturm-Liouville Theory, Groups, integral transforms, vector space and probability.	PSO1, PSO2	K2
CO3: To solve problems in complex analysis, conformal mapping, Sturm-Liouville Theory, Groups, integral transforms, vector space and probability.	PSO2, PSO3, PSO4	K3
CO4: To analyse principles learnt in this course by applying them in problems of different levels.	PSO2, PSO3	K4
CO5: To evaluate concepts learnt in this course that are applied in 21st century science and technology.	PSO2, PSO3	K5

SYLLABUS: Mathematical Physics II				
UNIT	**CONTENT**	**Hours**	**COs**	**Bloom's Taxonomy Level**
I	**Functions of Complex Variables** Complex numbers - Analytic functions - Elementary functions – Integrals – Cauchy Goursat theorem and Cauchy integral - Power series - Taylor series and Laurent's series- Residue and poles - Residue theorem - Applications of residue theorem - Evaluation of definite integrals and summation of series. Representation of functions of contour integrals - Gamma, Bessel and Legendre functions.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
II	**Conformal Mapping** Mapping of elementary functions - Conformal mapping - Applications of conformal mapping- Boundary value problems - Dirichlet and Neumann problems – Poisson's formula- Applications to fluid flow and electrostatic	10	1,2,3,4 &5	K1, K2, K3, K4, K5
III	**Sturm-Liouville Theory** Orthonormal functions set and expansion - Second order linear differential operators- Sturm Liouville problem - Self-adjoint operators – Orthonormality of Eigen functions – Expansion of function in terms of orthonormal basis- Completeness. Concepts of theory of distributions - Dirac delta function – Delta calculus - Representation of delta functions - Applications of the delta calculus.	10	1,2,3,4 &5	K1, K2, K3, K4, K5
IV	**Group Theory** Elements of group theory: Groups - Definitions and examples - Sub groups - Cayley's theorem – Cosets - Lagrange's theorem – Conjugate classes - Invariant subgroups – Factor groups – Homomorphism - Direct product group – Symmetry groups: Symmetry elements point groups and space groups - Group representation: Reducible and irreducible representation - Schur's Lemmas - The great orthogonality theorem - Criteria for irreducibility - Character of a representation- Character tables.	20	1,2,3,4 ,5&6	K1, K2, K3, K4, K5
V	**Integral Transforms** Laplace transform and inverse Laplace transforms - Faltung theorem - Application to solution of differential equations, partial differential equations, integral and integrodifferential equations. Fourier series - Analysis of periodic waveforms - Discrete frequency spectra – Fourier integral - Fourier transform - Applications to boundary value problems.	15	1,2,3,4 &5	K1, K2, K3, K4, K5
VI	**Linear Vector Space and Probability** Vectors in n – dimensions - Linear dependence and independence of Vectors - Basis – Representation of vectors and linear operators with respect to a basis - Transformation under change of basis - Schmidt orthogonalisation process - Bessel's inequality – Schwarz inequality - Unitary transformations. Definition of probability - Independent events - Mutually exclusive events – Repeated and independent trials - Compound events – Binomial, Poisson and normal (Gaussian) distributions - Standard deviations mean, variance, moments of the distributions - Theory of errors- Principle of least squares - Application of least squares to solution of linear equations - Curve fitting – Linear regression.	20	1,2,3,4 &5	K1, K2, K3, K4, K5

Prescribed Books/Text Books

1. B. D Gupta, *Mathematical Physics*, 2nd revised edition, Vikas pub. Co Ltd (1997) New Delhi.
2. R.V. Churchill, *Complex variables and Applications,* McGraw Hill, Kogakushs.
3. M. R Speigal, *Complex variables (Schaum's outline series),* McGraw Hill.
4. Sneddon I. N, *Fourier series, (Reutledge and Kegan Paul*).
5. R.V Churchill, *Fourier series and boundary value problems*
6. Frank Ayres. M. *Matrices (schaum's series)* (chapters 1-14)
7. M. R Speigel, *Laplace transforms (schaum's series*).
8. A.W Joshi, *Elements of group theory for physicists,* 3rd edition, Wiley Eastern Ltd.

Reference Books

1. Eugene Butkov, *Mathematical physics*
2. Sokolnikoff and Redheffer, *Mathematics for physicists*
3. M. Tinkham, *Group theory and quantum mechanical applications of group theory*

Suggested Reading

1. David M. Bishop, *Group theory*
2. Hammermesh, *Group theory*
3. M.K Venkatraman *Engineering mathematics vol III A* , The National Publishing Company, Madras.

Web Resources

http://homepage.physics.uiowa.edu/~ghowes/teach/2016phys4761/lec4761.html
https://www.physics.uoguelph.ca/phys3130-mathematical-physics-lecture-notes

Mathematical Physics II - Course Articulation Matrix

Course Outcomes	Programme Outcomes								Programme Specific Outcomes					Cognitive Level
	PO1	PO2	PO3	PO4	PO5	PO6	PO7		PSO1	PSO2	PSO3	PSO4		
CO 1	2	1	1	--	--	--	1		2	2	1	1		K1
CO 2	3	2	1	--	--	--	2		3	3	2	2		K2
CO 3	3	3	3	--	--	--	3		--	--	3	3		K3
CO 4	3	3	3	--	--	--	3		--	--	3	3		K4
CO 5	3	3	3	--	--	--	3		--	--	3	3		K5
Wt. Avg.	2.8	2.4	2.2	--	--	--	2.4		2.5	2.5	2.4	2.4		
							2.45					2.45		
Overall Mapping of the Course														**2.45**

CORE-Course title: Practical I General Physics Experiments

Course Code*	232PY2M03			
Credits				
Hours / Cycle	**12/Cycle (I Semester) and 9/Cycle (II Semester)**			
Category	**Part I Major Practical – I General**			
Semester	**I & II**			
Year of Implementation	**2023 /'24**			
Course Structure	**Theory**	**Tutorial**	**Practical**	**Total Hours**
	-	-		
Course Objectives	To demonstrate the understanding of the fundamental concepts and laws in physics by setting up laboratory equipments efficiently and carrying out experimental procedures.			

