Course Structure & Distribution of Credits.

M. Sc. in Physics Program consists of total 12 theory courses, total 6 practical lab courses and projects in third & fourth semesters. Twelve theory courses and practical lab course will be common and compulsory to all the learners.Each theory course will be of 4 (four) credits, a practical lab course will be of 4 (four) credits and a project will be of 8 credits. A project can be on theoretical physics, experimental physics, applied physics,development physics, computational physics or industrial product development.A student earns 24 (twenty four) credits per semester and total 96 (ninety six)credits in four semesters. The course structure is as follows:-

Theory Courses

Semester	Paper I	Paper II	Paper III	Paper IV
I	Mathematical Methods	Classical Mechanics	Quantum Mechanics -I	Solid state Physics & Devices
II	Advanced Electronics	Electrodynamics	Quantum Mechanics –II	Atomic & Molecular Physics
III	Statistical Mechanics	Nuclear Physics	Microcontrollers & Interfacing	Embedded System & RTOS
IV	Experimental Physics	Applied Thermodynamics	32 bit microprocessor &PIC microcontroller	VHDL and Communication Interface

Practical Lab Courses

Semester	Paper I	Paper II
I	Laboratory Course 1	Laboratory Course 2
II	Laboratory Course 3	Laboratory Course 4
III	Project 1	Elective Lab Course 1
IV	Project 2	Elective Lab Course 2

Semester I

M.Sc. in Physics Program for Semester-I consists of four theory courses and two practical courses. The details are as follows:

Theory Courses (4): 16 hours per week. Four lectures per paper per week

Theory Paper	Subject	Lecture Hours	Credit
PSPH11	Mathematical Methods	60	04
PSPH12	Classical Mechanics	60	04
PSPH13	Quantum Mechanics -I	60	04
PSPH14	Solid state Physics & Devices	60	04
	Total	240	16

Practical laboratory courses (02) : 16 hours per week

Practical Lab Course	Laboratory sessions in Hours	Credit
PSPHP11	120	04
PSPHP12	120	04
Total	240	08

Semester II

M.Sc. in Physics Program for Semester-II consists of four theory courses and two practical courses. The details are as follows:

Theory Courses (4): 16 hours per week. Four lectures per paper per week

Theory Paper	Subject	Lecture Hours	Credit
PSPH21	Advanced Electronics	60	04
PSPH22	Electrodynamics	60	04
PSPH23	Quantum Mechanics -II	60	04
PSPH24	Atomic and molecular physics	60	04
	Total	240	16

Practical laboratory courses (02) : 16 hours per week

Practical Lab Course	Laboratory sessions in Hours	Credit
PSPHP21	120	04
PSPHP22	120	04
Total	240	08

Semester III

M.Sc. in Physics Program for Semester-III consists of four theory courses and two practical courses. The details are as follows:

Theory Courses (4): 16 hours per week. Four lectures per paper per week

Theory Paper	Subject	Lecture Hours	Credit
20PSPHSM31	Statistical Mechanics	60	04
20PSPHNP32	Nuclear Physics	60	04
20PSPHMI33	Microcontrollers & Interfacing	60	04
20PSPHER34	Embedded System & RTOS	60	04
	Total	240	16

Practical laboratory courses (02) : 16 hours per week

Code	Practical Lab Course	Laboratory sessions in Hours	Credit
20PSPHP31	Project	120	04
20PSPHP32	Advance Physics Lab 1	120	04
Total		240	08

Semester IV

M.Sc. in Physics Program for Semester-III consists of four theory courses and two practical courses. The details are as follows:

Theory Courses (4): 16 hours per week. Four lectures per paper per week

Theory Paper	Subject	Lecture Hours	Credit
20PSPHEP41	Experimental Physics	60	04
20PSPHAT42	Applied Thermodynamics	60	04
20PSPHMP43	32 bit microprocessor and PIC Microcontrollers	60	04
20PSPHVH44	VHDL and communication interface	60	04
	Total	240	16

Practical laboratory courses (02) : 16 hours per week

Code	Practical Lab Course	Laboratory sessions in Hours	Credit
20PSPHP41	Project	120	04
20PSPHP42	Advance Physics Lab 2	120	04
Total		240	08

The Learner shall be awarded the degree of Master of Science in Physics (M.Sc. in Physics) after completing the course and meeting all the evaluation criteria. The Elective Course Titles will appear in the statement of marks. When the elective courses are chosen from Electronics specialization, the statement of marks shall also carry a name of the specializations as.

No	Group of elective course chosen	Name appearing in the statement of marks	Name appearing in the degree certificate
1	Electronics -I	M.Sc in Physics (Electronics-I)	M.Sc in Physics

2. Scheme of Examination and Passing:

(1) This course will have 40% Term Work (TW) / Internal Assessment (IA) and 60% external (Written examination of 2.5 Hours duration for each course paper)

(2) All external examinations will be held at the end of each semester and will be conducted by the University as per the existing norms.

(3) Term Work / Internal Assessment - IA (40%) and University examination (60%) shall have separate heads of passing. For Theory courses, internal assessment shall carry 40 marks and Semester-end examination shall carry 60 marks for each Theory Course.

(4) To pass, a student has to obtain minimum grade point E (i.e., 40% marks) and above separately in the IA and external examination.

(5) The Learners shall appear for external examination of 4 theory courses each carrying 60 marks of 2.5 hours duration and practical courses each carrying 100 marks.

(6) The Learner shall prepare and submit for practical a certified Journal based on the practical course carried out under the guidance of a faculty member with minimum number of experiments as specified in the syllabus for each group.

(7) PROJECT EVALUATION---Guideline given at the end of document.

Preamble

The course is designed to offer in-depth knowledge of the subject starting from its basic concepts and moving on to the state of art technologies in use today with a view to catering to the present day requirements in Industries, Research and Development fields, Higher studies and Self-employment.

Also the course structure intends to inculcate strong lab skills in synchronization of latest trends and demands from the industry so that the student can take up independent projects which will help to be an entrepreneur.

M.Sc. Electronics is a four-semester course spread over the period of two years. Learners are also provided extensive laboratory training on the course content and the current requirements of industries and research and development fields.

In the final semester every student has to undertake a project relevant to the industrial needs, the R& D activities and self –employment opportunities based on the specialization, he/she opts for.

In addition the course caters to the requirements of providing complete exposure to NET/SET syllabus for Electronics farmed by the U.G.C. The student after passing the M.Sc course has many opportunities of employment, self-employment and higher studies.

The systematic and planned curricula from these courses shall motivate and encourage learners to understand basic concepts of Physics.

Programme Outcomes

On successful completion of this course learners will be able to have

(1) Extensive command over Physics in general
(2) Specialization in Electronics
(3) Research based analytical and hands-on skills
(4) Understand the basic concepts and their applications
(5) Universally acceptable degree in Physics with theoretical and experimental advancements in electronic instrumentation.
(6) A thorough quantitative and conceptual understanding of the core areas of physics ·
(7) Ability to use contemporary experimental apparatus and analysis tools to acquire, analyse and interpret scientific data.
(8) To familiarize with current and recent scientific and technological developments.
(9) To enrich knowledge through problem solving, hands on activities, study visits,

SEMESTER III
Course – I
COURSE TITLE: Statistical Mechanics
COURSE CODE: 20PSPHSM31
[CREDITS - 04]

Course outcome: This course develops concepts in classical laws of thermodynamics and their applications. It postulates statistical mechanics and statistical interpretation of thermodynamics, various canonical ensembles.

Using statistical mechanics development of MB, BE and FD formulae are established and its applications are discussed.

