Centurion
UNIVERSITY

School of Applied Sciences

Centurion University of Technology & Management

M.Sc. (Physics) syllabus

(Two years programme)

2016-2018 Batch

M.Sc. Physics
(Two year programme)
Course Structure-2016

Semester-I

Sl No	Code	Subject Name	(L-T-P)	Credits
1	MSPH4701	Quantum Mechanics II	3-1-0	4
2	MSPH4702	Mathematical Physics II	3-1-0	4
3	MSPH4703	Electrodynamics II	3-1-0	4
4	MSPH4704	Classical Mechanics II	3-1-0	4
5	MSPH4705	Computational Physics II	2-0-3	4
6		Skill I	0-0-6	4
		Total		24

Students can choose one of the below given streams for the special papers

Semester-II

Stream-1: Electronics Special Paper

Sl. No	Code	Subject Name	(L-T-P)	Credits
1	MSPH4801	Computational Physics III (Common to all)	2-0-0	4
2	MSPH4805	Analog Communication Technique	3-1-0	4
3	MSPH4806	Digital Systems and Signal Processing	3-1-0	4
4	MSPH4807	Microprocessor and interfacing devices	3-1-0	4
5	MSPL4803	Signal processing Lab	0-0-3	2
6	MSPL4804	Microprocessor and interfacing devices Lab	0-0-3	2
7		Skill II	0-0-6	4
		Total		24

Stream-2: Material Science Special Paper

Sl. No	Code	Subject Name	(L-T-P)	Credits
1	MSPH4801	Computational Physics III (Common to all)	2-0-0	4
2	MSPH4802	Fluid Mechanics	3-1-0	4
3	MSPH4803	Physics of Materials I	3-1-0	4
4	MSPH3602	Statistical physics	3-1-0	4
5	MSPL4801	Physics of Materials Lab I	0-0-3	2
6	MSPL3501	Physics Laboratory 5	0-0-3	2
7		Skill II	0-0-6	4
		Total		24

Skill Elective Courses (Any two to be taken)

Sl. No	Code	Subject Name	(L-T-P)	Credits
1	SBFE3125	Image Processing through MATLAB-I	0-0-6	4
2	SBFE4102	Basic C Concepts	0-0-6	4
3	SBFE3130	Optical Fiber Technician	0-0-6	4

Semester-III

Stream-1: Electronics Special Paper

Sl No	Code	Subject Name	(L-T-P)	Credits
1	MSCP2301	Atomic and Molecular Physics	3-1-0	4
2	MSPH5105	Solid State Physics II	3-1-0	4
3	MSCP1202	Electronics Devices and Circuits	3-1-0	4
4	MSCP2401	Electronics Communication System	3-1-0	4
5	MSRM5101	Introduction to Research	2-0-0	2
6	MSCP1205	Electronics Devices Lab	0-0-3	2
7	MSPS2301	Seminar I	0-0-3	2
		Total		22

Stream-2: Material Science Special Paper

Sl No	Code	Subject Name	(L-T-P)	Credits
1	MSCP2301	Atomic and Molecular Physics	3-1-0	4
2	MSPH5105	Solid State Physics II	3-1-0	4
3	MSCP2305	Soft Matter Physics	3-1-0	4
4	MSCP2403	Introduction to Bio and Nano materials	3-1-0	4
5	MSRM5101	Introduction to Research	2-0-0	2
6	MSPL5103	Physics of Materials Lab II	0-0-3	2
7	MSPS2301	Seminar I	0-0-3	2
		Total		22

Semester-IV

Stream-1: Electronics Special Paper

Sl No.	Code	Subject Name	(L-T-P)	Credits
1	MSCP2302	Nuclear and Particle Physics	3-1-0	4
2	MSPH5103	Embedded System	3-1-0	4
3	MSPS2401	Seminar II	0-0-6	4
4	MSPP2401	Project/Dissertation	0-0-12	8
5	MSPL5101	Embedded System Lab	0-0-3	2
		Total		22

Stream-2: Material Science Special Paper

Sl No.	Code	Subject Name	(L-T-P)	Credits
1	MCSP2302	Nuclear and Particle Physics	3-1-0	4
2	MSPH5205	Advanced Condensed Matter Physics	3-1-0	4
3	MSPS2401	Seminar II	0-0-6	4
4	MSPP2401	Project/Dissertation	0-0-12	8
5	MSPL5202	Physics of Materials Lab III	0-0-3	2
		Total		22

Detailed Syllabus

Semester I

MSPH4701 Quantum Mechanics-II

Code	Course Title	Course Type	Credits	L-T-P
MSPH4701	Quantum Mechanics-II	Theory	4	3-1-0

Module-I (18Hrs)

Matter waves: De Broglie's hypothesis, Free Wave packets, The Heisenberg Uncertainty Relations, The probability Interpretation of the Wave Function, the Schrodinger Equation. Postulates of Quantum Mechanics.
The general structure of wave Mechanics: Vector spaces and operators, Dirac Notation, **O**perators and Observables,, Degeneracy and Simultaneous Observables, Observables as operators, Projection Operators, Harmonic Oscillator using creation-annihilation operators, The time dependence of Operators, Problems

Module-II (20Hrs)

Angular Momentum: The angular Momentum Commutation Relations, Raising and Lowering Operators for Angular Momentum, Representation of |l,m> States in Spherical Coordinates, Matrix Representations of Angular Momentum Operators, problems

The Schrodinger Equation in Three Dimensions and the Hydrogen Atom:

The central Potential, The Hydrogen Atom and its Energy Spectrum, The Degeneracy of the Spectrum, problems.

Spin: Eigenstates of spin ½, The intrinsic Magnetic Moment of Spin ½ particles, Addition of Two Spins, The addition of spin ½ and orbital angular momentum, General Rules for addition of angular Momenta, Problems

Module-III (18Hrs)

Perturbation Theory: Energy Shifts and Perturbed Eigen states, Degenerate Eigenstate and removal of degeneracy, The Stark Effect, Zeeman Effect, Hyperfine structure, Fermi's Golden rule. Introduction to Time-Dependent Perturbation Theory. Schrodinger, Heisenberg and Interaction Picture.

Text Books:

1. A text Book of Quantum Mechanics, PM Mathews and K Venkatesan, McGraw Hiil, 2010.
2. Quantum Physics by S. Gasiorowicz, John Wiley, 2013.
3. Introduction to Quantum Mechanics, D J Griffith, Pearson, 2014.
4. Modern Quantum Mechanics, J.J. Sakurai, Pearson, 2013.
5. Quantum Mechanics, Gupta & Kumar (Jai PrakashNath Publications)

MSPH4702 Mathematical Physics II

Code	Course Title	Course Type	Credits	L-T-P
MSPH4702	Mathematical Physics II	Theory	4	3-1-0

Module-I (17Hrs)

Vector Analysis: Vector calculus, Integral theorems, curvilinear coordinates, Differential vector operators in curvilinear coordinates, Coordinate Transformations.

Complex variable Theory: Cauchy's Integral Theorem, Cauchy's Integral Formula, Laurent Expansion, Calculus of residues.
Matrices and Tensors: Tensor analysis, Pseudo-tensors, Dual tensors.

Module-II (22Hrs)

Vector Spaces:

Definition of vector spaces, Scalar product, Hilbert Space, Dirac- Delta Function, Gram-Schmidt Orthogonalization, Operators, Commutation relations, Identity, Inverse and Adjoint operators.

Sturm-Lioville Theory:

Hermitian Operator, ODE eigenvalue problems, Bessel Functions of the First kind, Spherical Bessel Functions, Orthogonality and completeness of the eigen functions.

Gamma function: Definitions, Properties, The Beta Function

Module-III (20Hrs)

Fourier Transforms: Fourier Transforms, Properties of Fourier Transforms, Convolution Theorem.

Partial differential equations (PDEs): Second order PDEs, Classification of PDEs, Laplace equation, Fourier's Heat flow equation, Wave equation.

Green's Functions: One-dimensional problems, Qualitative idea of Green's functions in 2- and 3-dimentions.

Text Book:

1. Mathematical Methods for Physicists by G B Arfken, H J Weber and F E Harris, Elsevier, 2012.

Reference Books:

1. Mathematical Physics by C. Harper, PHI, 2012.
2. Mathematical Physics: The Basics by J D Joglekar, Universities Press, 2005.
3. Mathematical Physics: Advanced Topics by J D Joglekar, Universities Press, 2006.
4. Advanced Mathematical Methods for Scientists and Engineers, C M Bender and S AOrszag, Springer International Edition, 2013.
5. Mathematical Physics by Satya Prakash, Sultan Chand & Sons; Sixth edition (2014).