Course Outcome(s)**	**PSO Addressed**	**Bloom's Taxonomy Levels (K1 to K6)**	
CO1: To recall the formula behind the experiments.	**PSO-1, PSO3**	**K1**	**ALL GENERAL EXPERIMENTS**
CO2: To understand the basic principles and concepts involved in experiments through tabulation/ diagram/circuit diagrams.	**PSO-1, PSO 2, PSO 3**	**K2**	
CO3: To execute and demonstrate setting up of the experiments.	**PSO-2, PSO 3**	**K3**	
CO4: To experiment and tabulate the findings by performing the experiments.	**PSO-2, PSO 3**	**K4**	
CO5: To evaluate the results obtained through experimental observations.	**PSO-3, PSO 4**	**K5**	

LIST OF EXPERIMENTS - GENERAL		
S.No	**Exp. No.**	**Name of the Experiment**
1	G1	MEYER'S DISC – Viscosity of liquid
2	G2	BIPRISM
3	G3	HYPERBOLIC FRINGES – Young's Modulus and Poisson's ratio
4	G4	SOLAR SPECTRUM – Rydberg's constant
5	G5	PLANCK'S CONSTANT – Grating and Spectrometer
6	G6	ELLIPTIC FRINGES – Young's Modulus and Poisson's ratio
7	G7	LASER – Grating Constant
8	G8	STEFAN'S CONSTANT
9	G9	HYDROGEN SPECTRUM – **H_{α},H_{β} and H_{γ}**& Rydberg's constant
10	G10	THERMISTOR – Temperature Coefficient
11	G11	LASER – Thickness of thin wire
12	G12	BH CURVE – B-H response of the given ferromagnetic substance
13	G13	POLARIZABILITY OF LIQUIDS – Hg and H_2 spectrum
14	G14	SERIES AND PARALLEL RESONANT CIRCUIT – Capacitance

Course Articulation Matrix: Practical I General Physics Experiments

Course Outcomes	Programme Outcomes								Programme Specific Outcomes					Cognitive Level
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**		**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**		
CO 1	-	3	1	-	3	1	1		3	-	1	-		**K1**
CO 2	-	3	1	-	3	1	1		2	3	1	-		**K2**
CO 3	-	3	1	-	3	1	1		-	2	3	-		**K3**
CO 4	-	3	1	-	3	1	1		-	-	2	3		**K4**
CO 5	-	2	1	2	2	-	-		-	-	2	3		**K5**
Wt. Avg.	-	2.8	1	0.4	2.8	0.8	0.8		1	1	1.8	1.2		
							1.43					1.25		
													Overall Mapping of the Course	1.34

CORE-Course title: Practical II Electronics Experiments

Course Code*	232PY2M04			
Credits				
Hours / Cycle	**12/Cycle (I Semester) and 9/Cycle (II Semester)**			
Category	**Part I** Practical II Electronics Experiments			
Semesters	**I & II**			
Year of Implementation				
Course Structure	**Theory**	**Tutorial**	**Practical**	**Total Hours**
	-	-		
Course Objectives	To demonstrate the understanding of the fundamental concepts and laws in physics by setting up laboratory equipment efficiently and carrying out experimental procedures.			

Course Outcome(s)**	**PSO Addressed**	**Bloom's Taxonomy Levels (K1 to K6)**	
CO1: To recall the formula behind the experiments.	**PSO-1, PSO3**	**K1**	**All Electronics Experiments**
CO2: To understand the basic principles and concepts involved in experiments through tabulation/ diagram/circuit diagrams.	**PSO-1, PSO 2, PSO 3**	**K2**	
CO3: To execute and setting up experiment by wiring the circuit.	**PSO-2, PSO 3**	**K3**	
CO4: To experiment and tabulate the findings by performing the experiments.	**PSO-2, PSO 3**	**K4**	
CO5: To evaluate the results obtained through experimental observations.	**PSO-3, PSO 4**	**K5**	

