Centurion University of Technology & Management

M.Sc. (Physics)

(Two years Programme)

School of Applied Sciences

2019

M.Sc. Physics
(Two year programme)
Course Structure-2019

Semester-I

Sl. No	Code	Subject Name	L-T-P	Credits
1	MSCP1101	Mathematical Physics	3-1-0	4
2	MSCP1102	Classical Mechanics	3-1-0	4
3	MSCP1103	Quantum Physics I	3-1-0	4
4	MSCP1104	Electrodynamics & Special Relativity	3-1-0	4
5	MSCP1105	Modern Physics Lab	0-0-6	4
6		Skill I	0-0-6	4
		Total		24

Semester-II

Sl. No	Code	Subject Name	L-T-P	Credits
1	MSPH3602	Statistical Physics	3-1-0	4
2	MSCP1201	Solid State Physics	3-1-0	4
3	MSCP1202	Electronics Devices and Circuits	3-1-0	4
4	MSCP1203	Computational Physics	3-1-0	4
5	MSCP1204	Computational Physics Lab	0-0-3	2
6	MSCP1205	Electronics Devices Lab	0-0-3	2
7		Skill II	0-0-6	4
		Total		24

List of Skill Courses

Students can choose two of the below given Skill Courses

or any other suitable skill course offered by the University

Sl. No	Code	Subject Name	(L-T-P)	Credits
1	SBFE3125	Image Processing through MATLAB-I	0-0-6	4
2	SBFE4102	Programming in C	0-0-6	4
3	SBFE3130	Optical Fiber Technician	0-0-6	4
4	MSSE0204	Solar PV System Applications	0-0-4	4
5	MSSE0205	Renewable Energy Sources and Applications	0-0-4	4
6	MSSE0401	Introduction to Industrial Automation	2-0-2	4

Semester-III

Sl. No	Code	Subject Name	L-T-P	Credits
1	MSCP2301	Atomic and Molecular Physics	3-1-0	4
2	MSCP2302	Nuclear and Particle Physics	3-1-0	4
3	MSRM5101	Introduction to Research	2-0-0	2
4	MSCP2303	Quantum Physics II	3-1-0	4
5	MSPS2301	Seminar I	0-0-3	2
6		Special Paper I	3-1-0	4
7		Special Paper Lab I	0-0-6	4
		Total		24

Semester-IV

Sl. No	Code	Subject Name	L-T-P	Credits
1		Special paper II	3-1-0	4
2		Special paper III	3-1-0	4
3		Special paper Lab II	0-0-6	4
4	MSPS2401	Seminar II		4
5	MSPP2401	Project/Dissertation		8
		Total		24

Special Papers

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

Stream 1 - Electronics Special Paper

Sl. No	Code	Subject Name	(L-T-P)	Credits
1	MSCP2304	Microprocessor and Interfacing devices	3-1-0	4
2	MSCP2306	Microprocessor lab	0-0-6	4
3	MSCP2401	Electronics Communication System	3-1-0	4
4	MSPH5103	Embedded System	3-1-0	4
5	MSCP2402	Electronics simulation Lab	0-0-6	4

Stream 2 - Material Science Special Paper

Sl. No	Code	Subject Name	(L-T-P)	Credits
1	MSCP2305	Soft Matter Physics	3-1-0	4
2	MSCP2307	Materials Lab I	0-0-6	4
3	MSCP2403	Introduction to Bio- and Nano-materials	3-1-0	4
4	MSCP2404	Advanced Solid State Physics	3-1-0	4
5	MSCP2405	Materials Lab II	0-0-6	4

Students can choose one or more of the given Domain courses

Sl. No	Code	Subject Name	(L-T-P)	Credits
1		Machine Learning		
2		Embeded System		
3		Unity Gaming		
4		Auto Design		
5		Radio Imaging Technique		
6		Auto Service		
7		Renewable Energy		

Syllabus

Semester I

MSCP1101 Mathematical Physics

Code	Course Title	Course Type	Credits	L-T-P
MSCP1101	Mathematical Physics	Theory	4	3-1-0

Module-I (18Hrs)

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.

Tensors: Tensor analysis, Pseudo-tensors, Dual tensors.

Module-II (20Hrs)

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 eigenfunctions.

Gamma function and Beta Function: Definitions and properties.

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 SatyaPrakash, Sultan Chand & Sons; Sixth edition (2014).

MSCP1102 Classical Mechanics

Code	Course Title	Course Type	Credits	L-T-P
MSCP1102	Classical Mechanics	Theory	4	3-1-0

Module I: (22hrs)

Lagrangian Dynamics for holonomic systems and extensions: Constraints, D'Alembert's principle, Lagrange's equations from D'Alembert's principle, Lagrange's equations in presence of non-conservative forces, generalized potential, Gauge invariance of Lagrangian, Lagrange equations invariant under Galilean transformation.