On completion of this course a student should be able to:

1. Define and discuss the concepts of microstate and macro state of a model system.
2. Apply the machinery of statistical mechanics to the calculation of macroscopic properties resulting from microscopic models of magnetic and crystalline systems.

<table>
<tr><th>Unit I</th><th>Classical Statistical Mechanics</th><th>Number of lectures :15</th></tr>
<tr><td rowspan="2">1</td><td colspan="2">Learning Objective:
• To acquire the knowledge of Classical and Quantum Statistical Mechanics.
• To study the thermodynamic behaviour of systems
• To describe elementary statistical Physics to learners
• To establish the statistical background of thermodynamics
Learning Outcomes:
• Learners understand the need to use statistics to describe systems containing huge numbers of particles.
• Learners understand the statistical foundations of Gibbs paradox, Liouville theorem and their applications.</td></tr>
<tr><td colspan="2">(i) Phase space and number of accessible microstates Ω given the macrostate;
Statistical definition of entropy; Gibb’s paradox and correct counting of Microstates Ω.
(ii) Ensemble Theory: Phase space density. Liouville theorem; Microcanonical
Ensemble; Entropy as an ensemble average; Examples of classical ideal gas, ultra-relativistic gas, harmonic oscillators.
(iii) Canonical ensemble: Equilibrium between a system and an energy reservoir, Canonical partition function and derivation of thermodynamics; Applications to classical ideal gas, system of classical and quantum-</td></tr>
</table>

	mechanical harmonic oscillators, ultra-relativistic ideal gas; Energy fluctuations, Virial and equipartition theorems. Quantum systems in Boltzmann statistics – system of quantum mechanical harmonicoscillators, paramagnetic system. G : 5 , 6 , 7 , 8 ; P : Appendix H ; see also H : 5 , 6.	
Unit II	**Quantum Statistical Mechanics**	**Number of lectures :15**
2	**Learning Objective:** (i) To acquire the knowledge of Classical and Quantum Statistical Mechanics. (ii) To study the Grand canonical ensemble, Density operator (iii) To describe elementary statistical Physics to learners (iv) To understand the statistical background by Fermi and Maxwell-Boltzmann gases **Learning Outcomes:** (i) Learners understand the need to use statistics to describe systems containing huge numbers of particles. (ii) Learners understand the, Density operator, Liouville equation, and their applications (iii) Learners will understand Fermi and Maxwell-Boltzmann gases.	
	(i) Grand canonical ensemble: Equilibrium between a system and a particle-energy reservoir; Grand partition function and derivation of thermodynamics; Fluctuations. (ii) Density operator, density matrix and quantum Liouville equation. Quantum statistical micro-canonical, canonical and grand canonical ensembles and their partition functions. Examples. (iii) Ideal gas in q.m. micro canonical ensemble. Fermi and Maxwell-Boltzmann gases. G : 9 ; P : 5.1 - 5.3 , 6.1 ; see also H : 8 .	
Unit III	**Ideal Fermi and Bose Systems**	**Number of lectures :15**
3	**Learning Objective:** (i) To acquire the knowledge of Classical and Quantum Statistical Mechanics. (ii) To study the thermodynamic behaviour of ideal gas in quantum mechanical canonical and grand canonical ensembles (iii) To study Thermodynamics of blackbody radiation. (iv) To establish the thermodynamic behaviour of an ideal Fermi gas **Learning Outcomes:** (i) Learners understand the need to use statistics to describe systems containing huge numbers of particles. (ii) Learners will understand Thermodynamics of blackbody radiation.	

	(iii) Understand the Thermodynamic behaviour of an ideal Fermi gas	
	(i) Ideal gas in Q.M. canonical and grand canonical ensembles; Statistics of occupation numbers. (ii) Thermodynamic behaviour of an ideal Bose gas, phenomenon of Bose-Einstein condensation. Thermodynamics of blackbody radiation. (iii) Thermodynamic behaviour of an ideal Fermi gas, concept of Fermi energy, behaviour of specific heat with temperature. G : 12 , 13 , 14 ; or P : 6.2 – 6.3 , 7.1 , 7.3 , 8.1; see also H : 9.1 -9.4 , 10 , 11.	
Unit IV	**Non-Equilibrium Statistical Mechanics**	**Number of lectures :15**
	Learning Objective: (i) To acquire the knowledge of Classical and Quantum Statistical Mechanics. (ii) To study the. Brownian motion in details. (iii) To study Master equation and Fokker-Planck equation (iv) To learn about Spectral analysis of fluctuations **Learning Outcomes:** (i) Learners understand the need to use statistics to describe systems containing huge numbers of particles. (ii) Learners will understand Langevin theory of Brownian motion and Fluctuation-dissipation theorem (iii) Understand Spectral analysis of fluctuations.	
	(i) Brownian motion: as a random walk (Einstein theory), as a diffusion process; Langevin theory of Brownian motion; Fluctuation-dissipation theorem. (ii) Master equation and Fokker-Planck equation. (iii) Spectral analysis of fluctuations – the Wiener-Khintchine relations. P : 15.2 - 15.6 ; see also H : 16 , 18.1 - 18.7.	

References:

(1) Greiner, Neise and Stocker, Thermodynamics and Statistical Mechanics,
(2) Springer 1995. (G)
(3) RK Pathria and PD Beale (P), Statistical Mechanics (3 rd ed.), Elsevier 2011.
(4) Kerson Huang (H), Taylor and Francis, Introduction to Statistical Physics, 2001. (H)
(5) F Reif, Thermal and Statistical Physics
(6) D Amit and Walecka Statistical Mechanics
(7) Kerson Huang, Statistical Mechanics
(8) J.K. Bhattacharjee, Statistical Mechanics
(9) J.K. Bhattacharjee, Non-equilibrium Statistical Mechanics
(10) Richard Feynman, Statistical Mechanics
(11) Landau and Lifshitz, Statistical Mechanics

(12) H.B. Callen, Thermodynamics, S. Lokanathan and R. S. Gambhir (2008). An introduction to Statistical and Thermal Physics; NewDelhi: Prentice Hall of India.

SEMESTER III
Course – II
COURSE TITLE: Nuclear Physics
COURSE CODE: 20PSPHNP32
[CREDITS - 04]

Course outcome: After successful completion of this course learner will be able to:

1. Explain the different types of nuclear reaction with relevant examples.
2. Study Nuclear Properties, Measurement of Nuclear size
3. Acquire the knowledge of square well potential, Tensor force
4. Explain nucleon-nucleon scattering
5. Understand alpha and beta decay and Gamma decay detail theory
6. Details about Fermi theory and G-T transitions ,Charge-particle interaction with matter and Conservation laws
7. Get knowledge of nuclear fission, its Characteristics and Energy in Fission.
8. Get detail information about characteristics of Fusion, Solar Fusion and CNO cycle & Controlled fission
9. .