LIST OF EXPERIMENTS - ELECTRONICS		
S.No	**Exp. No.**	**Name of the Experiment**
1	E1	UJT - Characteristics & Relaxation oscillator
2	E2	OP AMP - Basic arithmetic and calculus operations – IC 741
3	E3	OP AMP: Solving the Simultaneous Equations – IC 741
4	E4	ASTABLE MULTIVIBRATOR – IC 741
5	E5	ASTABLE MULTIVIBRATOR – IC 555
6	E6	WIEN BRIDGE OSCILLATOR – IC 741
7	E7	PHASE SHIFT OSCILLATOR – IC 741
8	E8	FET – Common Source Amplifier
9	E9	TRIANGLE WAVE GENERATOR – IC 741
10	E10	FUNCTION GENERATOR– IC8038
11	E11	MONOSTABLE MULTIVIBRATOR – IC741
12	E12	MONOSTABLE MULTIVIBRATOR – IC 555
13	E13	MONOSTABLE MULTIVIBRATOR – IC 74121
14	E14	D/A CONVERTER – IC 741
15	E15	FET – Common Drain Amplifier
16	E16	SAWTOOTH WAVE GENERATOR – IC 555
17	E17	SCHMITT TRIGGER – IC741
18	E18	SCHMITT TRIGGER – IC 555
19	E19	PHASE LOCKED LOOP – Frequency multiplier
20	E20	ACTIVE FILTERS – IC 741
21	E21	VOLTAGE CONTROLLED OSCILLATOR – IC 555 & IC 741
22	E22	R-2R LADDER D/A CONVERTER – IC 741

Course Articulation Matrix														
Course Outcomes	**Programme Outcomes**								**Programme Specific Outcomes**					**Cognitive Level**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**		**PSO1**	**PSO2**	**PSO3**	**PSO4**		
CO 1	-	3	1	-	3	1	1		3	-	1	-		**K1**
CO 2	-	3	1	-	3	1	1		2	3	1	-		**K2**
CO 3	-	3	1	-	3	1	1		-	2	3	-		**K3**
CO 4	-	3	1	-	3	1	1		-	-	2	3		**K4**
CO 5	-	2	1	2	2	-	-		-	-	2	3		**K5**
Wt. Avg.		2.8	1	0.4	2.8	0.8	0.8		1	1	1.8	1.2		
							1.43					1.25		
Overall Mapping of the Course														1.34

ADVANCED QUANTUM MECHANICS

(For students admitted from June 2008)

Semester: III Course code: 082PY3M01 Hour/Week: 6 Credits: 4

UNIT 1: TIME EVOLUTION PROCESS

Time dependent perturbation theory – First and second order – Constant and harmonic perturbations – Transition probabilities – Selection rules for dipole radiation – Application to potential scattering and inelastic collisions – Adiabatic and sudden approximations.

UNIT 2: EMISSION and ABSORPTION of RADIATION

[Semi-classical treatment]: The EINSTEIN coefficients – Spontaneous and induced emission of radiation from semiclassical theory – Radiation field as an assembly of oscillators – Interaction with atoms – Emission and absorption rates.

UNIT 3: SCATTERING THEORY

The scattering problem – Formulation in QM – Scattering amplitude and cross-section – Effect of identity of particles – Scattering by spherically symmetric potentials – The method of partial waves – Phase shifts – Optical theorem - RAMSAUER-TOWNSEND effect – Scattering by a perfectly rigid sphere – Scattering by a square well potential – Resonance scattering – Green's function – BORN approximation and its validity – Scattering by YUKAWA potential – COULOMB scattering.

UNIT 4: ATOMIC and MOLECULAR STRUCTURE

Central field approximation – THOMAS-FERMI model – HARTREE's method – HARTREE-FOCK equation – The method of self-consistent field – Hydrogen molecule ion – HEITLER-LONDON method – Hydrogen molecule – Covalent bond – Spin-orbit interaction as correction to central field approximation – Alkali atoms – Doublet separation – Intensities – Complex atoms – Coupling schemes.

UNIT 5: RELATIVISTIC WAVE EQUATION

The KLEIN-GORDON equation – Charge current FOUR vector – The DIRAC equation – DIRAC matrices – Free particle solution – Spin angular momentum – Introduction of electromagnetic field and interpretation of negative energy states – Magnetic moment – The hydrogen atom – Spin orbit coupling energy.

UNIT 6: Some OTHER ASPECTS of QUANTUM MECHANICS

[BFS 6]Group theory and Quantum Mechanics: M.O. theory – Matrix element – transition probabilities –[BFS 4,5] FEYNMAN path integrals – [BFS 1 & 3] FEYNMAN Diagrams – QED: Positron theory – [BFS 4] Introduction to Quantum computing.

Books for Study:

1. V. K. Thankappan, *Quantum Mechanics*, New Age Intl., (2004) New Delhi.
2. P. M. Mathews and K. Venkatesan, *A Textbook of Quantum Mechanics*, TMH, (1977) New Delhi.
3. V .Devanathan, *Quantum Mechanics*, Narosa Pub. House, (2005) Chennai.
4. R. L. Liboff, *Introductory Quantum Mechanics*, Pearson Education (2003) New Delhi.
5. B. H. Bransden & C. H. Joachain, *Quantum Mechanics*, Pearson Education (2000) New Delhi.
6. F. A. Cotton, *Chemical applications of Group theory*,3rd Edition, Wiley Eastern Ltd.,(1990).

Books For References:

1. E. Merzbacher, *Quantum Mechanics*, 2nd Edition, Wiley International Edition (1970).

2. J.J. Sakurai, *Modern Quantum Mechanics*, Pearson Education (1994) New Delhi.
3. P.A.M. Dirac, *The Principles of Quantum Mechanics*, Oxford University Press (1991).
4. C. Cohen-Tannoudji, B.Diu, Franck L, *Quantum Mechanics Vol I & II*, John Wiley International Edition (1977) New York.