Hamiltonian dynamics: Generalized momentum and cyclic coordinates, conservation theorems, Hamilton function and conservation of energy, Hamilton's equations, Hamilton's equationsin different coordinate systems, examples in Hamilton dynamics,

Variational principle: Introduction, Euler-Lagrange's equations, Hamilton's principle, Deduction of Hamilton's principle from D'Alembert's principle, Modified Hamilton's principle, Deduction of Hamilton's equations from modified Hamilton's principle or (Variational principle), Deduction of Lagrange's equations from variational principle for non-conservative systems, Lagrange's equations of motion for non-holonomic systems (Lagrange's method of undetermined multipliers), physical significance of Lagrange's multipliers, principle of least action

Module II: (20hrs)

Central force problem: Reduction of two-body central force problem to the equivalent one-body problem, Central force and motion in a plane, Differential equation for an orbit, Inverse square law of force, Kepler's laws of planetary motion, Stability and closure of orbit under central force, Virial theorem, Scattering in a central force field, Rutherford Scattering cross section

Canonical transformations: Introduction of canonical transformations, Legendre transformations, Generating Functions, Application of canonical transformations, Conditions for canonical transformations, Infinitesimal contacttransformations.

Poisson Bracket: Introduction, Fundamental Poisson brackets and properties of Poisson brackets, Lagrange brackets, angular momentum and Poisson brackets, Invariance of Poisson bracket under canonical transformations, phase space, Liouville's theorem

Module III: (18hrs)

Hamiltonian-Jacobi Theory and transition to Quantum mechanics: Hamiltonian-Jacobi equation, Solution of harmonic oscillator by Hamiltonian-Jacobi method, Hamilton's characteristic function-conservative system, Solution of Kepler's problem by Hamiltonian-Jacobi method, Action and angle variables, Hamilton Jacobi equation- Geometrical optics and wave mechanics (Transition from Classical to Quantum Mechanics)

Small Oscillations: General theory of small oscillations**:** Secular and Eigen value equation, Solution to the Eigen value equation, Small oscillations in normal coordinates, Using General theory of small oscillations find out the Secular and Eigen value equation, Solutions, normal coordinates and normal frequencies of two coupled pendulum, double pendulum and vibrations of linear triatomic molecule

Text Book:

1. Classical Mechanics by J C Upadhyaya, Himalaya Publishing House, 2014.

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.

MSCP1103 Quantum Physics I

Code	Course Title	Course Type	Credits	L-T-P
MSCP1103	Quantum Physics I	Theory	4	3-1-0

Module-I (16Hrs)

Introduction: De Broglie's hypothesis, Wave packets, The Heisenberg Uncertainty Relations, Postulates of Quantum Mechanics, The probability Interpretation of the Wave Function, the Schrodinger Equation.

The general structure of wave Mechanics: Vector spaces and operators, Dirac Notation,Operatorsand Observables, Degeneracy and Simultaneous Observables, Observables as operators, Projection Operators, Harmonic Oscillator using creation-annihilation operators, The time dependence of Operators, Problems

Module-II (22Hrs)

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

Spin: Eigen states of spin ½, The intrinsic Magnetic Moment of Spin ½ particles, Addition of TwoSpins, The addition of spin ½ and orbital angular momentum, Pauli theory of spins, General Rules for addition of angular Momenta, Problems

Module-III (18Hrs)

Perturbation Theory: Energy Shifts and Perturbed Eigen states, Degenerate Eigen state and removal of degeneracy, The Stark Effect, Zeeman Effect, Hyperfine structure. The pictures of quantum mechanics: The Schrodinger picture, The Heisenberg picture, The interaction picture.

Text Books:

1. Quantum Mechanics by Satyaprakash, S Chand Publications
2. Quantum Mechanics: Concepts and Applications by N Zettili, Wiley Publications

Reference Books:

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

MSCP1104 Electrodynamics and Special Relativity

Code	Course Title	Course Type	Credits	L-T-P
MSCP1104	Electrodynamics and Special Relativity	Theory	4	3-1-0

Module-I (18Hrs)

EM Waves in vacuum: Maxwell's equations, the electromagnetic (EM) wave equation and its solution, energy and momentum in EM Waves.

EM Waves in matter: Propagation in linear non-conducting media, Reflection and Transmission at normal incidence, Reflection and Transmission at oblique incidence, Reflection and Transmission at a conducting surface.

Absorption and Dispersion: EM waves in conductors, Reflection at a conducting surface,The frequency dependence of permittivity.

Module-II (18Hrs)

Guided Waves: Wave Guides, TE waves in a rectangular wave guide, the coaxial transmission line.

Potentials: Scalar and Vector potentials, Gauge transformations, Coulomb Gauge and Lorentz Gauge, Retarded Potentials, Lienard-Wiechert Potentials, The fields of a moving point charge.

Radiation: Electric dipole radiation, Magnetic dipole radiation, Radiation from an arbitrary source, Power radiated by a point charge, radiation reaction.

Module-III(20Hrs)

The special theory of relativity: Einstein's postulates, the geometry of relativity, the Lorentz transformations, the structure of space-time.

Relativistic Mechanics: proper time and proper velocity, relativistic energy and momentum, relativistic kinematics, relativistic dynamics.

Relativistic Electrodynamics: Magnetism as a relativistic phenomenon, how the fields transform, the field tensor, Electrodynamics in tensor notation, the 4-vector potential and the field tensor.