MSPH4703 Electrodynamics II

Code	Course Title	Course Type	Credits	L-T-P
MSPH4703	Electrodynamics II	Theory	4	3-1-0

Module I

Electricity in Matter: (20Hrs)

The electrostatic field of conductors, energy of the electrostatic field of conductors, methods of solving problems in electrostatics, forces on the conductor, the electric field in dielectrics, dielectric permeability, thermodynamics of dielectrics, electric forces in a fluid dielectric, piezoelectric, Ferroelectrics, Current density and conductivity, Hall effect.

Module II (18Hrs)

Magnetism in Matter:

Matter in constant magnetic field, Force in magnetic field, Gyromagnetic phenomena, Dia-, Para-and Ferromagnetism, Ferromagnetic near the Curie point, Domain structure of ferromagnetic, Anti-ferromagnetism, Magnetic properties of superconductors, Superconductivity current, Critical field, Eddy currents, Skin effect.

Module III (17Hrs)

Electromagnetic Waves in Matter:

Maxwell's equations, EM waves in vacuum, field equations in a dielectric in the absence of dispersion, frequency dependence of dielectric and magnetic permeability, Dispersion relations, EM waves in waveguides and resonators, EM waves in non-homogeneous and anisotropic media, Scattering and absorption of em waves by small particles, EM waves and matter interaction.

Text Book:

1. Electrodynamics of Continuous Media, by L D Landau E M Lifshitz and L P Pitaevskii, CBS Publishers and Distributers, 2007.

Reference Book:

1. Introduction to Electrodynamics, D J Griffiths, Prentice Hall of India, 2012.
2. Introduction to Solid State Physics, C Kittel, Wiley, 2012.
3. Callister's Materials Science and Engineering, R Balasubramaniam, Wiley, 2014.

MSPH4704 Classical Mechanics-II

Code	Course Title	Course Type	Credits	L-T-P
MSPH4704	Classical Mechanics II	Theory	4	3-1-0

Module I: (20Hrs)

Lagrangian Dynamics for holonomic systems and extensions, Hamiltonian dynamics, conservation laws, central force problem, variational principle.

Module II: (20Hrs)

Canonical transformations, Poisson Bracket, Hamiltonian-Jacobi equation, Canonical perturbation theory, Time-dependent perturbation, Illustrations of time-dependent perturbation theory, Time-dependent perturbation theory in first order with one degree of freedom.

Small Oscillations: Coupled oscillators in Lagrangian formalism, Lagrangian formulation of continuous systems.

Anharmonic oscillations. Introduction to parametric resonance.

Module III: (20Hrs)

Introduction to Nonlinear systems: Simple non-linear models: logistic map, system of differential equations, phase space trajectories, dynamical behavior: period doubling, limit cycles, chaos.

Text Book:

1. Classical Mechanics by J C Upadhyaya, Himalaya Publishing House, 2014.
2. Nonlinear Dynamics and Chaos, S H Strogatz, Persius Books, 2000.

Reference Books:

1. Classical Mechanics by H Goldstein, Pearson, 3rd Edition, 2011.
2. Classical Mechanics by Landau &Lifshitz, 7th Ed, CBS Publishers, New Delhi, 2010.
3. Differential Equations, Dynamical Systems and an Introduction to Chaos, MW Hirsch, S Smale, RL Devaney, Elsevier, 2012.

MSPH4705 Computational Physics-II

Code	Course Title	Course Type	Credits	L-T-P
MSPH4705	Computational Physics II	Theory+ Practice	4	2-0-3

Module I (20Hrs)

Functions and roots: Bisection method, Newton-Raphson method. Numerical differentiation, Partial differentiation in space and time domains. Interpolation: Lagrange interpolation formula.

Numerical integration (Trapezoidal, Simpson, Gaussian quadrature). Computation of moment of inertia of various objects, Computation of electric and magnetic fields due to line.

Module II (18Hrs)

Solution of systems of linear algebraic equations: Gauss elimination method, Gauss-Jordan Elimination method. Solution of ordinary differential equations, the Initial Value problem, Euler method, Runge-Kuttamethod. The classical harmonic oscillator problem.

Module III (17Hrs)

Solution of partial differential equations, Boundary Value problem, The vibrating string. Steady state Fourier's heat equation in one dimension.

Text Book:

1. Numerical Methods for Scientific and Engineering Computation, M K Jain, S R K Iyengar, R K Jain, New Age International Publishers, 2012.

Reference Books:

1. A First Course in Computational Physics, by J. Hasbun& P. Devries,Viva Books, 2011.
2. Computational Physics by R C Verma, P.K.Ahluwalia, K C Sharma,New Age Publishers, 2007.
3. Computational Physics by N.J.Giordano&H.Nakanishi,Pearson, 2012.

Computational Physics Lab-II

1. Basics of SCILAB
2. Working with matrices and plotting graphs
3. Computing Taylor Series of functions
4. Working with loops, branches and control flow
5. Plotting graphs using for loop
6. Problem solving using for loops
7. Numerical Intergration using Trapizoidal rule
8. Numerical Integration using simpson's rule
9. Implementation of Gauss Legendre Integration
10. Solution of a system of linear equations using Gauss Elimination and Gauss-Jordan Elimination methods
11. Solution of a 2^{nd} order Ordinary Differential equation using Euler method, Runge-Kutta method
12. Solution of a 1-dimensional Partial Differential equation: The vibrating string problem.

Skill Course – 1

SBFE3125 Image Processing through MATLAB-I

Code	Course Title	Course Type	Credits	L-T-P
SBFE3125	Image Processing through MATLAB-I	Practice	4	0-0-6

Module 1 [15Hrs]
Basic of MATLAB

Introduction to MATLAB: Introduction, History and Installation MATLAB Interactive Sessions, Menus and the toolbar, Programming in MATLAB.

Matrix Operation: Matrix and Array Operation, Indexing & Standard Matrix generation, Relational Operators, Logical Operators and Standard In-built Functions, Character String.

Programming Techniques: Saving and Loading Data, Loop Branches and Control flow, Conditional Statements, The Switch Structure, Interactive Input

Graphics: Basic 2D Plot, Subplots and Multiple Graphs, Plotting Specifiers, Saving and Printing Graphs
Script & Function: Script File, Function Files, Language Specific Features
Errors & Help: Errors, Built-in Function & Online Help

Module 2 [15Hrs]
Basic of Signal & Image Processing using MATLAB

Basic of Signal Processing: Signal Generation, Signal Manipulation.

Image Acquisition &Operation: Reading, Displaying & Writing Images, Types of Images & Mathematical operation to Images,

Image Enhancement: Gray Level Transformation, Contrast Variation, Histogram Processing, Image Filtering: Smoothing & Sharpening.

Image Restoration: Images with Noise, Image Denoising, Denoising with Order Statistics Filter,
Image Segmentation: Edge Detection & Thresholding,

Module 3 [15Hrs]
Application of Image Processing using MATLAB

Application Oriented Technique: Color Image Processing, Image Compression, Image Recognition.
Application Development: Flow Diagram and Logic Development Application Development using MATLAB Simulation and Troubleshooting Output Development

Text Books:

1. Getting Started with MATLAB 7 by Rudra Pratap, Oxford University Press.
2. Digital Image Processing using MATLAB by R.C. Golzalez, R.E. Woods and S.L. Eddins, PEARSON Education.

Reference Books:

1. Introduction to Neural Network using MATLAB 6.0 by S. N. Sivanandam, S. Sumathi and S. N. Deepa, TATA McGraw Hill Publication.
2. Online Help: Help Browser MATLAB Software
3. Web Help: http://in.mathworks.com/matlabcentral/fileexchange/

Skill Course 2

Basic C Concepts

Code	Course Title	Course Type	Credits	L-T-P
SBFE4102	Basic C Concepts	Practice	4	0-0-6

Module I: **(16 Hours)**

Problem solving techniques: Algorithm, flow chart; Structure of C program, Character set, Identifiers, Keywords, Data Types, Constants and Variables, Input-output statements, relational and logical operators, increment and decrement operators, conditional operator, assignment operators, expressions, type conversions, conditional expressions, precedence and order of evaluation, statements and blocks, if and switch statements, loops: -while, do-while and for statements, break, continue, goto

Module II: **(16 Hours)**

Arrays-concepts, declaration, definition, accessing elements, two-dimensional and multidimensional arrays, applications of arrays. Designing structured programs: -Functions, parameter passing, user defined functions, recursive functions, storage classes-extern, auto, register, static, scope rules.