ELECTRONICS (SPECIAL) - II

8085 MICROPROCESSOR AND INTERFACING

(For students admitted from June 2008)

Semester – III Course code: 082PY3M02 Hours/week: 6 Credits: 4

UNIT 1: DECODERS AND MEMORY INTERFACE

Decoders and data selectors - MUX, DEMUX – Applications of MUX – Memory systems – Linear selection, coincidence selection and two dimensional selection addressing – ROM/RAM memory organizations – ROM & its applications - Address and word expansion - Memory map – Exhaustive decoding – Partial decoding – Memory interfacing with 8085

UNIT 2: INTERRUPTS & I/O OPERATIONS

Interrupt circuits – Software and hardware interrupts - SIM, RIM instructions – SID, SOD serial I/O transfer - IN and OUT instructions – Hardware design of I/O interface – direct I/O, memory mapped I/O & polled I/O – Interrupt driven I/O and hand shaking operations.

UNIT 3: INTERFACING PERIPHERIAL I/O DEVICES

8255 (PPI) – Matrix scanning – Keyboard interface – Seven segment display– Keyboard/ display interface 8279 – Timer interface 8253/8254 - Interrupt controller 8259 – DMA controller 8237 – Communication interface USART 8251.

UNIT 4: TRANSDUCERS

Classification of transducers – Selecting a Transducer – Strain gauges – Gauge factor – Metallic sensing elements – Gauge confirmation – Displacement Transducers- Capacitive, Inductive and LVDT, Piezo electric and potentiometric Transducers – Thermocouples and thermistor – Photo sensitive devices.

UNIT 5: ADC/DAC TECHNIQUES

DAC - Variable resistance network - Binary ladder - D/A converter - D/A accuracy and resolution – ADC – Simultaneous counter - Counter type counter - Continuous counter - Dual slope counter - Successive approximation method - Voltage to frequency conversion and Voltage to Time conversion.

UNIT 6: INTERFACING ADC/DAC

Interfacing D/A converter (DAC IC 0808) - Waveform generation - Interfacing a 10-bit D/A converter (AD7522) - A/D converter using Interrupt Integrator type A/D converter (ADC 0801) - Software controlled successive approximation A/D converter (AD 558) – stepper motor.

Books for Study:

1. Ramesh S. Gaonkar. B, *Microprocessor architecture, programming and application*, Wiley International Edition 11th Reprint (1989).
2. Douglas V Hall, *Microprocessor and Interfacing, Programming and Hardware*, 2nd edition Tata McGraw Hill Publications,(2005) New Delhi.
3. Malvino Leach, *Digital principles and applications*,5th edition Tata McGraw Hill Publications, (2002) New Delhi.
4. Millman and Grabel, *Microelectronics*, 2nd edition TMH Publishing Company Ltd.,(1999) New Delhi.
5. Taub And Schilling, *Integrated electronics*, Tata McGraw Kogakusha Ltd Hill, International student edition,11th printing (1984).
6. Albert D. Helfrich And William D. Cooper *Modern electronic instrumentation and measurement techniques*, 5th edition, Prentice Hall of India.

NUCLEAR PHYSICS AND PARTICLE PHYSICS

(For students admitted from June 2008)

Semester – III Course code: 082PY3M04 Hours/week:6 Credits: 4

UNIT 1: ELEMENTS OF NUCLEAR STRUCTURE AND LIQUID DROP MODEL

Nomenclature (isotopes, isotones, isobars, isomers, mirror pairs) – Experimental method for nuclear radius – Expression for electric quadrupole moment and magnetic dipole moment of nucleus.

Systematics of stable nuclides - Nuclear coulomb energy - Semi empirical mass formula of Weizacker - Nuclear stability - Mass parabola for odd A and even A nuclides - Hypothetical Z_0 - Line of beta stability - Radius constant from binding energy for mirror nuclei - Bohr Wheeler theory of fission - Condition for spontaneous fission- activation energy - Seaborg's expression.

UNIT 2: SHELL MODEL AND OTHER MODELS

Shell Model: Evidence for magic numbers - Square well potential - Linear harmonic oscillatory potential – Spin orbit potential - L-S splitting – Explanation of magic numbers - Energy level diagram - Prediction of shell model - Prediction of nuclear spin and parity – Nuclear statistics.

Schmidt model - Magnetic moments of nuclei - Schmidt lines - Nuclear isomerism.

Collective Model: Explanation of quadrupole moment - Prediction of sign of electric quadrupole moments – Rotational energy levels – High spin states - Shape transition.

Nilsson model – Deformed shell model.

Optical model: Elementary ideas.

UNIT 3: NUCLEAR FORCES

Properties of nuclear forces - Charge independence and spin dependence - Ground state of deuteron - Magnetic dipole moment and electric quadrupole moment of deuteron -Central and non central forces - Tensor force - Exchange forces – Majorana, Barlett, Heisenberg, Wigner forces - Isotopic spin formalism - Spin orbit force - Saturation condition - Meson theory of nuclear forces – Yukawa potential – Low energy nucleon - Nucleon scattering effective range theory.

UNIT 4: NUCLEAR DECAY

Nuclear disintegration studies: Laws of radioactivity - Successive radioactive transformation - Radioactive equilibrium between parent and daughter activities – Ideal, transient and secular equilibria – Parent-daughter relationship in radioactive dating.