Text Book:

1. Introduction to Electrodynamics, D J Griffiths, Prentice Hall of India, 2012.

Reference Books:

1. Classical Electrodynamics(2nd edn)- J.D Jackson, Wiley Eastern
2. Principles of Electromagnetics by M N O Sadiku, Oxford Publications

MSCP1105Modern Physics Lab

Code	Course Title	Course Type	Credits	L-T-P
MSCP1105	Modern Physics Lab	Practice	4	0-0-6

At least 8 of the following experiments to be done:

1. Verification of laws of photo electric effect. Hence determination of Planck's constant, work functions by using photoemission method.
2. Determination of surface tension of soap solution.
3. Determination of specific rotativity of sugar solution by using polarimeter.
4. Determination of rigidity modulus of of a wire by Maxwell's needle.
5. Determination of wavelength of unknown light by plane diffraction grating.
6. Determination of wavelength of monochromatic light using Michelson interferometer.
7. Determination of temperature variation of surface tension of water.
8. Study of characteristic frequencies (normal modes) of a coupled pendulum.
9. Study of p-n junction diode and MOSFET.
10. Study of Zeeman effect using Fabry Perot etalon.
11. Study of synchronization of weakly coupled oscillators.
12. Determination of Planck's constant suing optical pyrometer.
13. Determination of Lande's 'g' factor using Nuclear Magnetic Resonance technique.
14. Determination of Lande's 'g' factor using Electron Spin Resonance technique.

Skill Course 1

SBFE 3125 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 InstallationMATLAB Interactive Sessions,Menus and the toolbar,Programming in MATLAB.

Matrix Operation: Matrix and Array Operation,Indexing & Standard Matrix generation,RelationalOperators, 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 PrintingGraphs

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,ContrastVariation,Histogram Processing,ImageFiltering: Smoothing & Sharpening.

Image Restoration:Images with Noise,ImageDenoising,Denoising with Order StatisticsFilter,

Image Segmentation: Edge Detection &Thresholding,

Module 3[15Hrs]

Application of Image Processing using MATLAB

Application Oriented Technique: Color Image Processing, Image Compression,ImageRecognition.

Application Development:Flow Diagram and Logic Development Application Development usingMATLABSimulation 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.

ReferenceBooks:

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

SBFE4102 Programming in C

Code	Course Title	Course Type	Credits	L-T-P
SBFE4102	Programming in C	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, bit-wise operators, 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. pointers-concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory management functions, command line arguments.

Module III: **(12 Hours)**

Derived types-structures-declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, typedef, bit fields, C program examples.

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

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.

Skill Course 4

MSSE0204 Solar PV System Applications

Code	Course Title	Course Type	Credits	L-T-P
MSSE0204	Solar PV System Applications	Practice	4	0-0-4

Objectives:

- To provide a detailed exposure to various electrical power sources.
- To understand the concept of Solar Cell, Module, Battery, CCR & Inverter.
- To understand the concept of Solar photovoltaic systems.

- **Learning outcomes:** Upon successful completion of this subject, students should be able to:

- Demonstrate basics of various electrical power sources.
- Demonstrate basics of Photovoltaic concept.
- Explain in depth of its types and design of various PV-interconnected systems.

Evaluation System:

	Component	***% of Marks***	***Method of Assessment***
Internal Examination	Experiments	*100*	Lab work, Site visit, report & Viva Voce.

Course outline

Experiments

1. Study of Solar Energy Scenario in the World and in India.
2. Demonstration of measuring instruments and Tool kits.
3. Demonstration of Solar Photovoltaic (PV) Cell, Module, String and Array.
4. Demonstration of Solar module Junction Box (JB), AJB and MJB.
5. V-I measurement of Solar PV Cell/Module in different light condition.
6. Demonstration of Electrical wiring and input/output measurement.
7. Demonstration of Series & Parallel connection of Solar PV modules.
8. Identification & Specification of different types of Batteries, CCR and Inverter.
9. Design and connection practice of Solar PV system.
10. Design and connection practice of Solar Home Lighting system.
11. Design and connection practice of Hybrid Solar Photovoltaic system.
12. Design and connection practice of Small Electronics circuit.
13. Design and connection practice of Solar operated swing machine.
14. Design and connection practice of Solar water pumping system.
15. Installation process of Solar PV system.

References:

1 Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, 3rd Ed., Tata Mc-Graw Hill, 2012.
2 Renewable Energy Technology by C. S. Solanki; Prentice Hall India Learning Pvt. Ltd. 2008.
3 Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers by C. S. Solanki; Prentice Hall India Learning Pvt. Ltd. 2013.
4 Photovoltaic System Design: Procedures, Tools and Applications by Suneel Deambi, CRC Press; 1 edition (August 12, 2016).

Skill Course 5

MSSE0205 Renewable Energy Sources and Applications

Code	Course Title	Course Type	Credits	L-T-P
MSSE0205	Renewable Energy Sources and Applications	Practice	4	0-0-4

Objectives:

- To understand the importance of renewable energy sources on the Earth.
- To expose the students to various Renewable Energy systems and their applications in various fields of human activity.

- **Learning outcomes:** Upon successful completion of this subject, students should:
  - Have practical knowledge of renewable energy resources.
  - Acquire the skill of analyzing and designing Renewable Energy systems.