Module III: **(12 Hours)**

Derived types-structures-declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, unions, C program examples. File handling.

Text Books:

1. E. Balaguruswamy “Programming in C”, Tata McGraw Hill-3rdedition
2. Y. Kanetkar, “Let us C”, BPB Publications-9th edition.

Reference:

3. H. Scheldt, “C The Complete Reference”, Tata McGraw Hill 2.B.W. Kernighan & D.M. Ritchie, "C Programming Language", PHI.
4. Schaum Series-“C Programming”-Gotterfried

Semester II

MSPH4801 Computational Physics-III

Code	Course Title	Course Type	Credits	L-T-P
MSPH4801	Computational Physics III	Theory + Project	4	2-0-3

Module I

Partial Differential Equations: Laplace equation, Poisson Equation, Navier-Stokes equation.
Simulation of Nonlinear systems: Predator-prey model: the Logistic map, Lorentz attractor.

Module II

Statistical analysis of data: Regression, Correlation, Probability distribution of data, Fourier Transforms and spectral analysis.

Time Series: Characteristics of time series, stationary and non stationary data, correlation, autocorrelation. **Random Numbers:** Generation and use, Introduction to Monte-Carlo methods.

Module III

Optimization problems, Introduction to Neural Networks, Genetic Algorithm and Fuzzy Logic.

Books:

1. A First Course in Computational Physics, by J.Hasbun & P. Devries,Viva Books,2011.
2. Introduction to Time Series and Forecasting, by P.J. Brockwell & R.A.Davis, Springer-Verlag, 1998.
3. Fundamental of Neutral Networks, by Laurene V Fausett, Pearson Education, 2004.
4. Neural Network, fuzzy logic, Genetic Algorithm: Synthesis and Applications, by S. Rajasekaran & G.A.VijayalakshmiPai, PHI, 2003.

Note: The lab evaluation will be in project mode. The projects will be based on the topic mentioned above

MSPH4802 Fluid Mechanics

Code	Course Title	Course Type	Credits	L-T-P
MSPH4802	Fluid Mechanics	Theory	4	3-1-0

Module-I (16Hrs)

Kinematics of Fluids. Methods describing Fluid motion. General theory of stress and rate of strain. Lagrangian and Eulerian Methods. Translation and Rate of Deformation. Streamlines, Path lines an Streak lines, Fundamental equations of the flow of viscous compressible fluids. 1-D inviscid incompressible flow, Equation of continuity, motion and energy in Cartesian coordinate system.

Module-II (16Hrs)

2-D and 3-D inviscid incompressible flow. Basic equations and concepts of flow. Circulation theorems. Velocity Potential, Rotational and irrotational flows. Integration of the equations of motion. Bernoulli's Equation.

The equation of state. Fundamental equations of continuity, motion and energy in Cylindrical & Spherical coordinate systems.

Module-III (20Hrs)

Laminar flow of viscous incompressible fluids, the laminar boundary layer, introduction to turbulent flow, introduction to inviscid compressible flow, introduction to viscous compressible flow.

Books:

1. Fundationsof Fluid Mechanics by S.W.Yuan. Publisher: Prentice-Hall of India.1967. Chapters: 3(3.1 to 3.4), 5(5.1 to 5.6), 7(7.1 to 7.5).
2. An Introduction to Fluid Dynamics by G.K.Batchelor,Cambridge University Press,2013.
3. A text book of Fluid Mechanics, by R.K.Bansal, Laxmi Publisher 2005.
4. Viscous Fluid Dynamics by J.L.Bansal, IBH Publication, Jaipur. 2003.

MSPH4803 Physics of Materials-I

Code	Course Title	Course Type	Credits	L-T-P
MSPH4803	Physics of Materials I	Theory	4	3-1-0

Module-I (20Hrs)

Overview of Condensed matter physics: Water as an example, Energies and potentials.

Structure of materials through scattering: Elementary scattering theory- Bragg's law, The density operator and its correlation functions, Liquids and gases, Crystalline solids, The Kronig - Penney Model, Symmetry and crystal structure, Crystal defects, Liquid crystals, One and two-dimensional order in three dimensional materials.

Module-II (22Hrs)

Thermal Properties: Phonon theory, Phonon scattering; Specific heat of solids, Properties of heat conductors and insulators; Thermodynamics and statistical mechanics of homogeneous fluids, The ideal gas, Spatial correlations, Symmetry in ordered systems, Mean field theories of first-order phase transitions: liquid-gas and solid-liquid transitions.

Module-III (18Hrs)

Mechanical Properties: Elasticity of solids: the stess and strain tensors, Stress-Strain relations, Thermodynamics of deformations: The elastic free energy, Isotropic and cubic solids, Fluctuations, Vacancies and interstitials, The Lagrangian elasticity.

Books:

1. Principles of Condensed Matter Physics, by P M Chaikin and T C Lubensky, Cambridge University Press, (Indian Print) 2007.
2. Introduction to Solid State Physics, C. Kittel, Wiley, 2012.
3. Solid State Physics by M. A. Wahab, Narosa, 2005.
4. Elements of Materials Science and Engineering, L H Van Vlack, Prentice Hall; 1989.

MSPH3602 Statistical Physics

Code	Course Title	Course Type	Credits	L-T-P
MSPH3602	Statistical Physics	Theory	4	3-1-0

Module-I (17Hrs)

The Statistical Basis of Thermodynamics: The macroscopic and the microscopic states, Contacts between statistics and thermodynamics: physical significance of the number Ω (N, V, E), The classical ideal gas

Elements of Ensemble Theory: Phase space of a classical system, Liouville's theorem and its consequences, the micro-canonical ensemble, Examples: Ideal Monatomic gas.

The Canonical Ensemble: Equilibrium between a system and a heat reservoir, A system in the canonical ensemble, Physical significance of the various statistical quantities in the canonical ensemble, Alternative expressions for the partition function, The classical systems: Ideal monatomic gas, The equi-partition Theorem and the Virial Theorem.

Module-II (20Hrs)

The Grand Canonical Ensemble: Equilibrium between a system and a particle-energy reservoir, A system in the grand canonical ensemble, Physical significance of the various statistical quantities, Examples: Ideal monatomic gas, Density and energy fluctuations in the grand canonical ensemble: correspondence with other ensembles, Thermodynamic phase diagrams, Phase equilibrium and the Clausius-Clapeyron equation.

Formulation of Quantum Statistics: Quantum-mechanical ensemble theory: the density matrix, Statistics of the various ensembles, Examples, systems composed of indistinguishable particles, The density matrix and the partition function of a system of free particles.

Module-III (22Hrs)

The Theory of Simple Gases: An ideal gas in a quantum- mechanical canonical and microcanonical ensemble, Statistics of the occupation numbers.

Ideal Bose Systems: Thermodynamic behavior of an ideal Bose gas, Bose- Einstein condensation in ultra cold atomic gases, Thermodynamics of the blackbody radiation.

Ideal Fermi Systems: Thermodynamic behavior of an ideal Fermi gas, The electron gas in metals, Ultra cold atomic Fermi gases, statistical equilibrium of white dwarf stars.

Text Books:

1. Statistical Mechanics, R.K. Pathria & P D Beale, (Elsevier).

References Books:

1. Statistical Mechanics, K. Huang, (Wiley, India)
2. Statistical Mechanics by B. K. Agarwal (Universal Book Show Room).
3. Fundamentals of statistical mechanics by B.B. Laud, (New Age International Pulishers Ltd.)

MSPH4805 Analog Communication Techniques

Code	Course Title	Course Type	Credits	L-T-P
MSPH4805	Analog Communication Technique	Theory	4	3-1-0

Module I (15 hours)

Spectral Analysis: Fourier series, The Sampling Function. The Response of a linear System. Normalized Power in a Fourier expansion. Impulse Response. Power Spectral Density. Effect of Transfer Function on Power Spectral Density. The Fourier Transform. Physical Appreciation of the Fourier Transform. Transform of some useful functions. Scaling, Time-shifting and Frequency shifting properties. Convolution, Parseval's Theorem. Correlation between waveforms; Auto-and cross correlation. Expansion in Orthogonal Functions. Correspondence between Signals and Vectors. Distinguish ability of Signals.