Unit I		**Number of lectures :15**
1	**Learning Objective:** (i) Differentiate between types of nuclear reactions (ii) Study Nuclear Properties, Measurement of Nuclear size (iii) Learners will acquire the knowledge of square well potential, Tensor force, (iv) Learners will understand nucleon-nucleon scattering- **Learning Outcomes:** (i) Solve Q values for various nuclear reaction (ii) Derive Q value for scattering type reaction based on momentum conservation. (iii) To cover nuclear properties, models and stability. (iv) To acquire the knowledge of tensor force and nucleon-nucleon scattering	

	(i) Overview of Nuclear Physics (including Introduction to Regulatory framework and nuclear safety in India). (ii) Nuclear Properties, Measurement of Nuclear size and estimation of R_0 , (iii) Deuteron system and its characteristic, Estimate the depth and size of (assume) square well potential, introduction to Tensor force, nucleon-nucleon scattering-qualitative discussion on results, Spin-orbit strong interaction between nucleon, double scattering experiment, The Shell Model (extreme single particle): (iv) Introduction, Assumptions, Evidences, Spin-orbit interactions, Predictions, limitation, introduction to Nilsson Model.	
Unit II		**Number of lectures :15**
2	**Learning Objective:** (i) Differentiate between types of nuclear decay (ii) Study Fermi theory, Gamma decay and Charge-particle interaction with matter. **Learning Outcomes:** (i) Understand alpha and beta decay and Gamma decay detail theory (ii) Details about Fermi theory and G-T transitions (iii) Charge-particle interaction with matter	
	(i) Review of alpha decay, introduction to Beta decay and its energetic, Fermi theory, Information from Fermi–curie plots, Comparative half-lives, selection rules: (ii) Fermi and G-T transitions, Gamma decay, Multipole radiation, Selection rule for gamma ray transitions, (iii) Gamma ray interaction with matter, and Charge-particle interaction with matter.	
Unit III		**Number of lectures :15**
3	**Learning Objective:** (i) Understand Conservation laws (ii) Study nuclear fission, its Characteristics and Energy in Fission. (iii) Acquire knowledge regarding characteristics of Fusion, Solar Fusion and CNO cycle. (iv) Learn about Controlled fission reaction **Learning Outcomes:** (i) Understand nuclear fission and nuclear fusion in detail. (ii) Details about Solar Fusion and CNO cycle (iii) Controlled fission reaction	
	(i) Conservation laws, Types of nuclear reaction, Q- value equation of nuclear reaction, (ii) Center of Mass frame, reaction cross sections (Classical and Quantum), Compound nuclear reaction,	

	(iii) Introduction to fission reaction, Characteristics of Fission, Energy in Fission, Controlled fission reaction, Introduction to 3 stage- Nuclear programme of India, (iv) Introduction to Fusion Reaction, Characteristics of Fusion, Solar Fusion and CNO cycle, introduction to Controlled fission reaction.	
Unit IV		**Number of lectures :15**
	Learning Objective: (i) Understand the Quark Model, The standard Model (ii) Study Quantum Electrodynamics, (iii) Get familiar with introduction to CP violation and TCP theorem. (iv) Learn about Properties of Neutrino, helicity of Neutrino, Parity **Learning Outcomes:** (i) Understand the Quark Model, The standard Model, Quantum Electrodynamics (ii) Details about Properties of Neutrino, helicity of Neutrino, Parity (iii) Get familiar with introduction to CP violation and TCP theorem.	
	(i) Introduction to the elementary particle Physics, The Eight fold way, the Quark Model, the November revolution and aftermath, The standard Model, Revision of (ii) The four forces, cross sections, decays and resonances, Introduction to Quantum Electrodynamics, weak interactions and Unification Schemes (qualitative description). (iii) Revision of Lorentz transformations, Four-vectors, Energy and Momentum. Properties of Neutrino, helicity of Neutrino, Parity, Qualitative discussion on Parity violation in beta decay and Wu's Experiment, Charge conjugation, Time reversal, Qualitative introduction to CP violation and TCP theorem.	

References:

(1) Kenneth Krane, Introduction to Nuclear Physics, Wiley India Pvt. Ltd.
(2) Robert Eisberg and Robert Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles Wiley (2006)
(3) David Griffith, Introduction to Elementary Particles John Wiley and sons.
(4) Kenneth Krane, Introduction to Elementary Particles Wiley India Pvt. Ltd.
(5) Robert Eisberg and Robert Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, Wiley (2006)
(6) David Griffith, Introduction to Elementary Particles John Wiley and sons.
(7) http://dae.nic.in or http://www.npcil.nic.in for 3 stage- Nuclear programme of India.
(8) http://www.aerb.gov.in/ for Regulatory framework and nuclear safety in India.

Additional References:

(1) H. A. Enge, Introduction to Nuclear Physics, Eddison Wesley
(2) E. Segre, W. A Benjamin, Nuclei and Particle
(3) B. L. Cohen Concepts of Nuclear Physics
(4) H. Fraunfelder and E. Hanley, Subatomic Particles Prentice Hall
(5) H. S. Hans, Nuclear Physics, Experimental and Theoritical New Age International
(6) A. Das & T. Ferbel, Introduction to Nuclear and Particle Physics
(7) D. H. Perkins, Introduction to high energy physics Addison Wesley
(8) W. E. Burcham and M. Jobes, Nuclear and Particle Physics ,Addison Wesley
(9) S. N. Ghoshal, Nuclear Physics
(10) S. B. Patel, Nuclear Physics- An Introduction New Age International
(11) D. C. Tayal, Nuclear Physics.

SEMESTER III
Course – III
COURSE TITLE: Microcontrollers and interfacing
COURSE CODE: 20PSPHMI33
[CREDITS - 04]

Course Objective:

1. To develop an in-depth understanding of the operation of microprocessors and microcontrollers.
2. To master assembly language programming.
3. To understand the concept of Interrupts and interfacing.
4. Understand the architecture of microprocessors and microcontroller
5. Understand the programming model of microprocessors and micro controllers
6. Develop an assembly language program for specified application.

Unit I	**8085 Interrupts**	**Number of lectures :15**
	Learning Objective: (i) To understand various types of microprocessors (ii) 2. To understand the peripheral interface devices **Learning Outcomes:** (i) Learners will be able to know the internal architecture of a microprocessor (ii) Learners will also learn to write a program of 8085 microprocessor using vectored interrupt	
1	(i) The 8085 Interrupt, 8085 Vectored Interrupts, Restart as Software Instructions, Additional I/O Concepts and Processes. RSG - Ch 12: 12.1, 12.2, 12.3, 12.4 (ii) Programmable Peripheral and Interface Devices: The 8255A	

	Programmable Peripheral Interface, Interfacing Keyboard and Seven Segment Display, the 8259A Programmable Interrupt Controller, Direct Memory Access (DMA) and 8237 DMA Controller, the 8279 Programmable Keyboard/Display Interface RSG - Ch 15: 15.1, 15.2, 15.5, 15.6 & Ch 14: only 14.3 (iii) Serial I/O and Data Communication: Basic Concepts in Serial I/O, Software Controlled Asynchronous Serial I/O, The 8085 Serial I/O lines: SOD and SID RSG - Ch 16: 16.1, 16.2, 16.3,	
Unit II	**8086 microprocessor**	**Number of lectures :15**
	Learning Objective: (i) To understand various registers present in 8086 microprocessor (ii) To understand the various addressing modes present. (iii) To know the various instructions available in 8086 microprocessor **Learning Outcomes:** (i) Learners will be able to write short programs using simple data manipulation (ii) Learners will also learn to write a programs which include loops.	
2	(i) Register organization of 8086, Architecture, Signal Descriptions of 8086, Physical Memory Organization, General Bus operation, I/O Addressing Capability, Special Processor Activities, Minimum mode 8086 system and timings, Maximum mode of 8086 system and timings. AB - Ch 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9. (ii) Machine Language Instructions Formats, Addressing modes of 8086, Instruction set of 8086. AB - Ch 2: 2.1, 2.2, 2.3. (iii) A few machine level programs, Machine coding the programs, Programming with an assembler (only using Debug), Assembly language example programs. AB - Ch 3: 3.1, 3.2, 3.3.4 & 3.4 (iv) Introduction to Stack, Stack structure of 8086, interrupts and Interrupt Service Routines, Interrupt cycle of 8086, Non-maskable interrupt, Maskable interrupt (INTR). AB - Ch 4: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6	
Unit III	**8051 microcontroller**	**Number of lectures :15**
	Learning Objective: (i) To understand the difference between a microprocessor and microcontroller (ii) To understand the architecture of 8051 microcontroller **Learning Outcomes:** (i) Learners will know the architecture and various registers in 8051	