Evaluation System:

	Component	***% of Marks***	***Method of Assessment***
Internal Examination	Experiments	*100*	Lab work, Site visit, report & Viva Voce.

Course outline

Experiments

1. Study of different types of Renewable and Non-renewable Energy Sources.
2. Familiarization with Laboratory Instruments.
3. Verification of Voltage, Current and Power in a circuit/room.
4. Study of Solar Energy Sources.
5. Study of Electricity Generation from Solar Photovoltaic (PV) Panel.
6. Study of Electricity Generation from Solar Thermal.
7. Design and analysis of Solar Power Plant (1 KW).
8. Design of a Hybrid Solar PV System.
9. Study and analysis of Water Heating System.
10. Study and analysis of Solar Dryer.
11. Study of Electricity Generation from Wind Energy.
12. Renewable Energy in Medical Application.
13. Renewable Energy in Agriculture Application.
14. Study of Electricity Generation from Hydropower.
15. Study of Electricity Generation from Biomass.

Reference:

1. Kothari, D.P., Singal, K.C. and Ranjan, R. Renewable Energy Sources and Emerging Technologies, Prentice hall, New Delhi, 2016.
2. Electricity from Renewable Resources: Status, Prospects, and Impediments; Washington, DC: The National Academies Press. https://doi.org/10.17226/12619, 2010.
3. Mittal, K M, Biogas Systems: Principles and Applications, Publisher: New Age International Publishers Ltd.-New Delhi. 2016.
4. Johnson GL. Wind Energy Systems, (Electronic Edition), Prentice Hall Inc, 2011

Skill Course 6

MSSE0401 Introduction to Industrial Automation

Code	Course Title	Course Type	Credits	L-T-P
MSSE0401	Introduction to Industrial Automation	Practice	4	2-0-2

Leaning Objective:

- To introduce the student to the basic issues of Industrial Automation, the building blocks of a device which implements such automation
- To train the student in hardware and software (logic building) aspects of automation
- To introduce the student to Intouch SCADA software

Learning Outcome:

- Assemble and/or handle various interfaces between production/manufacturing/storage components and PLCs
- Design and implement elementary PLC circuits

Read, Write and Execute codes for elementary operations using Intouch SCADA

Evaluation Systems

	Component	**% of Marks**	**Method of Assessment**
Internal Examination	Internal Theory	30	Written Examination
	Assignment	5	Report or Presentation + Learning Record
	Attendance	5	Based on Class Attended
External Examination	External Theory	60	Written Examination
Total		**100**	

Course Outline

Module-I: Getting Initiated to Industrial Automation. (15 Hours)

Theory

Simulation of Gates, Relay, Contactor, Pushbutton, Toggle Switch, Limit Switch, Proximity Switch, Optical Switch, Pressure Switch, etc. Connection diagram of PLC with sensors, relay contactor and motors.

Practice

1. Latching and unlatching circuit using relay.
2. Interlocking circuit using relay.
3. Switching of 220Vac devices using (24Vdc)

Module-II: Introduction to PLC (5 Hours)

Theory

Introduction to controller Family, SLC 500 features: Details about CPUs, Memory Organisation, Program files and Data files. Architecture, Rack, slot, channel, full structure description and max expansion.

Practice

4. Understanding the physical Architecture of a PLC.
5. Understanding the physical Input Output connection of a PLC.

Module-III: Addressing, Hardwire Linking, Timer, Counter, Comparator (18 Hours)
Theory
Physical I/O addressing (both Digital & Analog), Memory Instructions Addressing like Timer, Counters, Binary, Integers etc.
Timer basics, Detail programming of TON, TOF, RTO, RES with applications.
Basics of Counter, Detail Programming of CTU, CTD, RES with applications.
Basics of comparators, Implementation of LIM, MEQ, EQU, NEQ, LES, GRT, LEQ, GEQ.
Practice
6. TON / TOF / RTO / RES programming
7. CTU / CTD / RES programming
8. LIM, MEQ, EQU, NEQ, LES, GRT, LEQ, GEQ programming

Module-IV: Math & Logical, Move & Copy, Shift & Rotate, Jump & MCR (17 Hours)
Theory
To understand the different operations like Math, Logical, Move, Copy, Shift, Rotate, Jump, MCR, FIFO & LIFO.
Practice
9. Math & Logical Operations
10. Move & Copy Operations
11. Shift & Rotate Operation
12. Jump & MCR Operations
13. FIFO & LIFO Operation

Module-V: Introduction to INTOUCH (7 Hours)
Theory
Introduction to InTouch, Basic operations related to Intouch Editor, types of windows, How to Open window, windows property.
Practice
14. Basic operation of Intouch SCADA software.

Module-VI: TOOLBARS (6 Hours)
Theory
General toolbar, New window, Open window, close window, save window, save all, duplicate selection, cut to clipboard, copy, paste, undo and redo.

Practice
15. Operation & utility of general toolbars.