Module II (14 hours)

Amplitude Modulation Systems: A Method of Frequency translation, Recovery of baseband Signal, Amplitude Modulation, Spectrum of AM Signal. The Balanced Modulator. The Square law Demodular. DSB–SC, SSB-SC and VSB-SC - Their Methods of Generation and Demodulation. Carrier Acquisition. Phase-locked Loop (PLL). Frequency Division Multiplexing.

Frequency Modulation Systems: Concept of Instantaneous Frequency. Generalized concept of Angle Modulation. Frequency modulation, Frequency Deviation, Spectrum of FM Signal with Sinusoidal Modulation. Bandwith of FM Signal Narrowband and wideband FM. Bandwith required for a Gaussion Modulated WBFM Signal. Generation of FM Signal. FM Demodulator. PLL, Preemphasis and Deemphasis Filters.

Module III (16 hours)

Mathematical Representation of Noise: Sources and Types of Noise. Frequency Domain Representation of Noise. Power Spectral Density. Spectral Components of Noise. Response of a Narrow band filter to noise. Effect of a Filter on the Power spectral density of noise. Superposition of Noises, Mixing involving noise. Linear Filtering. Noise Bandwidth.

Noise in AM Systems: The AM Receiver, Super heterodyne Principle, Calculation of Signal Power and Noise Power in SSB-SC, DSB-SC and DSB-C. Figure of Merit, Square law Demodulation. The Envelope Demodulation. Threshold. Mathematical Representation of the operation of the Limiter Discriminator; Calculation of output SNR. Comparison of FM and AM. SNR Improvement using preemphasis. Multiplexing. Threshold in frequency modulation.

Text Books:

1. Principles of Communication Systems by Taub & Schilling, Tata McGraw Hill. Selected portion from Chapter 1, 3, 4, 7, 8, 9 and 10.
2. Communication Systems by Siman Haykin, John Wiley & Sons, Inc.

Reference Books:

1. Modern Digital and Analogue Communication Systems by B.P. Lathi, 3rd Edition, Oxford University Press. Selected Portion from Ch. 2, 3, 4, 5 and 12.
2. Digital and Analog Communication Systems by Leon W. Couch, II, 6^{th} Edition Pearson Education Pvt. Ltd

MSPH4806 Digital Systems & Signal Processing

Code	Course Title	Course Type	Credits	L-T-P
MSPH4806	Digital Systems and Signal Processing	Theory	4	3-1-0

Module – I (20Hrs)

Continuous and discrete time signals: Some Elementary Continuous-time and Discrete-Time signals. Classification of Signals – Periodic and a periodic even – odd – energy and power signals – Deterministic and random signals – Causal and non causal signals and anti causal signals -- complex exponential and sinusoidal signals ---Simple Manipulations of Continuous and discrete time signals.

Continuous-Time Systems: LTI Continuous-Time systems, Block diagram and signal flow graph representation, response of LTI Continuous-Time system in time domain, classification of Continuous-Time systems, convolution of Continuous-Time signals.

Discrete-Time Systems: Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems; Correlation of Discrete-Time Signals: Cross correlation and Autocorrelation Sequences, Properties.

Module-2 (18Hrs)

The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Rational Z-Transforms: Poles and Zeros,

Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, the Inversion of the Z-Transform by Partial-Fraction Expansion;

Discrete Time Fourier Transform (DTFT): The discrete time fourier transform of Aperiodic signal, Convergence of fourier transform, the fourier transform of signal with poles on unit circle,frequency domain and time domain signal properties, properties of DTFT

Discrete Fourier Transform:

The Discrete Fourier Transform, the DFT as a Linear Transformation, Relationship of the DFT to other Transforms; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution.

Module-3 (18Hrs)

Efficient Computation of the DFT: FFT Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms: Decimation-In-Time (DIT), Decimation-In-Time (DIF);

Design of IIR Filters from Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

Design of FIR Filters: Symmetric and Ant symmetric FIR Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase FIR Filters by the Frequency-Sampling Method;

Books:

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson.
2. Digital Signal Processing: S.Salibhanaan, A. Vallavaraj, C.Gnanapriya, TMH.
3. Digital Signal Processing – Ramesh Babu, ScitechPublication.

MSPH4807 Microprocessors and Interfacing Devices

Code	Course Title	Course Type	Credits	L-T-P
MSPH4807	Microprocessor and interfacing devices	Theory	4	3-1-0

Module I: (20Hrs)

Introduction to Microprocessor, Microprocessor systems with bus organization, Microprocessor Architecture & Operations, Memory, I/O Device, Memory and I/O Operations

8085 Microprocessor Architecture, Address, Data and Control Buses, Pin Functions, De-multiplexing of

Buses, Generation of Control Signals, Instruction Cycle, Machine Cycles, T-States, Instruction set.

Assembly Language Programming Basics, Classification of Instructions, Addressing Modes, 8085 Instruction Set, Instruction And Data Formats, Writing, Assembling & Executing a Program.

Module II: (18Hrs)

Introduction, Architecture, pin description, mode of operations,clockgeneratorIntel-8284A,bidirectionalbustrans- receiver8286/8287,buscontroller8288,buscyclememoryread/write for minimum mode, 8086system ,memory interfacing, interrupt processing; software interrupts, single step interrupt, non-maskable interrupt, interrupt priority, DMA, Halt State, Wait for Test state, comparison between 8086 an 8088.Instructionsetandprogramming8086.

Module III: (20Hrs)

Interfacing Concepts, Ports, Interfacing of I/O Devices, Interrupts, Interfacing of ADC and DAC Data Converters, 8255A PPI, 8253/8254 Timer, 8259A PIC, 8237 DMA Controller, Serial I/O Concepts, SID and SOD, 8251A USART, Memory Interfacing, Memory and I\O mapping, interfacing of above chips With 8085 and 8086

8051 Microcontroller: overview and comparison with microprocessors.

Books:

1. Ramesh S. Gaonkar,"Microprocessor Architecture, Programming and Applications with the 8085", Penram International.

2. Microprocessors and Interfacing; by Douglas V Hall; McGraw-Hill.

3. Microprocessors and Microcontrollers Architecture, programming and system Design 8085,8086,8051,8096:byKrishnaKant;PHI..

4. Fundamentals of Microprocessor and microcontroller by B. Ram.

References:

1. The 8088 and 8086 Microprocessors Programming, Interfacing, Software, Hardware and Application; by Walter A. Triebel & Avtar Singh; Pearson India.

2. The 8086 Microprocessor: Programming & Interfacing the PC-Kenneth J. Ayala, Delmar Cengage Learning, Indian Ed.

MSPL4801 Physics of Materials Lab-I

Code	Course Title	Course Type	Credits	L-T-P
MSPL4801	Physics of Materials Lab I	Practice	2	0-0-3

1. Study of characteristic frequencies (normal modes) of a coupled pendulum.
2. Study of synchronisation of weakly coupled oscillators.
3. Temperature variation of Surface tension of water.
4. Temperature dependence of viscosity of glycerine using Ostwald Viscometer.
5. Measurement of velocity of sound.
6. Study of drag forces offered by different media (air, water, oil, glycerine).
7. Measurement of specific heat of solids.
8. Verification of Wiedemann-Franz law and determination of Lorentz number.
9. Measurement of thermal conductivity of metals.
10. Study of Zeeman effect using Fabry Perot etalon.
11. Determination of wavelength of monochromatic light using Michelson interfeter.

MSPL4803 Signal Processing Lab

Code	Course Title	Course Type	Credits	L-T-P
MSPL4803	Signal processing Lab	Practice	2	0-0-3

1. Study and design of AM modulator and demodulator
2. Study of angle modulation and Demodulation Techniques.

3. Convolution of sequences (Linear Convolution, Circular Convolution)
4. Correlation of two sequences (Auto correlation and Cross Correlation)
5. To design digital IIR filters (Low-Pass, High Pass, Band-Pass, Band-Stop).
6. To design FIR filters using windows technique.
7. Design and simulation of DFT and IDFT.
8. Implementation of FFT algorithm by decimation in time and decimation in frequency.
9. Implementation of IIR (Low pass and High pass) Filters DSP kit.
10. Implementation of IIR (Band Pass and band stop) Filters DSP kit.
11. Implementation of FIR (Low pass And High pass) Filters using DSP kit.
12. Implementation of linear phase FIR (Low pass and High pass) Filters using DSP kit.