	microcontroller in detail	
3	(i) Introduction to 8051, Microprocessor vs. Microcontrollers. Overview to 8051 family, Introduction to Harvard Architecture, RISC, CISC (ii) Architecture of 8051: 8051 microcontroller hardware: Oscillator and Clock, Role of PC and DPTR, Flags and PSW, CPU registers, Internal RAM and RAM organization, (iii) Internal Memory, Special Function Registers, I/O pins, ports and circuits, External memory, Counter and Timers, Serial Transmission, Interrupts.	
Unit IV	**8051 programming**	**Number of lectures :15**
	Learning Objective: (i) To understand ALP used in 8051 (ii) To understand various instructions of 8051 **Learning Outcomes:** (i) Learners will be able to write simple programs of 8051. (ii) Learners will also learn to interface LEDs, Buzzers etc.	
	(i) Assembly Language Programming of 8051: Assembly language programming, Jump Loop and Call Instructions, I/O Port Programming, Addressing Modes, Arithmetical and Logical Instructions, (ii) Light Emitting Diodes (LEDs); Push Buttons, Relays and Latch Connections; Keyboard Interfacing; Interfacing 7-Segment Displays; LCD Interfacing; ADC and DAC Interfacing with 89C51 Microcontrollers. (iii) Introduction and Measurement Applications (For DC motor interfacing and PWM refer Sec 17.3 of MMM)	

References:

(1) RSG: - Microprocessor Architecture, Programming and Applications with the 8085 by Ramesh S. Gaonkar, Fifth Edition Penram International Publication (India)
(2) AB: - Advanced Microprocessors and Peripherals by a K Ray and K M Bhurchandi Second Edition Tata McGraw–Hill Publishing Company ltd.
(3) Kenneth J. Ayala, ‘The 8051 microcontroller’, Cengage Learning, 2004
(4) Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, ‘The 8051 Microcontroller and Embedded Systems’, Second Edition, Pearson Prentice Hall.

Additional References:

(1) Douglas V. Hall ,Microprocessors and interfacing, programming and hardware, (TMH)
(2) Dr. Rajiv Kapadia (Jaico Pub.House) The 8051 Microcontroller & Embedded Systems-
(3) K.J.Ayala, Penram International 8086 Microprocessor: Programming and Interfacing
(4) Design with PIC microcontrollers by John B. Peatman, Pearson Education Asia.
(5) Programming & customizing the 8051 microcontroller By Myke Predko, TMH

SEMESTER III
Course – IV
COURSE TITLE: Embedded system and RTOS
COURSE CODE: 20PSPHER34
[CREDITS - 04]

Course Objective:

1. Learn basic concepts of programming.
2. Develop understanding of high level programming language (OOP).
3. Understand the concept of embedded systems in detail.
4. Understand and apply various features of C++ programming language
5. Write and test the problem/ task specific code using C++.
6. Design the application specific embedded system.

Unit I	**Programming Using C++: Introduction**	**Number of lectures :15**
1	**Learning Objective:** (i) Learners will learn the fundamentals of programming, problem solving and object oriented programming. (ii) Learners will also learn the components of programs, operators, expressions and their interactive (iii) Student will also understand working with control structures and functions in C++ **Learning Outcomes:** (i) Design input, processing, and output structure to solve problems using programs. (ii) Write C++ code using various control structures and functions.	
	(i) Introduction to Computers and programming , Introduction to C++, Expressions and interactivity , Making decisions, Looping , Functions , Arrays , Sorting arrays. TG – Ch 1: 1.3 to 1.7 , Ch 2: 2.1 to 2.14, Ch 3: 3.1 to 3.11, Ch 4: 41 to 4.15, Ch 5: 5.1 to5.13, Ch 6: 6.1 to 6.14, Ch 7: 7.1 to 7.9 , Ch 8: 8.3 ,	
Unit II	**Programming using C++: Advance**	**Number of lectures :15**
	Learning Objective: (i) Learners will learn the advanced features of C++ language like pointers, Data structures and classes. (ii) Learners will be able to understand the data flow through objects of C++ and hence learn concepts of data encapsulation, inheritance and	

	polymorphism. **Learning Outcomes:** (i) Apply object-oriented approaches to software problems in C++. (ii) Able to code problem specific C++ script using pointers and classes.	
2	(i) Pointers:- Getting the Address of a Variable, Pointer Variables, The Relationship Between Arrays, Pointers, Pointer Arithmetic, Initializing Pointers, Comparing Pointers, Pointers as Function Ch 9: 9.1 to 9.7 (ii) Structured data:- Abstract Data Types, Initializing a Structure, Arrays of Structures,Structures as Function Arguments, Returning a Structure from a Function, Pointers to Structures Ch. 11: 11.4 to 11.9 (iii) Introduction to classes: More about classes, Inheritance, polymorphism, virtual functions. TG – Ch 13: 13.1 to 13.11, Ch 14: 14.1 to 14.5, Ch 15: 15.1 to 15.6	
Unit III	**An overview of Embedded Systems**	**Number of lectures :15**
3	**Learning Objective:** (i) To understand the basics of an embedded system. (ii) Will learn the building blocks of embedded systems. (iii) To understand the typical components of an embedded system. **Learning Outcomes:** (i) Learners will be able to classify embedded systems based on different aspects. (ii) Will be able to distinguish between general purpose processors, microprocessors, microcontrollers etc. (iii) Will be to select different interfacing Modules for designing the embedded systems.	
	(i) Introduction to Embedded Systems , Core of Embedded Systems: Big endian and Little endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components. (ii) Embedded hardware: Memory map, i/o map, interrupt map, processor family, external peripherals, memory - memory testing, CRC, Flash memory. Characteristics and quality attributes of embedded systems: Characteristics, Operational and non-operational quality attributes, application specific embedded system, domain specific. Shibu Ch. 1.1-1.6, 2.1-2.3,	
Unit IV	**Embedded System Design: Introduction to RTOS**	**Number of lectures :15**
	Learning Objective: (i) To learn the design process of embedded system applications.	

	(ii) 2. To learn RTOS and inter-process communication. **Learning Outcomes:** (i) Understand embedded firmware design approaches (ii) Explain basics of RTOS design..
	(i) Programming Embedded Systems: Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging. (ii) The embedded system design environment : The integrated development environment (IDE), Simulator , emulator, debugging. RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. Shibu:- Ch. 4, Ch.13.1 - 13.4, Ch. 10.1-10.5

References:

(1) Starting out with C++ from Control structures through objects, by Tony Gaddis, Sixth edition, Penram International Publications, India
(2) Embedded Systems, Rajkamal, TataMcGraw-Hill
(3) Introduction to embedded systems, Shibu K. V.

M.Sc Physics Semester III Practical
COURSE CODE: 20PSPHP31 and 20PSPHP32

The student has to perform a minimum of 10 experiments from Group A and Group B
Experiments: 100 marks
Project: 100 marks

Group A:
A1: Microcontroller 8031/8051 based experiments:
(Experiment no. 1 is compulsory and any two experiments from 2, 3 & 4)

(1) 8031/51 assembly language programming: Simple data manipulation programs.(8/16-bit addition, subtraction, multiplication, division, 8/16 bit data transfer, cubes of nos., to rotate a 32- bit number, finding greatest/smallest number from a block of data, decimal / hexadecimal counter)
(2) Study of IN and OUT port of 8031/51 by Interfacing switches, LEDs and Relays: to display bit pattern on LED’s, to count the number of “ON” switches and display on LEDs, to trip a relay depending on the logic condition of switches, event counter (using LDR and light source).
(3) Study of external interrupts (INT0/INT1) of 8031/51.
(4) Study of internal timer and counter in 8031/51.