Alpha Decay: Q value of the decay - Energy carried by alpha particles - Gamow's theory of alpha decay - Geiger Nuttal law - Alpha spectra - Short and long - Range particles - cluster radioactivity - Alpha spectrometer.

Beta Decay: Transition energies of beta decay and electron capture – continuous beta spectrum – Neutrino hypothesis - Neutrino properties - Neutrino rest mass - Fermi's theory of Beta decay - Fermi-Kurie plot - Sargeant diagram - Comparative half life - Allowed and forbidden transition - Degree of forbiddenness - Fermi and Gamow -Teller selection rules - Parity non conservation in weak interactions - Wu's experiment – Neutrino helicity - Beta spectrometer.

Gamma decay: Internal conversion - Angular distribution and correlation - Gamma ray spectrometer.

UNIT 5: NUCLEAR REACTIONS AND REACTOR PHYSICS

Nuclear reactions and cross section-geometrical cross section - Resonance- Breit–Wigner dispersion formula for l=0 - statistical theory of nuclear reactions- Evaporation probability and cross section - Direct reactions - Theory of stripping and pick up reactions- Surface reactions.

Nuclear chain reaction - Four factor formula - Critical size of the reactor - Fermi age equation - Classification of reactors - Breeder reactors - Materials for reactors - Radioactive poisoning of the reactor - Radiation hazards - Dosimetry and shielding – Fusion- thermo nuclear reactions- Source of stellar energy- Controlled thermo nuclear reactions.

UNIT 6: ELEMENTARY PARTICLES

Classification - Mass, spin, interaction – Baryons, mesons, leptons – Fermions, Bosons – Field particles – Photon, graviton, hadrons – Conservation laws – Isospin and isospin quantum numbers – Strangeness – Hypercharge – Quark model – Gell Mann Okubo mass formula - Quark structure of Hadrons - Weak interactions - Decays of muon, neutron and strange particles

Books for Study:

1. R. Roy and P. Nigam, *Nuclear physics*, Wiley Eastern Ltd., New Delhi.
2. Bernard L Cohen, *Concepts of nuclear physics*, 9th reprint, TMH, (1989) New Delhi.
3. R.C Sharma, *Nuclear physics*, 4th revised edition K. Nath & co.,(1989) Meerut.
4. Samuel Wong, *Nuclear physics*, Prentice-Hall Of India Private Limited, (2005) New Delhi

Books for Reference:

1. H.A Enge, *Nuclear physics*, Addition Wesley pub.co. London.
2. Marmier and Shelton, Physics *of Nuclei and Particles Vol I*, 2nd print Academic press,(1971) London.
3. I. Kaplan, Nuclear *Physics*, 2nd edition, Narosa Pub. Co., (1989) Bombay.
4. J. M. Blatt and V. F. Weiss Kopf, Theoretical *Nuclear Physics*, John Wiley and Sons, (1952) New York.
5. R. D. Evans, The *Atomic Nucleus*, Tata McGraw Hill Book Co., (1978) New Delhi.
6. S. B. Patel, *Nuclear Physics* Wiley Eastern Ltd., (1991) Madras.
7. D. C. Tayal, *Nuclear Physics* ,1st edition, Himalaya Pub House,(2003) Bombay
8. S Glasstone, *Source Book on Atomic Energy* , 3rd edition Affiliated East-West Press, (1967) Madras.

SOLID STATE PHYSICS

(For PG students admitted prior to and from June 2011)

Semester –III Course code: 082PY3M03 Hours/week: 6 Credits:4

UNIT 1: STRUCTURE OF SOLIDS AND DEFECTS

i) Crystal Basics :7 crystal systems; 14 Bravais lattices; point groups (no derivation); Miller indices; reciprocal lattice and Ewald's construction.

ii) Types of bonding: Metallic, covalent, ionic, Van der Waals' and hydrogen bonding; Born-Meyer theory of ionic crystals and its limitations; Born-Haber cycle.

iii) Defects in crystals: Point defects; Schottky and Frenkel defects; color centers; slip, edge and screw dislocation; Burger vectors; effect of defects on properties.

UNIT 2: MECHANICAL PROPERTIES OF SOLIDS

i) Stress and strain tensor: Elastic constants; reduction in number of elastic constants in cubic crystals; wave propagation along (100) and (111) directions of a cubic crystals; experimental determination of the elastic constants; importance of elastic constants.

ii) Lattice vibrations: Lattice vibrations of 1D diatomic chain; acoustic and optical branches; qualitative discussion of the dispersion in 3D crystals; Brillouin zone; phonon states and experimental studies on phonons.

UNIT 3: THERMAL PROPERTIES OF SOLIDS

Average energy of an oscillator: Debye's theory of specific heats and T^3 law; representation of specific heat in terms of θ_D-T plots; derivation of Gruneisen's law of thermal expansion from free energy; phonon thermal conduction and its variation with temperature; normal and Umklapp processes; impurity and boundary scattering.

UNIT 4: FREE ELECTRON THEORY OF METALS

Free electron theory of metals: Density of states; Fermi-Dirac statistics; Fermi level; effective mass of the electron; Drude model of electrical conductivity; Wiedmann-Franz equation; thermal conductivity; electronic specific heat and paramagnetic susceptibility; Hall effect; magnetoresistance; electrical conductivity at high frequencies.
Energy band theory; periodic potential; Bloch theorem; Kronig and Penny model; tight binding approximation; experimental study of band structure.