MSPL3501 Physics Laboratory 5

Code	Course Title	Course Type	Credits	L-T-P
MSPL3501	Physics Laboratory 5	Practice	2	0-0-3

List of Experiments

1. Determination of Rigidity modules of a wire by Maxwell's Needle method.
2. Determination of surface tension of soap solution.
3. Determination of resolving power of grating.
4. Determination of specific rotativity of sugar solution using polarimeter.
5. Determination of wavelength of unknown light with a plane transmission grating.
6. Determination of the specific resistance of the material of the wire using Meter Bridge.
7. Measurement of the average resistance for unit length of a meter bridge wire by Carey Foster's method and hence to determine the value of an unknown resistance.
8. Comparison of emfs of two cells by stretched wire potentiometer.
9. Study of Hall Effect.
10. To determine the Planck's constant using a photo voltaic cell.

Reference books:

1. A text book of practical physics by Dr. Samir K Ghosh, Central Publishers, 2008.
2. An advanced course in practical physics by D. Chattopadhyay and P.C. Rakshit, Cantral 2012.
3. B.Sc. Practical Physics, by C.L. Arora, S. Chand 2006.

MSPL4804 Microprocessor & Interfacing Devices Lab

Code	Course Title	Course Type	Credits	L-T-P
MSPL4804	Microprocessor and interfacing devices Lab	Practice	2	0-0-3

Experiment List (Total10 (Ten) experiments have to be completed.)

A) 8085

1. Addition, Subtraction, Multiplication, Division of two 8bit numbers resulting 8/16bit numbers. 2. Smallest/Largest number among two numbers and n number in a given data array.

2. - Binary to Gray Code / Hexadecimal to decimal conversion & segment display.

B) Interfacing Compulsory

3. Generatesquarewavesonalllinesof8255withdifferent frequencies (concept of delay program)

4. Study of stepper Motor and its operations (Clockwise, anticlockwise, angular movement, rotate in various speeds)

C) Optional (Any Two)

5. Study of Traffic Light controller
6. Study of Elevator Simulator
7. Generation of Square , triangular and saw tooth wave using Digital to Analog Converter
8. Study of 8253 and its operation (Mode 0,Mode 2, Mode 3)
9. Study of Mode 0, Mode 1,BSR Mode operation of 8255.
10. Study of 8279(keyboard& Display interface)
11. Study of 8259 Programmable Interrupt controller.

Optional (any one)

13. Addition, subtraction of 16 bit numbers. 14. Multiplication, Division of 16 bit numbers

15. Transfer a block of data to another memory location using indexing. 16. Operation of 8255 using8051 microcontroller

D) 8086

Compulsory

17. Addition, subtraction, Multiplication, Division of 16 bitnos - 2'scomplement of a 16 bit no.

Optional (Any One)

18. Finding a particular data element in a given data array.
19. Marking of specific bit of a number using look-up table.
20. Largest /Smallest number of a given data array.
21. To separate the Odd and Even numbers from a given data array.
22. Sorting an array of numbers in ascending/descending order.

Skill Course 3

SBFE3130 Optical Fiber Technician

Code	Course Title	Course Type	Credits	L-T-P
SBFE3130	Optical Fiber Technician	Practice	4	0-0-6

45 Days Industrial Training Skill free elective courses Module-1 (18 Hours)

Optical Fiber Fundamentals:

Fiber Types & Transmission Characteristics ,principles of optical transport media and OFC communication, knowledge of Optical fiber characteristics like refraction, polarization, attenuation, dispersion, bands in optical fibre and their usability, loss characteristics, signal strength and quality KPIs – design values and margins, functionality of optical equipment like cleaver, mechanical and fusion splicing kit, protection sleeves, fiber stripper, fiber reinforced plaster during splicing and jointing, functionality of optical test equipment like OTDR and power meter, optimal values of OTDR, Power meter and light meter test results, utility of As-build route diagrams, standard trenching, cable laying, pit preparation, splicing, jointing, blowing and back-filling process for installation of OFC cables, different types of OFC connectors based on the type of equipment

Fiber Optic Light Sources: LEDs, SLEDs – Surface Emitting LEDs, ELEDs – Edge Emitting LEDs, LDs – Laser Diodes, Tunable Lasers

Detectors: PIN photodiode, Avalanche Photodiodes
Optical Fiber: Fabrication & Cabling

Optical Fiber**:** Joints & Connections
OFC Link: Budgets & Analysis

Module -2 (12 Hours)

Fiber Optic Cable Testing

1. OTDR Uses:

Measure loss, Locate breaks, splices, and connectors, Produces graphic display of fiber status, Can be stored for documentation and later reference, Cable can be measured from one end.

2. Demo/Practical Session: Splicing & Connectors
3. Demo/ Practical Session: OTDR & Fault location
4. Study of attenuation and bending losses in optical fibers at different wavelengths.
5. Setting up a fiber optic digital link and to determine the maximum bit rate transmitted through the link

Module-3 (15 Hours)

Co-ordinate Installation & Commissioning of Optical Fiber Cables (OFC): This unit is about coordinating installation and commissioning of optical fiber cables as per route plan and testing the effectiveness of joints

Undertake Condition based Maintenance & Planned repair activities: This unit is about carrying out condition based maintenance and planned repair activities of OFC cables to ensure network availability and high quality network transmission

Perform corrective maintenance/restoration of optical fault): This unit is about carrying out corrective maintenance/ fault management of OFC to ensure network availability and high quality network transmission.

Semester III

MSCP2301 Atomic and Molecular Physics

Code	Course Title	Course Type	Credits	L-T-P
MSCP2301	Atomic and Molecular Physics	Theory	4	3-1-0

Module - I (18 classes)

One electron atoms and its interaction with electric and magnetic fields: Introduction, Schrodinger equation, energy levels, eigen functions of bound states, expectation values. Zeeman Effect, Stark Effect, Lamb shift. Hyper fine interaction and isotope shift.

Two electron atoms: Schrodinger's equation, Spin wave functions and role of Pauli Exclusion Principle, level scheme of two electron atoms, independent particle model, ground and excited state, doubly excited states, Auger effect, Resonance.

Module – II (20 classes)

Many electron atom: Central field approximation; corrections to central field approximation: L-S and j-j coupling; selection rules, Alkali spectra.

Molecular structure: General nature of molecular structure, Born-Oppenheimer approximation, Rotation, vibration of diatomic molecules, centrifugal distortion, electronic structure of diatomic molecules. Hydrogen molecular ion, the exact solution, molecular hydrogen, molecular orbital treatment, Hitler-London approach.

Module - III:

Molecular spectra (22 classes)

Rotational energy levels of diatomic molecules, vibrational and rotational spectra of diatomic molecules, Raman scattering, electronic spectra of diatomic molecules, vibrational structure of electronics spectra, rotational structure of electronics spectra, Franck-Condon principle

Laser: Spontaneous and stimulated emission, Einstein A& B coefficients, optical pumping, population inversion, rate equation, modes of resonators and coherence length.

Textbook:

1. Physics of Atoms and Molecules by B.H. Bransden and C.J. Joachain

Reference Books:

2. Lasers, Theory and Applications by K. Thyagarajan and A.K. Ghatak
3. Fundamentals of Molecular Spectroscopy by C.B. Banwell
4. Introduction to Atomic spectra by H. E. White

MSPH5105 Solid State Physics II

Code	Course Title	Course Type	Credits	L-T-P
MSPH5105	Solid State Physics II	Theory	4	3-1-0

Module1: (18 hours)

Crystalline state, crystal structure, Mechanical properties: Classical and quantum theory of harmonic crystal, phonons in metals, phonon dispersion, anharmonic effects.

Metals: Drude theory – model, dc electrical conductivity, Hall Effect, thermal conductivity, failures Sommerfeld theory – model, ground state properties of electron gas, Fermi Dirac distribution, Thermal conductivity, failure of free electron theory

Energy Bands in solids: Nearly free electron model, origin of energy gap, Bloch theorem and review of Kronig-Penny model (detailed derivation not required), band theory, Metal, insulators and semiconductors. Tight binding method

Module-2: (18 hours)

Insulators: Dielectric properties, theory of the local field, Clausius-Mossotti relation, theory of polarizability, optical properties of ionic crystals, pyroelectric and ferroelectric crystals.