Module-VII: WIZARDS (22 Hours)
Theory
Wizard toolbar, Alarm display, Buttons, clock, lights, meter, runtime tools (for alarm monitor), slider, switches, SYMBOL FACTORY, Text Display, Trend, Value Display Fonts, Bold/Italic/Underline, Enlarge/ reduce font, Left/Centre/Right.
Practice
16. Wizard toolbar details, value display, user input.
17. Symbol factory toolbar.
18. Different operational properties

19. Device Connectivity

Reference Book

Madhuchhanda Mitra and Samarjt Semgupta,"Programmable Logic Controllers and Industrial Automation: An Introduction" 2nd Edition"

Session Plan

Topics	**No. of Sessions** (in hrs.)	**Activity**	**Assignment**	**Suggested Reading**
Module – 1 (Basic Electronics and Industrial Automation) (Theory- 2 hrs + Practice- 13 hrs)				
What are gates. What is a relay. What is contactor. Pushbuttons, toggle switches, Limit switch, proximity switch, optical switch, pressure switch, etc. Connection diagram of PLC with sensors, relay contactor and motors. **Practice** 1. Latching and unlatching circuit using relay. 2. Interlocking circuit using relay. 3. Switching of 220Vac devices using (24Vdc).	5+10	Lecture+ Practice	Assignment 1.1	Reference Book (RB)
Module – 2 (Introduction to PLC) (Theory- 6 hours)				
Introduction to controller Family, SLC 500 features: Details about CPUs, Memory Organisation, Program files and Data files. Architecture, Rack, slot, channel, full structure description and max expansion. **Practice** 4. Understanding the physical Architecture of a PLC. **5.** Understanding the physical Input Output connection of a PLC.	5	Lecture	Assignment 1.2	RB
Module – 3 (Addressing, Hardwire Linking, Timer, Counter, Comparator) (Theory- 5 hours)				
Physical I/O addressing (both Digital & Analog). Memory Instructions Addressing like Timer, Counters, Binary, Integers etc Timer basics, Detail programming of TON, TOF, RTO, RES with applications. Basics of Counter, Detail Programming of CTU, CTD, RES with applications. Basics of comparators, Implementation of LIM, MEQ, EQU, NEQ, LES, GRT, LEQ,	5+13	Lecture+ Practice	Assignment 1.3	RB

GEQ. **Practice** 6. TON / TOF / RTO / RES programming 7. CTU / CTD / RES programming. 8. LIM, MEQ, EQU, NEQ, LES, GRT, LEQ, GEQ programming				
Module – 4 (Math & Logical, Move & Copy, Shift & Rotate, Jump & MCR) (Theory- 5 hours + Practice- 15 hours)				
To understand the different operations like Math, Logical, Move, Copy, Shift, Rotate, Jump, MCR, FIFO & LIFO. **Practice** 9. Math & Logical Operations 10. Move & Copy Operations 11. Shift & Rotate Operation 12. Jump & MCR Operations 13. FIFO & LIFO Operation	5+12	Lecture+ Practice	Assignment 1.4	RB
Module – 5 (Introduction to Intouch) (Theory- 1 hours + Practice- 4 hours)				
Introduction to InTouch, Basic operations related to Intouch Editor, types of windows, How to Open window, windows property. **Practice** 14. Basic operation of Intouch SCADA software.	3+4	Lecture+ Practice	Assignment 1.5	RB
Module – 6 (TOOLBARS) (Theory- 2 hours + Practice- 14 hours)				
General toolbar, New window, Open window, close window, save window, save all, duplicate selection, cut to clipboard, copy, paste, undo and redo. **Practice** 15. Operation & utility of general toolbars.	3+3	Lecture+ Practice	Assignment 1.6	RB
Module – 7 (WIZARDS) (Theory- 2 hours + Practice- 6 hours)				
Wizard toolbar, Alarm display, Buttons, clock, lights, meter, runtime tools (for alarm monitor), slider, switches, SYMBOL FACTORY, Text Display, Trend, Value Display Fonts, Bold/Italic/Underline, Enlarge/ reduce font, Left/Centre/Right. **Practice** 16. Wizard toolbar details, value display, user input. 17. Symbol factory toolbar. 18. Different operational properties 19. Device Connectivity	4+18	Lecture+ Practice	Assignment 1.7	RB
Total- 90 Hours(Theory- 30 hours + Practice- 60 hours)				

Semester II

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 itsconsequences, 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 ultracold atomic gases, Thermodynamics of the blackbody radiation.

Ideal Fermi Systems: Thermodynamic behavior of an ideal Fermi gas, The electron gas in metals, Ultracold 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.)

MSCP1201 Solid StatePhysics

Code	Course Title	Course Type	Credits	L-T-P
MSCP1201	Solid State Physics	Theory	4	3-1-0

Module-I (18Hrs)

Overview of Condensed matter physics: Water as an example, Crystal Structures: Fundamental Types of Lattices (2D and 3D), Index System for Crystal Planes, Simple Crystal Structures. Non ideal Crystal Structures, Primitive Lattice, Primitive Lattice Vector for cubic systems (that is for simple cubic (sc), face centered cubic (fcc), and body centered cubic (bcc)), Reciprocal Lattice,Reciprocal Lattices of cubic systems (simple cubic, face centered cubic, and body centered cubic), Diffraction of waves by crystals: Bragg's law, Scattering Wave amplitude, Atomic structure factor, Structure factor for sc, fcc and bcc, wigner-Seitz Cell, Brillouin Zones.