A2: Interfacing 8031/8051 based experiments:

(Any two experiments from 1, 2 & 3)

(1) Interfacing 8 bit DAC with 8031/51 to generate waveforms: square, saw tooth, triangular.
(2) Interfacing stepper motor with 8031/51 to control direction, speed and number of steps.
(3) Interface 8-bit ADC (0804) with 8031/51: to convert an analog signal into its binary equivalent.

Group B:

B1: 8085/8086 Microprocessor based experiments:

(Any one experiment from 1 & 2.Experiment no. 3 is compulsory).

(1) Study of 8085 interrupts (Vector Interrupt 7.5).
(2) Study of PPI 8255 as Handshake I/O (mode 1): interfacing switches and LED's.
(3) 8086 assembly language programming: Simple data manipulation programs.(8/16-bit addition, subtraction, multiplication, division, 8/16 bit data transfer, finding greatest/smallest number, finding positive/negative numbers, finding odd/even numbers, ascending/descending of numbers, converting BCD nos. into Binary using INT 20, displaying a string of characters using INT 20)

Please note: Assembly language programming of 8086 may be done by operating PC in real mode by using Debug program. Separate 8086 study kit not needed.

B2: C++ experiments:

(Any three experiments from following)

(1) C++ Program (Conversion from decimal system to binary, octal, hexadecimal system
(2) C++ Program (Program on mean, variance, standard deviation for a set of numbers).
(3) C++ Program (Sorting of data in ascending or descending order).
(4) C++ Program (Programs on class)
(5) C++ experiment (Programs on inheritance, overloading)
(6) C++ program(based on pointers and data structure)

SEMESTER IV
Course – I
COURSE TITLE: Experimental Physics
COURSE CODE: 20PSPHEP41
[CREDITS - 04]

Course Objective

On completion of this course, learners should be able to:

(1) Learn Data analysis, data distribution.
(2) Various types of errors
(3) Introductory knowledge about research methodology
(4) Details about vacuum techniques, High Vacuum Pumps, Rotary vane pump, Ultra High Vacuum Pumps and its applications.
(5) Study different types of nuclear detectors and their working such as GM counter, NaI Scintillation detector, Gamma ray spectrometer using NaI scintillation detector.
(6) Study Characterization techniques for materials analysis

Unit I	Data Analysis for Physical Sciences	Number of lectures :15
	Learning Objective: After successful completion of this Module, learners will able to, (i) Perform the data analysis ,Measurement of various types of errors (ii) Study The central limit theorem, the t distribution, log normal distribution, Poisson distribution **Learning Outcomes:** (i) Learn Data analysis, data distribution. (ii) Various types of errors. (iii) Different theorems for data analysis..	
1	(i) Review : - (Experimental Error, Measurement, error and uncertainty, The process of measurement, True value and error, Precision and accuracy, Random and systematic errors, Random errors.) (ii) Population and Sample, Data distributions Probability, Probability Distribution, Distribution of Real Data, The normal distribution, The normal distribution, From area under a normal curve to an interval, Distribution of sample means, The central limit theorem, The t distribution, The log-normal distribution, (iii) Assessing the normality of data, Population mean and continuous distributions, Population mean and expectation value, The binomial distribution The Poisson distribution, , Uncertainty in measurement, Combining uncertainties, Expanded uncertainty, Relative standard	

	uncertainty, Coping with outliers, Weighted mean , Least squares, The equation of a straight line, Excel's LINESTQ function, Using the line of best fit, Fitting a straight line to data when random errors are confined to the x quantity, Linear correlation coefficient, Residuals, Data rejection, Transforming data for least squares analysis	
Unit II	**Vacuum Techniques**	**Number of lectures :15**
2	**Learning Objective:** (i) Familiarizes with Vacuum Techniques (ii) Study various types of vacuum pumps. (iii) Get familiar with vacuum pump and their working.. **Learning Outcomes:** (i) Understand the Vacuum Techniques (ii) Details about High Vacuum Pumps, Rotary vane pump, Ultra High Vacuum Pumps and its applications.	
	(i) Vacuum Techniques: Fundamental processes at low pressures, Mean Free Path, Time to form monolayer, Number density, Materials used at low pressures, vapour pressure Impingement rate, Flow of gases, Laminar and turbulent flow, Production of low pressures; High Vacuum Pumps, Rotary vane pump, and systems, Ultra High Vacuum Pumps and System, Turbo Molecular Vacuum Pump Measurement of pressure, Leak detections.	
Unit III	**Nuclear Detectors and accelerators**	**Number of lectures :15**
3	**Learning Objective:** (i) Understand the working of accelerators and nuclear detectors. (ii) Study different types of nuclear detectors and their working. (iii) Get familiar with GM counter, NaI Scintillation detector, Gamma ray spectrometer using NaI scintillation detector **Learning Outcomes:** (i) Details about various types of nuclear detectors (ii) Get familiar with different types of accelerators.	
	(i) Gas Detector with emphasis on GM counter, NaI Scintillation Detector, Gamma ray spectrometer using NaI scintillation detector (ii) Accelerators: Van de Graff Generator, Sloan and Lawrence type Linear Accelerator, Proton Linear Accelerator, Cyclotron, Synchrotron. large hadron collider(qualitative)	
Unit IV	**Characterization techniques for materials analysis**	**Number of lectures :15**
	Learning Objective: (i) Study Characterization techniques for materials analysis (ii) Get familiar with various techniques such as FTIR spectroscopy, Raman Spectroscopy, Mossbauer Spectroscopy, RBS, XRD, XRF, SEM, EDAX,TEM, XPS	

	Learning Outcomes: (i) Understand the the detail of various Characterization techniques used for materials analysis.
	(i) UV Visible spectroscopy, FTIR spectroscopy, Raman Spectroscopy, Mossbauer Spectroscopy, RBS, XRD, XRF, SEM, EDAX, TEM, XPS

References:

(1) Data Analysis for Physical Sciences (Featuring Excel®) Les Kirkup, 2nd Edition, Cambridge University Press (2012), Chapters 1-6 and 9
(2) Statistical Methods in Practice for scientists ad Technologists, Richard Boddy and Gordon Smith, John Wiley & Sons (2009)
(3) A. Roth Vacuum Technology, , North Holland Amsterdam
(4) D. K. Avasthi, A. Tripathi, A. C. Gupta, Ultra High Vacuum Techniques Allied Publishers Pvt. Ltd (2002)
(5) V. V. Rao, T. B. Ghosh, K. L. Chopra, Allied Publishers Pvt. Ltd (2001)Vacuum Science and Technology,
(6) Douglas A. Skoog, F. James Holler, and Stanley R. Crouch, Brooks/Cole Pub Co, 6th edition Reference: Principles of Instrumental Analysis,
(7) William James Price Nuclear Radiation Detection-, McGraw Hill
(8) W.R. Leo, Springer- Verlag Techniques for Nuclear and Particle Physics Experiments,
(9) Glenn F. Knoll, John Wiley and sons, Inc. Radiation Detection and Measurement,
(10) M. S.; Blewett, J. Particle Accelerators, Livingston,
(11) Introduction to Nuclear Physics, HA Enge, pp 345-353
(12) Electricity & Magnetism and Atomic Physics Vol. II,
(13) E. Persico, E. Ferrari, S.E. Segre Principles of Particle Accelerators,
(14) Khangaonkar P. R., Penram An Introduction to Materials Characterization International Publishing
(15) G. K. Wertheim, Mössbauer Effect: Principles and Applications, Academic Press (1964),
(16) C. N. Banwell Fundamentals of Molecular Spectroscopy, Tata-McGraw Hill
(17) W.K.Chu, J.W.Mayer, M.ANicolet. Rutherford Backscattering Spectrometry, , Academic Press
(18) A Guide to Materials Characterization and Chemical Analysis, John P. Sibilia, Wiley-VCH; 2 edition
(19) Fundamentals of Surface and Thin Film Analysis, L.C. Feldman and J.W.Mayer North Holland Amsterdam
(20) Elements of X-ray diffraction, Cullity, B. D Addison-Wesley Publishing Company, Inc