Semiconductors: Band gap, instrinsic semiconductors (Si and Ge), intrinsic mobility, effective masses, doping and extrinsic semiconductors, impurity conductivity.

Module-3: (20 hours)

Magentic properties, Van-Vleck and Pauli paramagnetism, Curie's law, Larmor and Landau diamagnetism, Ferromagnetism and antiferromagnetism (comparative description), magnetic resonance.

Superconductivity: Superconductivity, thermodynamics of superconducting transition, London equation, BCS theory, Dc and Ac Josephson's effect.

Textbook:

1. Introduction to Solid State Physics, C. Kittel, Wiley, 2012.

Reference Book:

2. Solid State Physics, by N. W. Ashcroft and N. D. Mermin (Cornell University), 2003.
3. Introduction to Solid State Physics,S. O. Pillai, New Age International (2005)

MSCP2305 Soft Matter Physics

Code	Course Title	Course Type	Credits	L-T-P
MSCP2305	Soft Matter Physics	Theory	4	3-1-0

Module I: (21 lectures)

Introduction to Soft Matter: Types of Soft Matter, What makes them soft?

Soft Matter Solutions: Definitions, Phase transitions, Lattice model of polymer solutions

Elastic soft matter: Viscosity and elasticity of polymers and gels, Elastic coefficients and their relationships, Elasticity of a polymer chain, Balloon inflation, Swelling equilibrium of a polymer gel, Volume Transition of a polymer gel

Surfaces and surfactants: Surface tension, Grand canonical free energy, Interfacial free energy, Gibbs-Duhem equations, Surface excess, Wetting, Surfactants: Surface adsorption and surface tension, Micelles, Gibbs and Langmuir monolayers

Module II: (21 lectures)

Liquid crystals: Classification, Nematic liquid crystals, Order parameter for nematics, Mean Field Theory for Isotropic-Nematic transition, Free energy function for order parameter, Landau- de Gennes theory: Free energy near transition point

Brownian motion and thermal fluctuations: Brownian motion and its relevance for soft materials dynamics, correlation functions for position and velocity; Langevin equation for a free particle, Langevin equation for a particle acted upon by an external potential, Velocity and displacement correlation, Einstein's fluctuation-dissipations relations.

Variational Principles of for Soft Matter: The Raleighian, Raleighian approach for fluid flow in porous media, Onsager principle, Diffusion of particles in dilute and concentrated solutions. Sedimentation

Module III: (14 lectures)

Diffusion and Permeation in Soft Matter: Diffusio-mechanical coupling in particle sedimentation, Kinetics of Phase separation

Flow and deformation in Soft Matter: Visco-elasticity, Complex modulus, Nonlinear viscosity.

Text Books:

1. Soft Matter Physics by Masao Doi, Oxford University Press, 2013.

Reference books:

1. Polymer Physics by M Rubinstein and R.H. Colby, Oxford University Press, 2014.

MSCP1202 Electronics devices and circuits

Code	Course Title	Course Type	Credits	L-T-P
MSCP1202	Electronics Devices and Circuits	Theory	4	3-1-0

Module-I (18 Hours)

Semiconductor Diodes: PN-junction diode structure, Diode Operation in Forward and Reverse bias condition, Diode Currents, Characteristics, Operating Point and Load line, Frequency dependency and Application in Rectification, Clipping and Clamping of waveforms.

Special Purpose Diodes: Zener diode, Tunnel diode, Schottky barrier diode, Varactor diode, Light Emitting Diode(LED), Photo Diode, Solar Cell, Light Dependent Resistor.

Module-II (20 Hours)

Bipolar junction Transistor: Transistor Construction and Operation, Transistor operating modes, Transistor Currents and their relation, Transistor action, Transistor Amplifier configurations(CB, CE & CC) and characteristics, Transistor ratings, The Ebers-Moll model, BJTDC Biasing: Transistor Operating Point and Load Line, BJT DC Biasing Configurations.

Field Effect Transistors: Junction Field Effect Transistor(JFET) construction and operation, JFET

Parameters, Shockley's Equation, Drain and Transfer Characteristics, Metal Oxide Semiconductor Field Effect Transistor (MOSFET) types, Construction and Operation, Drain and Transfer Characteristics, MESFET , JFET & MOSFET DC Biasing configurations, CMOS inverter basics and logic circuits: Logic Gates and Flip Flops (Applications not required). Brief idea on OptoElectronic Devices: LED, Photodiode, Photo detectors, PIN and APD.

Module-3 (18 Hours)

Operational Amplifiers : Differential Amplifier, Op-Amp Basics, Differential and Common mode operation of OP-AMP, Op-Amp Specification and Characteristics, Ideal and Practical Op-Amp, Analysis of Inverting and Non – inverting circuits, OP-AMP applications on constant gain Multiplier, Voltage summing, Integrator, Differentiator. Instrumentation Amplifier, Active filters.

Text Books:

1. Electronics Devices and Circuit Theory By - Robert L. Boylestad and Lewis Nashelsky,

Reference Books:

1. Electronic Devices and Circuits By David A. Bell, 4th Edition, PHI
2. Fundamentals of Semiconductor devices By Yang, McGraw Hill International Edition,
3. Op-Amps and Linear Integrated Circuits, 4/E By RamakantaGayakward
4. Electronic fundamental and application by J.D. Ryder, PHI, Learning Pvt Ltd
5. Integrated Electronics by Milman and Halkies, TMH

MSCP2403 Introduction to Bio- and Nano-Materials

Code	Course Title	Course Type	Credits	L-T-P
MSCP2403	Introduction to Bio and Nano materials	Theory	4	3-1-0

Module-I (17Hrs)

Bio Materials Introduction: Types of bonds in materials, Ionic bond, metallic bond, covalent bond, secondary bond. Different types of materials – Ceramic, metals, polymers and composites. Impact of biomaterials.

Basic properties of materials: Mechanical properties – tensile testing, compressive testing, shear testing, bend or flexural tests, viscoelastic behavior, ductile and brittle fracture, stress concentration, fracture toughness, fatigue, Electrochemical properties – Corrosion, types of corrosion, Surface properties – Contact angle, hardness

Module–II (18Hrs)

Natural biomaterials: Collagen, elastin, silk, chitosan, cellulose, alginate, hyaluronan, chondroitin sulfate, coral.

Nano-Materials Introduction: History and scope of nanomaterials, Classification of Nanostructured materials, unique properties of nanomaterials, microstructure and defects

Application of nanomaterials: Nano-electronics, Nano-electromechanical systems, nanosensors, water treatment, energy, nanomedicine, environmental, health and safety issues,

Synthesis Routes: Bottom-up approaches, Top-down approaches.

Module-III: (20Hrs)

Nanostructured Materials: Quantum Dots, Carbon Nanotubes, Nanowires, Films, Multilayered films
Characterization: X-ray diffraction, Electron microscopies (SEM, TEM, AFM, STM), Three-dimensional Atom Probe (3DAP), Infrared and Raman spectroscopy, Trends and highlights in instruments and metrology, chromatography – high-performance liquid chromatography, gel permeation chromatography.

Text Books:

1. Introduction to Biomaterials: Basic Theory with Engineering Applications (Cambridge Texts in Biomedical Engineering) 1st Edition, by C. Mauli Agrawal, Joo L Ong, Mark R. Appleford, Gopinath Mani
2. Text book of Nanoscience and Nanotechnology, by B S Murty, P Shankar, B Raj, B B Rath and J Murday, Universities Press (India) Pvt Ltd, 2013.

Reference Books:

1. An Introduction to Biomaterials, Second Edition, Jeffrey O. Hollinger
2. Biomaterials, An introduction, Joon Park, R S Lakes
3. Introduction to Nanotechnology, C P Poole (Jr), F J Owens, John Wiley & Sons, 2003.
4. A Text book of Nanoscience and Nanotechnology, T Pradeep, McGraw Hill Education India Private Limited, (2012).