Crystal Binding and Elastic Constants: Crystals of Inert Gases, Ionic Crystals, Covalent Crystals,Metals, Hydrogen Bonds, Analysis of Elastic Strains, Elastic Compliance and Stiffness Constants.

Module-II (20Hrs)

Crystal Vibrations (Phonon theory):phonon dispersion of crystals with monoatomic basis, Phonon dispersion of crystals with two atoms per primitive basis, phonon momentum.

Thermal Properties of Solid: Derivation of specific heat of solid by classical theory, Einstein theory and Debye theory, anharmonic crystal interactions, Thermal conductivity

Free electron Fermi gas: Energy Levels in One Dimension, Effect of Temperature on the Fermi-Dirac Distribution, Free Electron Gas in Three Dimensions, Drude-Lorentz theory, Heat Capacity of the Electron Gas, Electrical Conductivity and Ohm's Law,Thermal Conductivity of Metals.

Module-III (20Hrs)

Semiconductor Crystals: Band Gap, direct and indirect band gap, intrinsic carrier concentration, intrinsic semiconductors (Si and Ge), intrinsic mobility, effective masses, Impurity Conductivity, Semimetals.

Point defects: Lattice vacancy defect, Frenkel defect, Schottky defect, diffusion, Colourcentres.

Dielectrics and Ferroelectrics: Macroscopic Electric Field, Local Electric Field at an Atom, Dielectric Constant and Polarizability: Clausius-Mossotti relation, optical properties of ionic crystals, pyroelectric and ferroelectric crystals.

Textbook:

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

Reference Books:

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

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, Photodetectors, 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

MSCP1203 Computational Physics

Code	Course Title	Course Type	Credits	L-T-P
MSCP1203	Computational Physics	Theory	4	3-1-0

Module I: (20Hrs)

Roots of Algebric equations: Bisection method, Newton-Raphson Method, Examples: Particle in a soft one-dimensional box and other problems.

Numerical Solutions of systems of linear algebraic equations: Gauss Elimination, Gauss-Jordan Elimination; Evaluation of Eigen-value and Eigen-vectors, Solutions of Coupled Oscillator systems

Module II: (15Hrs)

Interpolation and data fitting: Lagrange Interpolation formula, construction of functions from observed experimental data.

Numerical Differentiation: total and partial derivatives, evaluation of electric and magnetic fields from potentials.

Numerical Integration: Newton-Cotes Formulas (Trapezoidal and Simpson Rules), Gaussian Quadrature: Gauss-Legendre Integration, Moment of Inertia of various objects, evaluation of electric and magnetic fields using Coulomb's Law and Biot-Savart law.

Module III: (15Hrs)

Solutions of linear ODEs (2^{nd} order with constant coefficient): Euler method, Runge-Kutta method. Simple harmonic motion with and without damping.

Solution of PDEs (linear, 2^{nd} order with constant coefficient): Laplace equation, Wave equation and Heat equation.

Text Books:

1. Numerical Methods for Scientific and Engineering Computations by M K Jain, SRK Iyengar, R K Jain, New Age International Publishers, 2012

References Books:

1. Computational Physics by N J Giordano and H Nakanishi, Pearson, 2012.
2. Nonlinear Dynamics and Chaos by S H Strongatz, Persius Books, 200.

MSCP1204 Computational Physics lab

Code	Course Title	Course Type	Credits	L-T-P
MSCP1204	Computational Physics lab	Practice	2	0-0-3

Any 8 of the following experiments are to be done.

1. Basics of Scilab, Working with matrices and plotting graphs.
2. Working with loops, branches and control flow.
3. Using for loops, plotting graphs using for loop and solving programs using function.
4. Computing Taylor Series of functions.
5. Roots of transcendental equations by Newton-Raphson method
6. Derivatives of functions: evaluation of electric and magnetic fields from potentials
7. Numerical Integration using Trapizoidal Rule, Simpson Rule: evaluation of electric potential by Coulomb's law
8. Implementation of Gaussian Quadrature: Gauss-Legendre Integration.
9. Solution of a system of linear equations using Gauss Elimination and Gauss-Jordan Elimination methods.

10. Linear Regression: Fitting of experimental data by method of Least Squares
11. Solution of First Order Ordinary Differential Equation (ODE) by Euler and RK4 method: the Radioactive Decay problem
12. Solution of Second Order ODE: Pendulum motions
13. Solution of Laplace equation.
14. Solution of Fourier Heat equation

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 anInverting 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 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 (18Hrs)

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 (20Hrs)

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 (22Hrs)

Molecular spectra

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:

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

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

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:

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

MSCP2303 Quantum Physics II

Code	Course Title	Course Type	Credits	L-T-P
MSCP2303	Quantum Physics II	Theory	4	3-1-0

Module – I (16Hrs)

Variational Methods: Introduction, Ground State of One-Dimensional Harmonic Oscillator, First Excited State of One-Dimensional Harmonic Oscillator, Second Excited State One-Dimensional Harmonic Oscillator, Ground State of Hydrogen atom

WKB Approximation: General Formalism, Validity of WKB Approximation Method, Bound States for Potential Wells with no rigid walls, Bound States for Potential Wells with One Rigid Wall, Bound States for Potential Wells with Two Rigid Walls, Tunneling through a Potential Barrier