SEMESTER IV
Course – II
COURSE TITLE: Applied Thermodynamics
COURSE CODE: 20PSPHAT42
[CREDITS - 04]

Course outcome: After successful completion of this course learner will be able to:

1. Understand, model and appreciate concept of dynamics involved in thermal energy transformation.
2. Study about the process of thermal conductivity, viscosity and diffusion in gases
3. Understand the nature of thermodynamic properties of matter like internal energy.
4. Apply the knowledge of mathematics, science to model the energy conversion phenomenon.
5. Identify and formulate power production based on the fundamentals laws of thermodynamics.
6. Instil upon to envisage appropriate experiments related to heat engines.
7. To investigate the effectiveness of energy conversion process in mechanical power generation for the benefit of mankind.
8. Understand appreciate concepts learnt in fundamentals laws of thermodynamics from which learning ideas how to sustain in energy crisis and
9. Think beyond curriculum in the field of alternative and renewable sources of energy.
10. To communicate effectively the concepts of internal combustion engines and
11. Try to think beyond curriculum in alternative sources of energy.
12. Understand the interrelationship between thermodynamic functions and ability
13. To use such relationships to solve practical problems

Unit I	**Laws of Thermodynamics & their applications**	**Number of lectures :15**
1	**Learning Objective:** (i) Learners will be able to learn and comprehend the concept of equilibrium, enthalpy. (ii) They will also be able to understand different laws of thermodynamics and further will be able to understand the concept of entropy and to understand difference between temperature and it's techniques in temperature production. **Learning Outcomes:** (i) Learners will be comprehend the equilibrium and the laws of thermodynamics should be able to solve different states where in different parameters are provided. Carnot examples, temperature scales,	

	clausius inequality and including all the laws of thermodynamics	
	(i) First Law of Thermodynamics: Energy, enthalpy, specific heats, and first law applied to systems and control volumes, steady and unsteady flow analysis. (ii) Second Law of Thermodynamics: Kelvin- Planck and Clausius statements, reversible and irreversible processes, Carnot theorems, thermodynamic temperature scale, Clausius inequality and concept of entropy, principle of increase of entropy; availability and irreversibility. (iii) Zeroth Law of Thermodynamics: concept of temperature, Overview of techniques in low temperature production.	
Unit II	**Properties of Pure Substances & Thermodynamic Relations:**	**Number of lectures :15**
2	**Learning Objective:** (i) Learners will be able to learn and comprehend the concepts of different states of matter, reversible and irreversible processes. (ii) They will be able to comprehend the ideal and the real behaviour of gases including the ideal gas equation. (iii) The learners will be able to understand TDS relationship and also JT coefficient and different processes which adiabatic and isothermal etc. **Learning Outcomes:** (i) Learners will be able to solve various questions and problems related to the different states of equation resembling the ideal gas equation. (ii) They will also be able to solve questions and problems related to Maxwell's equations and liquefaction of gases, Clapeyron equation and different laws of compressibility, isothermal and adiabatic expansions.	
	(i) Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases, P-V-T behaviour of simple compressible substances, phase rule, ideal and real gases, equations of state, compressibility chart. (ii) Thermodynamic Relations: T-ds relations, Maxwells Equations, Liquefaction of Gases: Joule-Thomson Effect, Joule-Thomson Coefficient, Coefficient of volume expansion, adiabatic and isothermal compressibility, Clapeyron equation.	
Unit III	**Equilibrium concept in Thermodynamics & Thermodynamic Cycles:**	**Number of lectures :15**
	Learning Objective: (i) Learners will to understand, model and appreciate concept of dynamics involved in thermal energy transformation. (ii) Learners will be able to learn and comprehend the concepts of different thermodynamic cycles and equilibrium concept **Learning Outcomes:**	

3	(i) Learners will be familiar with Equilibrium concept in Thermodynamics. (ii) Acquire knowledge about different Thermodynamic Cycles	
	(i) Equilibrium concept in Thermodynamics: Unary, binary, and multicomponent systems, phase equilibria, evolution of phase diagrams, Calculation of Phase diagrams, Thermodynamics of defects, Solution Models. (ii) Thermodynamic Cycles: Carnot vapour power cycle, Ideal Rankine cycle, Rankine Reheat cycle, Otto cycle, Diesel cycle.	
Unit IV	**Thermodynamics of Phase Transformation and Heterogeneous System:**	**Number of lectures :15**
	Learning Objective: (i) Learners will be able to learn and analyse phase transformations in one or multi component systems from thermodynamic data. **Learning Outcomes:** (i) Learners can construct the phase diagrams of different material system.	
	(i) Melting and Solidification, precipitation, eutectoid, massive, spinodal, martensitic, order disorder transformations and glass transition, First order and second order phase transitions, Equilibrium constants and Ellingham diagrams.	

References:

(1) M. Modell and R.C. Reid, Thermodynamics and its Applications, Prentice- Hall, Englewood Cliffs, New Jersey, 1983.
(2) H.B. Callen, Thermodynamics and an Introduction to Thermostatics, Jonh Wiley and Sons, New York, 1985.
(3) R.T. DeHoff, Thermodynamics in Materials Science, McGraw- Hill, Singapore,
(4) L.S. Darken and R.W. Gurry Physical Chemistry of Metals:
(5) Thermodynamics of Solids: R.A. Swalin
(6) D.A. Porter and K.E. Easterling Phase Transformations in Metals and Alloys:
(7) H.S. Ray Principles of Extractive Metallurgy:

Note: Good Number of numbers of numerical on each module are supposed to cover

SEMESTER IV
Course – III
COURSE TITLE: 32 bit Microprocessor and PIC Microcontroller
COURSE CODE: 20PSPHMP43
[CREDITS - 04]

Course Objective:

(1) To develop an in-depth understanding of the operation of ARM microprocessors and PIC microcontrollers.
(2) To understand the concept of Interrupts and interfacing in ARM

Course Outcome:

(1) Understand the architecture of ARM microprocessors and PIC microcontroller
(2) Understand the programming model of ARM microprocessors and PIC micro Controllers.
(3) Develop the skill of basic system designing with proper choice of PIC or ARM microcontroller.

Unit I	**16C61/71 PIC Microcontrollers:**	**Number of lectures :15**
1	**Learning Objective:** (i) To introduce the microcontroller, design specially for peripheral interface. (ii) To develop knowledge of various Hardware features of advanced microcontroller with RISC instruction set. (iii) To understand memory management and Input/ output interface. **Learning Outcomes:** (i) Study architecture of PIC microcontroller. (ii) Understand basic the I/O configuration required for interfacing (iii) Develop the skill of assembly language programming with RISC instruction set.	
	(i) 16C61/71 PIC Microcontrollers: Overview and Features, PIC 16C6X/7X, PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organization, PIC 16C6X/7X (ii) Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers and relevant programs. AVD – Ch 9: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10.	
Unit II	**PIC 16F8XX Flash Microcontrollers**	**Number of lectures :15**
	Learning Objective: (i) To develop knowledge of advanced features of PIC microcontroller. (ii) To understand application of CCP module for various operations.	