UNIT 5: MAGNETIC PROPERTIES OF SOLIDS

Review of basic concepts & formulae – Distinction between magnetic materials- Diamagnetism : Classical theory – paramagnetism : Classical theory & Weiss modification – Quantum theory of paramagnetism – Quenching of orbital angular momentum – ferromagnetism : Classical theory – Quantum theory of ferromagnetism – Curie – Weiss law – Domain wall - Antiferomagnetism & Ferrimagnetism (Introduction) – Structure of Ferrites– Meissner Effect – Type I and Type II Superconductors – London equation.

UNIT 6: DIELECTRICS AND OPTICAL PROPERTIES OF SOLIDS

Dielectrics : Classification of dielectric materials – Dielectric polarization – Dielectric constant & displacement vector – Claussius- Mossitti relation – Types of polarizability – Dipolar Polarizability – frequency dependence of dipolar Polarizability – Ionic Polarizability-

Electronic Polarizability – The Classical theory – Dependence of frequency & temperature on total Polarizability – Peizo electricity , ferroelectricity (Introduction)

Optical properties of Ionic Crystals: Drude model – macroscopic theory of optical constants – dispersion and absorption – excitons- luminescence types- introduction to NLO and Liquid crystals

BOOKS FOR STUDY:

1) Solid State Physics – C. Kittel, 5th edition, Wiley Eastern Ltd.
2) Solid State Physics – A. J. Dekker, Macmillan and Co. Ltd.
3) Handouts given by the course teacher.
4) Solid State Physics – S. O. Pillai, New Age International (P) Ltd., Publishers, Reprint 2003.
5) Solid State Physics – Gupta and Kumar, K. Nath and Co. Reprint 2006
6) Material Science and Engineering – A first course, V. Raghavan, 5th Edition, Prentice Hall of India, 2004.
7) Solid State Physics – Structure, Properties of Materials – M. A. Wahab, Narosa Publishing house Pvt. Ltd, 2005

BOOKS FOR REFERENCE:

1) Solid State Physics – C. M. Kachhava, Tata McGraw Hill Co.(1990)
2) Physics of Solids – C. A. Wert and R. M. Thomson, McGraw Hill Book Co.
3) Fundamentals of Solid State Physics – B. S. Saxena, R. C. Gupta and P. N. Saxena, Pragati Prakashan, Meerut (1990).
4) Principles of Solid State – H.V. Keer, Wiley Eastern Ltd (1993)
5) Quantum theory of Solid State: An introduction by Ler Kantorovich, Kluwer Academic Publishers

NUCLEAR REACTOR PHYSICS (Optional)

(For students admitted from the June 2008)

Semesters – IV Course code: 082PY4E01 Hours/week: 3 Credits: 3

UNIT 1: INTRODUCTION

Particle wavelength – Nuclear radii - Nuclear mass - Binding energy of radioactivity – Q value of nuclear reactions - Nuclear cross sections – Macroscopic cross sections - Differential cross sections – Critical energies for fission fragments – Prompt neutrons – Delayed neutrons –Energy release per fission – Reactor power – Fuel burn – Up and Fuel consumption rates.

UNIT 2: DIFFUSION OF NEUTRONS

Neutron Flux – Neutron current density – The equation of continuity – Fick's law – the diffusion equation – Steady state solution for infinite planar source, point source in an infinite medium – Diffusion length – The reciprocity theorem.

UNIT 3:

Energy loss in elastic collisions – Moderation of neutrons in hydrogen – Lethargy – Moderation of neutrons for A>1 – Fermi Age theory – Solution to the age equation – Planar source in an infinite slab – In an infinite medium – Point source in an infinite medium – Measurement of neutron age.

UNIT 4:

Criticality of an infinite homogenous reactor – Buckling – Criticality of rectangular parallelepiped. Sphere and infinite cylinder.

UNIT 5:

Infinite rector with no delayed neutrons – The reactivity equation – The prompt critical condition – Changes in reactivity – Temperature coefficients – Fission poisoning.

UNIT 6:

Control – Rod worth – Fuel management – Natural reactors – Thermal reactors - Intermediate reactors – Fast reactors – Breeding – The Thorium converter – Light water Reactors – Heavy water Reactors – Heat generation and removal – Radiation shielding and reactor safeguards – Evolution of reactors – India Reactors – Nuclear submarines.

Books for Study:

1. John R Lamarsh, *Introduction to Nuclear Reactor Theory* Addison Wesley Publishing Company 2nd printing (1992)
2. Paul .F. Zweifel, *Reactor Physics*, Mc Graw Hill Book Company (1973) India.

Books for Reference:

1. Richard Stepheson, Introduction *to nuclear Engineering*, Mc Graw Hill Book Company (1974) New York.
2. Suresh Gard, Feroz Ahmed and L.S Kothari ,*Physics of Nuclear Reactors* , Tata McGraw Hill Pub. Co. Ltd, London.
3. Samuel Glasstone and Edmund , *Nuclear reactor theory*

MATERIALS SCIENCE (Optional)

(For students admitted from June 2008)

Semesters –IV Course code: 082PY4E02 Hours/week: 3 Credits: 3

UNIT 1:

Crystal structures – Bonds – Quantum mechanics of solids – Band Structure – Quantum nature of nanoworld.