Module – II (20Hrs)

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

Applications ofTime Dependent Perturbation Theory: Interaction of Atoms with Radiation, classical treatment of incident radiation, Quantization of the Electromagnetic Field, Transition Rates for Absorption and Emission of Radiation, Transition Rates within the Dipole Approximation, Electric Dipole Selection Rules, Spontaneous Emission

Module – III (20 classes)

Scattering Theory: Scattering and cross section: connecting the angles in the Lab and CM frames, connecting the Lab and CM cross sections, Scattering cross section and amplitude, Born approximation: The first Born approximation, Validity of the first Born approximation, Application to Coulomb Potential, Application to Screened Coulomb Potential, Partial Wave Analysis for Elastic Scattering, Partial Wave Analysis for Inelastic Scattering, Effective Range and Scattering Length, Optical Theorem, Black Disc-Scattering, Scattering of Identical Particles

Text Book:

1. Quantum Mechanics: Concepts and Applications by NouredineZettili

Reference Books:

1. Advanced Quantum Mechanics by Satyaprakash, S Chand Publications
2. Introduction to Quantum Mechanics, D J Griffith, Pearson, 2014.
3. Modern Quantum Mechanics, J.J. Sakurai, Pearson, 2013.

Special Papers

MSCP2304 Microprocessors and Interfacing Devices

Code	Course Title	Course Type	Credits	L-T-P
MSCP2304	Microprocessors and Interfacing Devices	Theory	4	3-1-0

Module I (20 Hours)

Introduction to Microprocessor, Evolution of Microprocessors, Word length of microprocessor, Intel8085 Microprocessor Architecture, register organization, Address, Data and Control Buses, 8085 Pin Functions, multiplexing of Buses, Control Signals, Instruction Cycle, Machine Cycles, T-States, timing diagram, 8085 Instruction Set, Addressing Modes of 8085, Writing Assembly language program & executing programs using 8085.

Module II (15 Hours)

Architecture, pin description and operations of 8255 PPI, 8253/8254 Timer, 8259 PIC, 8237 DMA Controller, 8251 USART, Serial I/O Concepts, SID And SOD, Address space partitioning, Memory and I/O interfacing, Interfacing of above chips with 8085, Interrupts of 8085

Module III (20 Hours)

Architecture and register organization of 8086, Principle of pipelining, modes of operation, 8086 pin configuration and description of function of pins, 8086 instruction set, 8086 addressing modes, assembly language programming with 8086, Comparison of 8085 and 8086, comparison of 8086 and 8088 microprocessor, Introduction to 32-bit and 64-bit microprocessor.

Text Books:

1. Ramesh S. Gaonkar, "Microprocessor Architecture , Programming and Applications with the 8085", Penram International.
2. Fundamentals of Microprocessor and microcontroller by B. Ram, DhanpatRai Pub

Reference Books

1. Microprocessors and Microcontrollers Architecture, programming and system Design 8085, 8086, 8051,8096: by Krishna Kant; PHI..
2. Advanced microprocessor by A.P Mathur
3. Microprocessors and Interfacing by Douglas V Hall; McGraw-Hill.

MSCP2306 Microprocessors Lab

Code	Course Title	Course Type	Credits	L-T-P
MSCP2306	Microprocessors Lab	Practice	4	0-0-6

At least 8 of the following experiments to be done:

Using microprocessor kits/ Simulator

Write Assembly Language Program using 8085 microprocessor

1. Addition of two numbers.
2. Subtraction of two numbers.
3. Find 1^{s} complement of a number
4. Find 2^{s} complement of a number
5. Find the largest number from a given array of 8- bitnumbers.
6. Find the smallest number from a given array of 8- bit numbers.
7. Perform Decimal addition using 8085.
8. Find Ascending order of numbers
9. Find Descending order of numbers
10. Find Square of a Number using look-up table

Interfacing

11. Generate square waves on all lines of 8255 with different frequencies (concept of delay program)
12. Interfacing of stepper motor and rotating stepper motor by N steps clockwise/anticlockwise with speed control.

MSCP2401 Electronics Communication Systems

Code	Course Title	Course Type	Credits	L-T-P
MSCP2401	Electronics Communication Systems	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

andGraded 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

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.

MSCP2402 Electronics Simulation Lab

Code	Course Title	Course Type	Credits	L-T-P
MSCP2402	Electronics Simulation Lab	Practice	4	0-0-6

At least 8 of the following experiments to be done.

Using simulator/ Hardware kit

1. Write programme to add two numbers using 8051.
2. Write programme for Multiplication of two numbers using 8051.
3. Write programme to convert Hexadecimal to Decimal number using 8051.
4. Write a 8051 program to send a value 00-FF h to port 0.
5. Write programme to toggle the bits of an I/O port using 8051.
6. Write programme to obtained 1 sec delay using 8051
7. Write a8051 program to toggle all the pins of Port 1 continuously with a 10 ms delay.
8. Interfacing of Seven Segment with 8051
9. Interfacing of Switch with 8051
10. Interfacing of Motors with 8051

Using MATLAB/ SCILAB/LabVIEW /Hardware kit

11. Generate a carrier and a modulating signal. Modulate the carrier using AM. Show the waveform in time domain and analyze its frequency spectrum.
12. Generate a carrier and a modulating signal. Modulate the carrier using FM. Show the waveform in time domain and analyze its frequency spectrum.
13. Study and design of AM modulator and demodulator
14. Study and design of FM modulator and demodulator
15. Generation and demodulation of DSB-SC, SSB Signal. SSB generation and demodulation
16. Generation and study of Sampling and Quantization of Sinusoidal signal and Signal Reconstruction.
17. Study of pulse modulation schemes PAM, PWM and PPM.