MSCP2401 Electronics Communication Systems

Code	Course Title	Course Type	Credits	L-T-P
MSCP2401	Electronics Communication System	Theory	4	3-1-0

Module-1 (20 Hours)

Analog Modulation Systems: General communication model, modulation, needs for modulation

Amplitude Modulation: Expression for AM wave, Spectrum of AM Signal, Total power radiated in AM-DSB-C, DSB-SC and SSB-SC, VSB-SC, Methods of AM modulators and demodulators, Frequency Division Multiplexing. AM Receiver, Super heterodyne Principle, Noise in AM. Figure of Merit.

Frequency Modulation: Generalized concept of Angle Modulation, Frequency modulation, Frequency Deviation, Expression for FM wave, Spectrum of FM Signal, Bandwidth of FM Signal, Narrowband and wideband FM. FM Demodulator, PLL, Pre-emphasis and De-emphasis Filters.

Module-2 (15 Hours)

Digital Modulation Systems: Pulse modulation**,** Quantization of Signals, Quantization error, PCM system, Electrical representation of binary digits, Companding, Time Division Multiplexing, Differential PCM, Delta Modulation, Adaptive Delta Modulation. ASK,FSK,PSK.

Digital Modulation Technique: Generation, Transmission, Reception, Spectrum and Geometrical Representation in the Signal Space of BPSK, DPSK, QPSK, QASK, M-ary PSK, BFSK, M-ary FSK, and Minimum Shifting Keying (MSK), Spread Spectrum(SS) and CDMA Systems, Direct-Sequence Spread Spectrum, Frequency-Hopping Spread Spectrum Systems

Module-3 (20 Hours)

Optical Communication System: Elements of an optical fiber communication system, Principle of light ray propagation through Optical fiber, Total Internal Reflection. Numerical Aperture, Step Index and Graded Index fiber, Monomode and multimode optical fiber, Attenuation: Factors contributing to losses, Signal Distortion – Inter-and Intra-Modal dispersion.

Mobile Communication: Trends in Cellular Communications—1G to 3G and 4G,The Cellular Concept, Frequency Reuse, Cell Splitting, Propagation Problems:-Path Losses, Multipath Fading, Adjacent Channel Interference (ACI),

Satellite Communication: Satellite band designation, Satellite Communication Fundamentals, HEO, MEO, LEO satellites, Digital Satellite Communication Techniques, Multiple Access Techniques, Geostationary Satellite communication, VSAT, Satellite TV Systems.

Text Books

1. Taub's Principles of Communication Systems by H Taub. D. L. Schilling and G Saha, 3rd Edition 2008, TMH Education Pvt Ltd, New Delhi,
2. T S Rappaport, Wireless Communications, Pearson Education, India
3. Optical Fiber Communications by G. Keiser. 3rd Edition McGraw Hill Book Co.
4. Satellite Communication by T. Pratt, C. Bostian and J. Allnutt. 2nd Edition ,Joihn Wiley Co.

Reference Books

1. Modern Digital and Analogue Communication Systems by B.P.Lathi and Z Ding, 4th Edition 2010, Oxford University Press, New Delhi
2. Electronic Communication Systems by Kennedy/Davis, McGraw HillPublication, 4th edition
3. Optical fibers and Fiber Optic communication systems by Subir Kumar Sarkar , Publication : S. Chand & Co
4. W C Y Lee, Mobile Communication Engineering – Theory and Applications; TMH
5. Satellite Communiation By D.C.Agrawal

MSRM5101 Introduction to research

Code	Course Title	Course Type	Credits	L-T-P
MSRM5101	Introduction to Research	Theory	2	2-0-0

Module-I: (13Hrs)

Research: Introductory Concepts: Curiosity and Research, Common sense vs. Sciences, Role of Observation and Scientific Methods, Experiments as the basis of Sciences, Various types of Research Methods in Sciences, Discussion of various research methods.

Overview of Research Process: Problem Definition, Proposition of Hypotheses, Hypothesis Testing, Types of Possible Errors in Hypothesis Testing, Proposition of Models and Theories, Literature Review, Experimental Design, Sampling and Survey, Measurement of Values and Dealing with Errors, Validation of Results, Improving Theories, Models and Experiments, Safety and Ethics.

Module-II: (12Hrs)

Data Analysis-I: Use of Statistics in Data Analysis, Probability Distributions, Central Limit Theorem and its applications in Data Analysis, Comparing many experimental measurements, Data with many values of independent variables.

Data Analysis-II: Building Mathematical Models, Ingredients of Mathematical Models, Estimation, Regression methods, Fourier Transforms, Interative Maps, Differential Equations.

Other Methods of Data Analysis: Tables, Graphs and Charts.

Module: III (5hrs)

Documentation and Presentation: Scientific Proposal Writing, Scientific Report Writing, Parts of a Scientific Report, Presentations, Ethical Issues in Report Writing.

Text Books:

1. Michael P Marder, 2011, Research Methods for Science, Cambridge University Press.

Reference Books:

2. Eugene Bright Wilson, 1991, An Introduction to Scientific Research, Dover Publications Inc.
3. Ranjit Kumar, 2011, Research Methodology: A Step by Step Guide, Sage South Asia Publication.

MSPL5103 Physics of Materials II Lab

Code	Course Title	Course Type	Credits	L-T-P
MSPL5103	Physics of Materials Lab II	Practice	2	0-0-3

1. Study of Hall Effect.
2. Determination of wavelength of light by using Michelson Interferometer
3. Comparison of static and dynamic methods of finding rigidity modulus of a material.
4. Comparison of static and dynamic methods of finding Young's Modulus of a material.
5. Finding the surface tension of soap solution.
6. Study of p-n junction diode and MOSFET.
7. Measuring the magnetic susceptibility of a solution of paramagnetic salt in water using Quincks method.
8. Synthesis of materials using sol-gel method.
9. Determine the diffusion of a Newtonian fluid and find a relationship between viscosity coefficient & diffusion coefficient.
10. Depletion induced phase separation study in a colloid-polymer mixtures and determination of the phase diagram by visual observation.

MSCP1205 Electronics devices lab

Code	Course Title	Course Type	Credits	L-T-P
MSCP1205	Electronics Devices Lab	Practice	2	0-0-3

At least 8 of the following experiments to be done:

1. Identification, specification and testing of Electronic Components-Resistors, capacitors, Inductors, Junction Diodes, Zener Diode, BJT, FET, OPAMP.
2. Study of different types of measuring instruments (Ammeter, Volt meter, DMM, AMM, Oscilloscope (CRO, DSO), Function Generator and regulated power supplies.
3. Verification of Current voltage characteristics of PN-junction Diode by using hardware and/or Circuit simulators.
4. Verification of Current voltage characteristics of Zener Diode by using hardware and/or Circuit simulators.
5. Design and verification of Rectifiers circuits, half wave Rectifier, Full wave Bridge Rectifier, Full wave Center Tap Rectifier using hardware and/or Circuit simulators.
6. Verification of Current voltage characteristics of Common Base and Common Collector BJT configuration using hardware and/or Circuit simulators.
7. Design and verification of any BJT biasing circuit emitter bias or Voltage divider bias circuit using hardware and/or Circuit simulators.
8. Verification of Current voltage characteristics (Drain and Transfer) of Junction/Metal Oxide Semiconductor Field Effect Transistor using hardware and/or Circuit simulators.
9. Design and verification of any FET biasing circuits Self bias or Voltage divider bias circuit using hardware and/or Circuit simulators.
10. Study and Verification of OPAMP as an Inverting amplifier and Non-inverting amplifier using IC741by help of hardware and/or Circuit simulators.
11. Study and Verification OPAMP as Summing amplifier, Integrator, Differentiator, filter using hardware and/or Circuit simulators.

Semester IV

MSCP2302 Nuclear and Particle Physics

Code	Course Title	Course Type	Credits	L-T-P
MSCP2302	Nuclear and Particle Physics	Theory	4	3-1-0

Module I: (20hrs)

Introduction: Basic Properties of The Nucleus: Basic nuclear properties: size, shape and charge distribution, spin, isospin, and parity, Nuclear mass, Mass defect, binding energy, magnetic and electric moments.
Understanding the Nuclear Force: Nucleon-nucleon interaction, The Yukawa model, Charge independence and charge symmetry of nuclear forces, The Deuteron and its solution: ground state and excited states, Dependence on central forces and tensor forces Magnetic moment of the deuteron, Low energy neutron-proton scattering, Scattering length, spin dependence

Module II: (23hrs)

Nuclear models: **Shell Model:** Evidence of shell structure, Basic idea of Shell Model: single particles models, Single particle states and the shell structure, Magic Numbers, Limitations of the Model

Liquid Drop Model: Bethe-Weizsacker semi-empirical mass formula. **Collective model:** Vibrational spectra and rotational spectra.