UNIT 2: ANALYTIC TECHNIQUES IN MATERIALS SCIENCE

X-ray and neutron diffraction techniques – Thermo Luminescence Spectroscopy [TLS] – UV-VIS-IR spectroscopy – FTIR – AUGER Spectroscopy – Secondary Ion Mass spectrometry[SIMS] – Field Ion Microscope[FIM] – TEM & SEM – ESCA,EDAX,EXAF – Impedance measurements – Magnetic measurements- Ultrasonic measurements.

UNIT 3: NANO TECHNOLOGY

FEYNMAN revisited – N.Taniguchi – Definition – Introduction – Nanomaterials –Quantum Wells, Wires, and Dots – Carbon Nanostructure -Thin Film Technology – Overview of deposition methods and applications.

INTEL nanometer technology – VLSI progress – INTEL's record – Silicon laser technology – Integrated optics – Components and integrated optic systems.

UNIT 4: NEW MATERIALS

Polymers, HTS, Ceramics, SuperIonic Conductors: Introduction – Structure – Production – Characteristic properties – Applications.

ZIRCONIAS, SIALONS, ZEOLITES, FULLERENES.

UNIT 5: APPLICATIONS

Magnetic memory devices - GMR reading head.- Display devices : LED – LCD – TFT – OLED – Plasma.- Energy - Solar Cells – Fuel Cells – Electric Cells – The basic lead-acid technology – Li-polymer – Li-MH.

UNIT 6:

A review document on any recent material/materials science aspect: [25 pages]: to be evaluated.

Books for Study:

1. J. C. Anderson, K.D. Leaver, R.D. Rawlings, J.M. Alexander, *Materials Science for Engineers*, Nelson Thornes (2003) UK.
2. C. M. Srivastava, C. Srinivasan, *Science of Engineering materials*,
3. M. A. Wahab, *Solid state physics (structure and properties of materials)*, New Age International Pvt Ltd (2003) New Delhi.
4. Charles P. Poole, Jr., Frank J. Owens, *Introduction to Nanotechnology*, John Wiley & Sons, Inc. (2003) New York.
5. Woodruff And Delchar, *Experimental techniques of Surface Science*, CUP (1994) Camb.
6. *Handbook of Analytical Methods for Materials, Materials Evaluation and Engineering*, Inc (2001) MN.
7. Goswami. A, *Thin Film Fundamentals*, New Age International Publishers, (1996) Delhi.

Books for Reference:

1. Edward L. Wolf, Nanophysics *and Nanotechnology, An Introduction to Modern Concepts in Nano science*, John Wiley & Sons, (2004) New York.
2. Bharat Bhushan, Ed., Springer *Handbook of Nanotechnology*, Springer Verlag, (2004) London.

3. **Wilson, Mick; Kannangara, Kamali; Smith, Geoff et al.,** *Nanotechnology Basic Science and Engineering Technologies*,**CRC Press, (2002) Mass.**
4. Bowen D K And Hall C R, *Microscopy of Materials Modern Imaging Methods using Electron, X-ray and Ion Beams*, Macmillan, (1975) London.
5. R. Saito, G. Dresselhaus and M.S. Dresselhaus (Eds.), *Physical Properties of Carbon nanotubes*, Imperial College Press, (1998) London.

MOLECULAR AND SPIN RESONANCE SPECTROSCOPY

(For students admitted from June 2008)

Semester – IV Course code: 082PY4M01 Hours/week: 6 Credits:4

UNIT1: MICROWAVE SPECTROSCOPY

Rotation of molecules - Rigid and non-rigid rotator - Diatomic molecules-Linear polyatomic molecules - Symmetric top molecules - Stark effect - Quadrupole moment and hyperfine structure - Inversion spectrum of ammonia - Experimental techniques- Ammonia Maser.

UNIT2: INFRARED SPECTROSCOPY

Vibration of polyatomic molecules - Classical and quantum mechanical theories -Vibration spectra of simple polyatomic molecules (linear, spherical, symmetric top) –Rotation - Vibration interaction - General force field - Force constant -Morse potential energy curve - Experimental techniques - Applications. Reflectance – Absorbance – IR spectroscopy (RAIRS).

UNIT3: RAMAN AND ELECTRONIC SPECTROSCOPY

Classical and quantum mechanical theories - Depolarization ratio - Pure rotation and Rotation-vibration Raman spectra - Experimental techniques - Determination of the structure of molecules and crystals - Group theory and normal modes of vibration of polyatomic molecules - Laser Raman Techniques.

Electronic spectra of diatomic molecules - Born-Oppenheimer approximation -Intensity of electronic bands - Franck-Condon principle - Dissociation energy - Fortrat parabola - Experimental techniques - Electron energy loss spectroscopy (EELS).

UNIT4: NMR SPECTROSCOPY

Theory - Bloch's equations - Steady state solutions of Bloch's equations - Relaxation Processes - Line shape and line width - Screening constants - Theory of chemical shift – high resolution NMR - NMR spectra of liquids -Spin-spin interaction - First order spectrum - Quadrupole effect - Experimental techniques - Applications.

UNIT5: ESR AND NQR SPECTROSCOPY

Theory - spectra of organic free radicals in solution - Hyperfine structure - Splitting of spectral lines - ESR of hydrogen atom - Spectrum of radicals containing multiple sets of equivalent protons - g-factor - Crystal field effects - Experimental techniques-Applications.