	Learning Outcomes: (i) To develop understanding regarding harward consideration and related settings of PIC for system design. (ii) To design the interface with analog (real world) sensors and its application for controlling various operations.	
2	(i) Develop the skill of system design with proper hardware and software interface Introduction, Pin Diagram, STATUS Register, Power Control Register (PCON), OPTION_REG Register, Program memory, Data memory, I/O Ports, relevant programs. AVD- Ch 10: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.10 (ii) Capture/Compare/PWM (CCP) Modules in PIC 16F877, Analog-to-Digital Converter, Interfacing considerations for various electronic components AVD – Ch 11: 11.1, 11.2, 11.5	
Unit III	**ARM Architecture and organization**	**Number of lectures :15**
	Learning Objective: (i) To learn ARM architecture with a programmer model. (ii) To learn about the ARM organization and its implementation for data movement. **Learning Outcomes:** (i) Will be able to explain the ARM machine based on its architecture. (ii) Will be able to analyze the implementation of the ARM instructions based on its organization.	
3	(i) The ARM Architecture: The Acorn RISC Machine, Architectural inheritance, The ARM Programmer's model, ARM development tools. SF - Ch 2: 2.1, 2.2, 2.3, 2.4 (ii) ARM Organization and Implementation: 3 – stage Pipeline ARM organization, ARM instruction execution, ARM implementation. SF - Ch 4: 4.1, 4.3, 4.4 (iii) ARM Processor Cores: ARM7TDMI SF – Ch 9: 9.1 only	
Unit IV	**ARM Programming**	**Number of lectures :15**
	Learning Objective: (i) To learn about different ARM assembly instructions. (ii) To learn the ARM and Thumb Instructions set. **Learning Outcomes:** (i) Will be able to write ARM and Thumb assembly program (ii) Will able to distinguish between the ARM and Thumb program	
	(i) ARM Assembly language Programming: Data processing instructions, Data transfer instructions, Control flow instructions, Writing simple assembly language programs.	

	SF – Ch 3: 3.1- 3.4 (ii) The ARM Instruction Set: Introduction, Exceptions, Condition execution, Branch and Branch with Link (B, BL), Branch, Branch with Link and exchange (BX,BLX), Software Interrupt (SWI), Data processing instructions , Multiply instructions, Count leading zeros (CLZ), Single word and unsigned byte data transfer instructions, Half- word and signed byte data transfer instructions, Multiple register transfer instructions, Swap memory and register instructions (SWP), Status register to general register transfer instructions, General register to Status register transfer instructions SF – Ch 5: 5.1-5.15 (iii) The Thumb Instruction Set: the Thumb bit in the CPSR, The Thumb programmer's model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation, Thumb applications, Example and exercises. SF – Ch 7: 7.1- 7.11

References:

(1) AVD: - Microcontrollers by Ajay V. Deshmukh, Tata-Mcgraw Hill Publication
(2) SF: - ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson

SEMESTER IV
Course – IV
COURSE TITLE: VHDL and Communication interface
COURSE CODE: 20PSPHVH44
[CREDITS - 04]

Course Objective:

1. Learn the basic knowledge of VHDL programming.
2. To design circuits and systems using VHDL.
3. Describe USB and other on board communication interfaces.
4. Understand the detailed data transmission in I2C and Bluetooth.
5. Explain the basic features of VHDL programming.
6. Apply the knowledge to write VHDL for different types of circuits.
7. To select and connect the appropriate communication interface for system specific application.

Unit I	VHDL-I	Number of lectures :15
1	**Learning Objective:** (i) To introduce with hardware description language (VHDL). (ii) Learn various features of VHDL (iii) To learn about behavioural modelling of VHDL (iv) To understand sequential processing. **Learning Outcomes:** (i) Understand the importance and application of VHDL. (ii) Differentiate between software language and HDL (iii) Develop the skill to write processes. (iv) Able to design simple digital electronic modules for testing.	
	(i) Introduction to VHDL: VHDL Terms, Describing Hardware in VHDL, Entity, Architectures ,Concurrent Signal Assignment , Event Scheduling, Statement concurrency, Structural Designs, Sequential Behaviour, Process Statements, Process Declarative Region, Process Statement Part, Process Execution, Sequential Statements, Architecture Selection, Configuration Statements, Power of Configurations. DLP - Ch 1 (ii) Behavioural Modelling: Introduction to Behavioural Modelling, Transport Versus Inertial Delay, Inertial Delay, Transport Delay, Inertial Delay Model, Transport Delay Model, Simulation Deltas, Drivers, Driver Creation, Bad Multiple Driver Model, Generics, Block Statements, Guarded Blocks. DLP - Ch 2 (iii) Sequential Processing: Process Statement, Sensitivity List, Process Example, Signal Assignment Versus Variable Assignment, Incorrect Mux Example, Correct Mux Example, Sequential Statements, IF Statements, CASE Statements, LOOP statements, NEXT Statement, EXIT Statement, ASSERT Statement, Assertion BNF, WAIT Statements, WAIT ON Signal, WAIT UNTIL Expression, WAIT FOR time expression, Multiple WAIT Conditions, WAIT Time-Out, Sensitivity List Versus WAIT Statement, Concurrent Assignment Problem, Passive Processes. DLP - Ch 3	
Unit II	**VHDL-II**	**Number of lectures :15**
	Learning Objective: (i) To learn data types of VHDL and its application in package design.	

	(ii) Understand advance features of VHDL like subprograms and packages, attributes etc, **Learning Outcomes:** (i) To design a VHDL module for testing specific systems/ digital circuits with proper data types and delay. (ii) To design various packages with necessary attributes. (iii) To understand and employ different configurations to accomplish given tasks.	
2	(i) Data Types: Object Types, Signal, Variables, Constants, Data Types, Scalar Types, Composite Types, Incomplete Types, File Types, File Type Caveats, Subtypes. DLP - Ch 4 (ii) Subprograms and Packages: Subprograms Function, Conversion Functions, Resolution Functions, Procedures, Packages, Package Declaration, Deferred Constants, Subprogram Declaration, Package Body. DLP - Ch 5 (iii) Predefined Attributes: Value Kind Attributes, Value Type Attributes, Value Array Attributes, Value Block Attributes, Function Kind Attributes, Function Type Attributes, Function Array Attributes, Function Signal Attributes, Attributes ‘EVENT and ,LAST-VALUE Attribute ‘LAST-EVENT Attribute, ‘ACTIVE and ‘LAST- ACTIVE Signal Kind Attributes, Attribute ‘DELAYED, Attribute ‘STABLE, Attribute ‘QUIET, Attribute TRANSACTION, Type Kind Attributes, Range Kind Attributes. DLP - Ch 6 (iv) Configurations: Default Configurations, Component Configurations, Lower-Level Configurations, Entity-Architecture Pair Configuration, Port Maps, Mapping Library Entities, Generics in Configurations, Generic Value Specification in Architecture, Generic Specifications in Configurations, Board-Socket-Chip Analogy, Block Configurations, Architecture configurations. DLP - Ch 7	
Unit III	**Understanding USB and other on board communication interface**	**Number of lectures :15**
	Learning Objective: **Learning Outcomes:** (i)	
	(i) USB Basics: Uses and limits, Evolution of an interface, Bus components, Division of Labor, Developing a Device. Inside USB Transfers: Transfer Basics, Elements of a Transfer, USB 2.0 Transactions, Ensuring	