Nuclear Reactions: Radioactive decays and their selection rules, Half life, Fission and fusion, Nuclear reactions and reaction mechanism, Compound nuclei and direct reactions.

Module III: (22hrs)

Sub-nuclear particles and their properties: Production of sub-nuclear particles, electromagnetic interaction, strong and weak interactions among these particles, classification of elementary particles, leptons, hadrons, mesons, baryons, quantum numbers – spin, charge, parity, lepton number, baryon number, isospin, strangeness, Gell-Mann-Nishijima scheme, Hypercharge, conservations laws – conservation of charge, lepton number, Baryon number, isospin, hypercharge, parity, charge conjugation parity, time reversal symmetry, CPT theorem. Quark and lepton model of sub-nuclear particles.

Text Books:

1. Nuclear Physics by S N Ghosal
2. Introduction to Nuclear and Particle Physics by V K Mittal, R C Verma and S C Gupta
3. Introductory Nuclear Physics by K S Krane

Reference books:

1. Introductory Nuclear Physics by David Halliday
2. Introductory Nuclear Physics by S S M Wong
3. Nuclear physics by Satyaprakash.
4. The Nuclear Shell Model, Basic Ideas and Concepts in Nuclear Physics by K Heyde

MSPH5205 Advanced Condensed Matter Physics

Code	Course Title	Course Type	Credits	L-T-P
MSPH5205	Advanced Condensed Matter Physics	Theory	4	3-1-0

Module–I (19Hrs)

Time Dependent Perturbation Theory: Transition Probability, Constant and Harmonic Perturbation, Fermi's Golden rule and electric dipole radiation and selection rules, Adiabatic and Sudden Approximations.

WKB Approximation Method: General Formalism, Validity of WKB Approximation Method, Bound States for Potential Wells with One Rigid Wall.

Module-II (22Hrs)

Variational methods - Ground State, First Excited State and Second Excited State of One-Dimensional Harmonic Oscillator, Ground State of H-atom.

Scattering Theory – Scattering cross section and amplitude, Born approximation, Application to Coulomb and Screened Coulomb Potential, Partial Wave Analysis for Elastic and Inelastic Scattering, Effective Range and Scattering Length, Optical Theorem, Black Disc-Scattering.

Module-III (22Hrs)

Many body systems: Systems of identical particles, Slater determinant, many body Hamiltonians, Self-Consistent Field approach, Valence Electrons and the Adiabatic Approximations, The Hartree Approximation, The Hartree–Fock Approximation. Density Functional Theory, Thomas Fermi model, Hohenberg-Kohn theorem; Kohn-Sham Equation.

Magnetism: Interaction of ferromagnetic materials: Weiss molecular field theory, origin of the Weiss molecular field: Quantum mechanics of the He atom, Collective electron theory of ferromagnetism: The Slater-Pauling curve, Ferromagnetic domain: why ferromagnetic domain occurs: magnetostatic, magneto crystalline and magnetostrictive energy.

Text Books:

1. Introduction to Condensed Matter Physics by Feng Duan and Jin Guojun
2. Quantum Mechanics Concepts and Applications by Nouredine Zettili
3. Magnetic Materials: Fundamentals and Device Applications by Nicola A. Spaldin

Reference Books:

1. Introduction to Solid State Physics by C. Kittel
2. Solid State Physics by Aschroft, Mermin
3. Density Functional Theory of Atom and Molecules by Robert G Parr and Wei Tao Yang
4. Advanced Quantum Mechanics by Satyaprakash
5. Advanced Quantum Mechanics by J.J. Sakurai
6. Electronics Structure: Basic Theory and Practical Methods by Richard M Martin
7. Principles of Condensed Matter Physics by Chaikin and Lubensky

MSPH5103 Embedded System

Code	Course Title	Course Type	Credits	L-T-P
MSPH5103	Embedded System	Theory	4	3-1-0

Module -1 **(12 Hours)**

Introduction to Embedded system, General Purpose Computing System Vs Embedded System, Harvard Vs Von-Neumann Architecture, RISC Vs CISC, Little Endian Vs Big Endian, classification & applications of Embedded System, Introduction to 8085 Microprocessor ,Architecture, Addressing modes, 8085 instruction set, 8085 interrupts, Programming concept, Memory and I/O interfacing, Interfacing 8255, 8253, 8257, 8251 with 8085 Microprocessors.

Module-2 **(12 Hours)**

Introduction of High – level Programming Language, Introduction of data in C. Operators and its precedence, Various data types in C, Storage classes in C, Decision making and forming loop in program, Handling character, strings, Arrays in C, Structure and union, User defined function, Pointers in C, Advanced pointer. Pointer to structures, pointer to functions, file handling in C,

Introduction to object oriented Programming and C--.

Module-3 **(12 Hours)**

Introduction Of 8051 Microcontroller, Pin Diagram, Memory Organization, Registers of 8051, Embedded C Programming concepts, Interfacing of Led, Seven Segment, LCD, Keypad, Motors With 8051.

Text Books

1. Microcontrollers [Theory and Applications], Ajay V. Deshmukh, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Introduction to Embedded Systems, Shibu K.V, TMH Private Limited, New Delhi, 2009
3. Fundamentals of Microprocessor and microcontroller by B.Ram, DhanpatRai Publication
4. The 8051 Microcontroller and Embedded Systems by M. Ali Mazidi, J. G. Mazidi&Rolin D. McKinlay; Pearson Prentice Hall; 2nd Ed. 5th Impression 2009

Reference Books

1. Raj Kamal, Embedded Systems – Architecture, Programming and Design, Tata McGraw Hill Publishing Company Limited, New Delhi,
2. C. Baron, J. Geffroy and G. Motet, Embedded System Applications, Kluwer, 1997.
3. .Microprocessors and Microcontrollers Architecture, programming and system Design 8085,8086 ,8051, 8096:by Krishna Kant;PHI.
4. Kenneth J. Ayala, The 8051 Microcontroller – Architecture, Programming and Applications, 2nd Edition, Thomson Delmar Learning, 2004.

MSPL5202 Physics of Materials Lab III

Code	Course Title	Course Type	Credits	L-T-P
MSPL5202	Physics of Materials Lab III	Practice	2	0-0-3

1. Verifying the Kerr effect and calculating Kerr's constant.
2. Faraday rotation experiment – observe the effect of magnetic field on linearly polarized light
3. Determine temperature dependent viscosity of Newtonian fluid using capillary viscometer.
4. Calculate the magnetic/electric properties (permeability, permittivity)
5. Learning how to do calculations for synthesis of materials.
6. Synthesis of material (material can be chosen depending on the availability).
7. Analysis of dielectric properties of a material.
8. Analysis of electrical properties of a material.
9. Analysis of AC and DC conductivity of a material.
10. Brownian motion x^2 vs t plot
11. Determine temperature dependent viscosity of Newtonian fluid using capillary viscometer.
12. Study the temperature induced melting and freezing of thermo-responsible colloids.

MSPL5101 Embedded System Lab

Code	Course Title	Course Type	Credits	L-T-P
MSPL5101	Embedded System Lab	Practice	2	0-0-3

List of General Experiments:

1. Write a 8051 c program to send a value 00-FF h to port 0.
2. Write a 8051 c program to send hex values for ASCII characters of 0,1,2,3,4,5,A,B,C,D To port 2.
3. Write a 8051 c program to toggle all the bits of port 2 200 times.
4. Write a 8051 c program to toggle all the pins of Port 1 continuously with a 10 ms delay.
5. Write a 8051 c program to get a byte of data from Port 1 and then send it to Port 3.

6. Write a 8051 c program to get a byte of data from Port 0. If it is less than 100, send it to Port 1, otherwise send it to port 2.

List of Interfacing Experiments:

7. Interfacing Of Seven Segment With 8051
8. Interfacing Of LCD With 8051
9. Interfacing Of Switch With 8051
10. Interfacing Of Keypad With 8051
11. Interfacing Of Motors With 8051

List of small projects:

12. Metro Train Prototype with 8051
13. Visitor counter with 8051 using LCD
14. Logic Gate with 8051
15. Password Based Door Locking System with 8051