NQR - Theory - Axial symmetry and non-axial symmetry - Factors influencing the line width - Effect of applying weak magnetic field - Experimental techniques - Applications.

UNIT6: LASERS,MOESSBAUER SPECTROSCOPY AND SURFACE SPECTROSCOPY

Laser principle and theory - Characteristics of laser beam - Einstein's coefficients – Solid state lasers - Ruby laser-Nd: YAG laser - Gas lasers - He-Ne gas laser, CO_2 laser -semiconductor laser - Injection lasers.

Principle - Experimental set up to study Moessbauer effect - Major interactions - Chemical Isomer shift - Quadrupole splitting and Zeeman splitting - Applications.

Surface Spectroscopies**:** Photo electron spectroscopy (PES) – X ray photo electron spectroscopy (XPES) – Ultraviolet PES – Auger electron spectroscopy (AES).

Books For Study:

1. Straughan and Walker, Chapman and Hall *Spectroscopy Vol I, II, III*, John Wiley and sons Inc., (1976) New York.
2. Colin.N. Banwell And Elaine M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th edition, Tata Mc Graw Hill Publishing Company Ltd(2003) New Delhi.
3. R. Chang, *Basic principles of spectroscopy*, International student edition, copyright (1971) McGraw Hill Kogakusha Ltd.

4. G.Herzberg,D.Van nostrand Co.,Inc.,*Infrared and Raman spectroscopy*,2nd edition van Nostrand Company, New York.
5. S. L Gupta, V. Kumar and R. C. Sharma- Pragathi Prakashan, *Elements of spectroscopy*, (2003) Meerut.
6. B. B. Laud, Lasers *and Non-Linear Optics*, Edition. John Wiley & Sons, Inc. (1996) New York.

ELECTRONICS (SPECIAL) - II
MICROCONTROLLER AND COMMUNICATION SYSTEM
(For students admitted from June 2008)

Semester – IV Course code: 082PY4M02 Hours/week: 6 Credits:4

UNIT 1**:** 8086 ARCHITECTURE

Architecture – Minimum and maximum mode – BIU – EU – Segmentation of memory – Pipe line processing – Interrupt types and 8086 response – Internal interrupts – Interrupt priorities - NMI

UNIT 2: 8086 PROGRAMMING

Software model – Addressing modes – Instruction set - Programming: Block transfer – Averaging a set of data – Linear selection of 16 bit signed binary numbers – Factorial of a byte – Code conversion: binary to BCD and BCD to binary – Use of MASM.

UNIT 3**:** MICROCONTROLLER & INTERFACING:

Introduction to 8 & 16 bit microcontroller families – Flash series - Architecture of 8051 – Key features – Memory organization (internal & external) – SFR – Timers and counters – Instruction set – SFR bit addresses – Addressing modes – Simple programs.

Interfacing I/O ports, external memory, counters and timers – Interfacing 8051 with ADC, DAC, LED display, keyboard and stepper motor.

UNIT 4: EMBEDDED MICROCONTROLLER

Basics - Embedded microcontroller system – Types of embedded operating system – micro chip PIC16C6X/7X family – Features – Architecture – Memory organization – Register file map – I/O ports – Data and flash program memory – Asynchronous serial port – Applications in communication and industrial controls.

UNIT 5**:** SIGNAL ANALYSIS:

Fourier transform of gate function, delta function at the origin - Two delta functions and periodic delta function - Properties of Fourier transform - Frequency shifting property and time shifting property - Convolution theorems - Sampling theorems.

PULSE COMMUNICATION:

Pulse amplitude modulation - Natural sampling - Instantaneous sampling - Pulse modulation: PAM, PWM, PPM, and PCM - Time division multiplexing and frequency division multiplexing - Comparison of time division and frequency division multiplexing.

UNIT 6: SATELLITE COMMUNICATION

Introduction - Satellite orbits - Satellite altitude - Transmission path - Path loss - Noise consideration - Satellite systems - Effective isotropic radiated power.

OPTICAL COMMUNICATION:

Propagation with in fiber - Classification of fibers - Modes of propagation - Losses in fibers - Dispersion in optical fibers - Advantages and disadvantages - Hartley Shannon theory – Noise-Signal ratio - Channel capacity.

Books for Study**:**

1. Doughlas V Hall, *Microprocessor and interfacing, programming and hardware*, Tata McGraw Hill Publications, New Delhi.
2. Kenneth J. Ayala, *The 8051 Microcontroller*, 3rd edition, Penram international (1997)
3. Frank Vahid And Tony Givargis, *Embedded system design*, John Wiley & Sons, Inc.(2005).

4. John B. Peatman, *Design with PIC Microcontrollers*, 7th Indian reprint (2004), Pearson education.

Books for Reference:

1. Walter A Triebel And Avtar Singh, *16 bit microprocessor architecture, software and interface techniques*, 2nd printing, Prentice Hall Inc., Englewood Cliffs,(1996) New Jersey.
2. B.P.Lathi, *Communication systems, B.S* Publication 1968.Reprint (2001).
3. George Kennedy, *Electronic Communication systems*
4. Dennis Roddy And John Coolen , *Electronic communications* , 4th edition, Prentice Hall of India Pvt Ltd.,(1998) New Delhi.
5. Raj Kamal, *Introduction to Embedded system*, 2nd printing, Pearson Education, (2005).