3	Successful Transfers, Super Speed Transactions. JA – Ch 1, Ch 2 (ii) On board Communication Interface: Inter Integrated Circuit (I2C), Serial Peripheral Interface (SPI), Universal Asynchronous Receiver Transmitter (UART), Wire Interface, Parallel Interface Shibu Ch. 1.1-1.6, 2.1-2.3,	
Unit IV	**Communication Interface**	**Number of lectures :15**
	Learning Objective: (i) Learn different external interfaces. (ii) Understand in detail I2C bus and Bluetooth **Learning Outcomes:** (i) Able to select the interfaces depending about the specifications. (ii) Specify in detail and distinguish the I2C and Bluetooth communications.	
	(i) External Communication Interfaces: RS-232 & RS-485, USB, IEEE 1394 (Firewire), Infrared (IrDA), Bluetooth, Wi-Fi, ZigBee, GPRS. SKV: Ch – 2: 2.4 (ii) Detailed studies of I2C Bus refer: I2C Bus Specification Version 2.1 by Philips (Pages 4-18 and 27-30) (Download from www.nxp.com) (iii) The I2C-Bus Benefits designers and manufacturers (Art 2: 2.1, 2.2) Introduction to the I2C-Bus Specification (Art 3) The I2C-Bus Concept (Art 4) General Characteristics (Art 5) Bit Transfer (Art 6) Data validity (6.1), START and STOP conditions (6.2) Transferring Data (Art 7) Byte format 7.1, Acknowledge 7.2 Arbitration and Clock Generation (Art 8) Synchronization (8.1), Arbitration (8.2), Use of the clock synchronizing mechanism as a handshake (8.3) Formats with 7-Bit Addresses (Art 9) 7-Bit Addressing (Art 10) Definition of bits in the first byte (10.1) 10-Bit Addressing (Art 14) Definition of bits in the first two bytes (14.1), Formats with 10-bit addresses (14.2) Detailed study of Bluetooth: Overview, Radio Specifications, FHSS WS: Ch- 15: 15.1, 15.2 upto Page 512	

References:

(1) DLP: - VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw-Hill
(2) SKV :- Introduction to embedded systems, by Shibu K. V. ,Sixth Reprint 2012, Tata Mcgraw Hill
(3) WS:-Wireless Communications and Networks, by William Stallings, 2 nd edition Pearson

M.Sc Physics Semester IV Practicals
COURSE CODE: 20PSPHP41 and 20PSPHP42

The student has to perform a minimum of 10 experiments from Group A and Group B
Experiments: 100 marks
Project: 100 marks

Group A:
A1: (16F84 or 16FXXX) PIC Micro-controller based experiments (Using assembly/ embedded C language): (Any two experiments from 1, 2, 3 & 4)

(1) Interfacing LED's: flashing LED's, to display bit pattern, 8-bit counter.
(2) Interfacing Push Buttons: to increment and decrement the count value at the output by recognizing of push buttons, etc
(3) Interfacing Relay: to drive an ac bulb through a relay; the relay should be tripped on recognizing of a push button.
(4) Interfacing buzzer: the buzzer should be activated for two different frequencies,

A2: Interfacing (16F84 or 16FXXX) PIC Micro-controller based experiments
(Using assembly/ embedded C language)(Any two experiments from 1, 2 & 3):
(Any two experiments from 1, 2 & 3)
(1) Interfacing Opto-Couplers: using as input and output.
(2) Interfacing 7-Segment Display in the multiplexing mode: to display a two-digit number.
(3) Use of built-in ADC or Interface 8-bit ADC (0804): converting an analog signal into its binary equivalent by using built-in ADC of the PIC micro-controller.

OR

(4) Interface an 8-bit ADC 0804 to the PIC micro-controller and convert an analog signal into its binary equivalent.

Group B:
B1: Basic VHDL experiments:
(Any two experiments from 1, 2, & 3.)
(1) Write VHDL programs to realize: logic gates, half adder and full adder

(2) Write VHDL programs to realize the following combinational designs: 2 to 4 decoder, 8 to 3 encoder without priority, 4 to 1 multiplexer, 1 to 4 de-multiplexer
(3) Write VHDL programs to realize the following: SR – Flip Flop, JK – Flip Flop, T –Flip Flop
(4) Write a VHDL program to realize a 2/3/4 - bit ALU (2- arithmetic,2-logical Operations

B2: VHDL Interfacing based experiments:
(Any two experiments from 1, 2, & 3.)
(1) Interfacing stepper motor: write VHDL code to control direction, speed and number of steps.
(2) Interfacing dc motor: write VHDL code to control direction and speed using PWM.
(3) Interfacing relays: write VHDL code to control ac bulbs (at least two) using relays.

B3: ARM7 based experiments:
(Any two experiments from 1, 2, 3 & 4, Using assembly/ embedded C language)
(1) Simple data manipulation programs (addition, subtraction, multiplication, division etc).
(2) Study of IN and OUT port of ARM7 by Interfacing switches, LEDs etc.
(3) Study of Timer.
(4) Interfacing DAC/ADC using I2C Protocols.

M.Sc. (Physics) Projects -1 & 2

Semesters III and IV
Project evaluation guidelines

Every student will have to complete one project each in Semester III and Semester IV with four credits (100 marks) each. Learners can take one long project (especially for SSP/SSE/Material SC /Nanotechnology/Nuclear etc.) or two short projects (especially for EI /EII). However for one long project learners have to submit two separate project reports / dissertation consisting of the problem definition, literature survey and current status, objectives, methodology and some preliminary experimental work in Semester III and actual experimental work, results and analysis in semester IV with four credits each. Those who have opted for two separate projects will also have to submit two separate project reports at each examination. The project can be a theoretical or experimental project, related to advanced topic, electronic circuits, models, industrial project, training in a research institute, training of handling a sophisticated equipment etc.

Maximum three learners can do a joint project. Each one of them will submit a separate project report with details/part only he/she has done. However he/she can in brief (in a page one or two) mention in Introduction section what other group members have done. In case of electronic projects, use of readymade electronic kits available in the market should be avoided. The electronics project / models should be demonstrated during presentation of the project. In case a student takes training in a research institute/training of handling sophisticate equipment he/she should mention in a report what training he/she has got, which instruments he/she handled and their principle and operation etc.

Each project will be of 100 marks with 50% by internal and 50% by external evaluation.
The project report should be file bound/spiral bound/hard bound and should have following format

(1) Title Page/Cover page
(2) Certificate endorsed by Project Supervisor and Head of Department
(3) Declaration
(4) Abstract of the project
(5) Table of Contents
(6) List of Figures
(7) List of Tables
(8) Chapters of Content –
(9) Introduction and Objectives of the project
(10) Experimental/Theoretical Methodology/Circuit/Model etc. details
(11) Results and Discussion if any
(12) Conclusions
(13) References

Evaluation by External/Internal examiner will be based on following criteria: (each semester)

Criterion	**Max Marks**
Literature survey	05
Objectives/ Plan of the project	05
Experimental/theoretical methodology/working condition of project or model	10
Significance and the originality of the study/Society applications and inclusion of recent references	05
Depth of knowledge/Results and discussions	10
Presentation	15
Maximum marks by external examiner	50
Maximum marks by internal examiner/guide	50
Total marks	100

Evaluation Pattern (Theory):
For each course I, II, III and IV
External Evaluation – Semester End Examination (60 M)- Duration : 2 hours
Theory Paper Pattern

Question No.	Module	Marks/question	Marks without option
Q.1(A) Attempt any 2/3 (B) Attempt any 1/2	1	06 03	12 03

Q.2(A) Attempt any 2/3 (B) Attempt any 1/2	2	06 03	12 03
Q.3(A) Attempt any 2/3 (B) Attempt any 1/2	3	06 03	12 03
Q.4(A) Attempt any 2/3 (B) Attempt any 1/2	4	06 03	12 03

Internal Evaluation 40 Marks

Evaluation Type	Marks
Class Test and Assignment / Poster presentation/ field visit report/ simple project	30+10
OR	
Project +presentation+ report writing+ Viva	40
OR	
Chapter review +presentation+ report writing +Viva	40