MSCP2305 Soft Matter Physics

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

Module I: (21Hrs)

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: (21Hrs)

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: (14Hrs)

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.

MSCP2307 Materials lab I

Code	Course Title	Course Type	Credits	L-T-P
MSCP2307	Materials lab I	Practice	4	0-0-6

At least 8 of the following experiments to be done:

1. Comparison of static and dynamic methods of finding rigidity modulus of a material.
2. Comparison of static and dynamic methods of finding Young's Modulus of a material.
3. Temperature dependence of viscosity of glycerine using Ostwald Viscometer.
4. Study of drag forces offered by different media (air, water, oil, glycerine).
5. Verification of Wiedemann-Franz law and determination of Lorentz number.
6. Measurement of thermal conductivity of metals.
7. Faraday rotation experiment – observe the effect of magnetic field on linearly polarized light
8. Analysis of AC and DC conductivity of a material.
9. Measurement of thermal conductivity of metals.
10. Measuring the magnetic susceptibility of a solution of paramagnetic salt in water using Quincks method.

11. Measuring the magnetic susceptibility of a solid using magnetic balance.
12. Study of Hall Effect.
13. Determination of specific heat of solid.
14. Determination of band gap of semiconductor by Four Probe method.
15. Study dispersion relation and band gap frequency by using Lattice Dynamics kit.

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 MaterialsIntroduction: 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 nanomaterial, Classification of Nanostructured materials, unique properties of nanomaterial, microstructure and defects

Application of nanomaterial: Nano-electronics, Nano-electromechanical systems, Nano sensors, water treatment, energy, Nano medicine, 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 BRathandJMurday, 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).

MSCP2404 Advanced Solid State Physics

Code	Course Title	Course Type	Credits	L-T-P
MSCP2404	Advanced Solid State Physics	Theory	4	3-1-0

Module-I (16Hrs)

Many Body Systems: Introduction, Systems of identical particles, Slater determinant and 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.

Module-II (20Hrs)

Energy Bands: Nearly Free Electron Model, origin of energy gap, Bloch Functions, Kronig-Penney Model, Wave Equation of Electron in a Periodic Potential, Number of Orbitals in a Band. Band theory, Metal, insulators and semiconductors, Tight binding method, Plasmons, Polaritons, and Polarons: Dielectric function of the Electron Gas, Plasmons, Electrostatic Screening, Polaritons, Electron-Electron Interaction, Electron-Phonon Interaction: Polarons.

Module-III (20Hrs)

Magnetic properties, Van-Vleck and Pauli paramagnetism, Curie's law, Larmor and Landau diamagnetism, Ferromagnetism and anti-ferromagnetism (comparative description), magnetic resonance: Nuclear Magnetic Resonance, Line Width, Hyperfine Splitting.Nuclear Quadrupole Resonance, Ferromagnetic Resonance, Antiferromagnetic Resonance,Electron Paramagnetic Resonance, Superconductivity: Superconductivity, thermodynamics of superconducting transition, London equation, BCS theory, Dc and Ac Josephson's effect.

Text Books:

1. Introduction to Condensed Matter Physics by Feng Duan and JinGuojun
2. Introduction to Solid State Physics by C. Kittel

Reference Books:

1. Solid State Physics by Aschroft, Mermin
2. Density Functional Theory of Atom and Molecules by Robert G Parr and Wei Tao Yang
3. Advanced Quantum Mechanics by Satyaprakash
4. Advanced Quantum Mechanics by J.J. Sakurai
5. Electronics Structure: Basic Theory and Practical Methods by Richard M Martin

MSCP2405 Materials lab II

Code	Course Title	Course Type	Credits	L-T-P
MSCP2405	Materials lab II	Practice	4	0-0-6

At least 8 of the following experiments to be done:

1. Synthesis of materials using sol-gel method.
2. Determine the diffusion of a Newtonian fluid and find a relationship between viscosity coefficient & diffusion coefficient.
3. Depletion induced phase separation study in a colloid-polymer mixtures and determination of the phase diagram by visual observation.
4. Verifying the Kerr effect and calculating Kerr's constant.
5. Determine temperature dependent viscosity of Newtonian fluid using capillary viscometer.
6. Calculate the magnetic/electric properties (permeability, permittivity)
7. Learning how to do calculations for synthesis of materials.
8. Synthesis of material (material can be chosen depending on the availability).
9. Analysis of dielectric properties of a material.
10. Analysis of electrical properties of a material.
11. Analysis of AC and DC conductivity of a material.

12. Brownian motion x^2 vs t plot
13. Determine temperature dependent viscosity of Newtonian fluid using capillary viscometer.
14. Study the temperature induced melting and freezing of thermo-responsible colloids.