R. E. Society's

R. P. Gogate College of Arts & Science and R. V. Jogalekar College of Commerce (Autonomous), Ratnagiri

Second Year (Semester III & IV)
Master of Science in Physics Programme
(NEP 2020 & CBCS)

For Academic Year 2024-25

Program Outcomes of M.Sc. Physics

Name of Programme	**Master of Science**
Level	PG
No of Semesters	04
Year of Implementation	**2024-25**
Programme Specific Outcomes (PSO)	On completion of the MSc Physics, the learners should be enriched with knowledge and be able to 1. **Physics knowledge**: Understand current developments in various domains of modern physics, like nuclear physics, electrodynamics, atomic and molecular physics, classical mechanics, quantum mechanics, statistical mechanics, mathematical physics, solid-state physics, advanced electronics, solid-state devices, experimental techniques, and electronics. 2. **Practical Skills and Analytical Abilities:** Develop analytical abilities and acquire practical skill in handling measuring equipment required to carry out experiments in different areas of Physics, verify complex Physics problems through experimentation and use them to develop science and technology. Learner will be able to design Assembly level and High-level language program related microcontroller, microprocessor, C++, VHDL, Python, ARM etc. 3. **Motivation and life-long learning:** Acquire skills like collaborative work, communication and independent learning required for lifelong learning to overcome challenges ahead. 4. **Research:** Clear competitive examination like SET, NET, JRF, PET and JEST required for pursue research at different research institutes and Universities. Get trained for a career in basic sciences and contribute in educational institutes, industries and emerging branches of science. 5. **Ethics:** Demonstrate professional behaviour such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behaviour such as fabricating, falsifying or misrepresenting data or committing plagiarism; (ii)the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment.
Relevance of PSOs to the local, regional, national, and global developmental needs	The Master of Science in Physics programme equips the candidate with knowledge, general competence, and analytical skills on an advanced level, needed in industry, consulting, education, and research and public and private administration. The M.Sc.-I and II (Physics) Programme includes various core courses such as Solid-State physics, statistical mechanics, nuclear and particle physics, spectroscopy and microprocessors and advance experiment in electronics. The choice of courses offers a glimpse into the frontier areas of research and allows learners to work on research projects. The programme also provides adequate exposure for the learners to pursue higher education in the fields of technology (M. Tech.), physics (M.Phil./Ph.D.), and other job opportunities in academia and industry. On completion of the programme, the postgraduates will be

	able to: 1. Apply knowledge and skill in the design and development of electronic system and programming to fulfil the needs of the electronic industry. 2. Pursue research related to physics and material characterization. 3. Able to teach core physics to higher secondary and undergraduate learners. 4. Demonstrate the highest standards of actuarial ethical conduct and professional actuarial behaviour, critical, interpersonal and communication skills as well as a commitment to life-long learning.

Evaluation Scheme

Course Evaluation Scheme: -

The performance of the learners shall be evaluated into two parts. The learner's performance shall be Evaluated by Continuous Evaluation with 40% marks and by conducting the Semester End Examination with 60% marks.
The allocation of marks for the continuous Evaluation and Semester End Examinations are as shown below: -

Continuous Evaluation: (40% marks)

Sr.No.	Particulars	% Marks
01	Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

Semester End Examination: (60% marks)
The Examination shall be of 2 hours duration for 4 credit course and 1 hour duration for 2 credit courses.

Standard of Passing:

For each course of M.Sc. Physics, there will be separate head of passing for Continuous Evaluation and Semester End Examination. The learner to earn the course credits, shall have to obtain a minimum of 40% marks in the Continuous Evaluation and 40% marks in Semester End Examination separately.

Conversion of Marks: -

The Continuous Evaluation for 2 credit Practical courses of M.Sc. Physics will be of 40 marks. In such cases, the marks obtained by a learner in Continuous Evaluation of a course out of 40, will be converted to marks out of 20.
The Semester End Evaluation for 2 credit Practical courses of M.Sc. Physics will be of 60 marks. In such cases, the marks obtained by a learner in Semester End Evaluation of a course out of 60, will be converted to marks out of 30. Converted marks will be reflected in learner's marksheet. There will be no mark conversion for 4 credit courses.

Performance Grading:

Letter Grades and Grade Points

% of Aggregate Marks Obtained	Course Grade Point	Course Grade	Performance Indicator	Credits Earned
90.0 to 100	10	O	Outstanding	As per course credit
80 to 89.99	9	A+	Excellent	
70 to 79.99	8	A	Very Good	
60 to 69.99	7	B+	Good	
55 to 59.99	6	B	Above Average	
50.0 to 54.99	5	C	Average	
40 to 49.99	4	P	Pass	
Less Than 40	0	F	Fail	0
Absent	0	Ab	Absent	

Courses Offered by Department of Physics for M.Sc.-II

No. of Courses	Semester III	Credits	No. of Courses	Semester IV	Credits
	Major Mandatory			Major Mandatory	
PSPH 301	Nuclear Physics	02	PSPH 401	32-bit microprocessor and interfacing of microcontrollers	04
PSPH 302	8,16-bit Microprocessors and Microcontrollers	04	PSPH 402	VHDL, Understanding USB and Communication Interface.	04
PSPH 303	Programming using C++, Python, Embedded System, RTOS	04	PSPH 403	Physics lab-2	04
PSPH 304	Physics LAB-I	04			
	Major Electives			Major Electives	
PSPH 305	Statistical Mechanics	04	PSPH 404	Atomic and Molecular Physics	04
	OR			OR	
PSPH 306	Laser Physics	04	PSPH 405	Experimental Physics	04
PSPH 307	Research Project	04	PSPH 406	Research Project	06
Total Credits		22	Total Credits		22

SEMESTER-III

No. of Courses	Semester III	Credits
	Major: Mandatory	
PSPH301	Nuclear Physics	02
PSPH302	8, 16 – bit Microprocessors and Microcontrollers	04
PSPH303	Programming Using C++, Python, Embedded Systems and RTOS	04
PSPH304	Physics Lab-1	04
	Major: Elective (Any one from below)	
PSPH305	Statistical Mechanics	04
PSPH 306	Laser Physics	04
PSPH 307	Research Project	04
Total Credits		22

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2024-2025

Name of the Course	Nuclear Physics
Class	M.Sc.-II
Semester	III
Course Code	PSPH301
No of Credits	02
Nature	Theory
Type	Core

Nomenclature: Nuclear Physics

Course Outcomes:
On successful completion of this course, learners will understand:

CO-1 all static properties of nuclei.
CO-2 the Deuteron Problem and its ground state properties.
CO-3 the double scattering experiments.
CO-4 the development and concepts of various nuclear models.
CO-5 the differences between various radioactive decays, state selection rules.
CO-6 selection rule for radioactive decay.
CO-7 concept of scattering and reaction cross sections of nuclear reaction.
CO-8 the concept of elementary particles.

Curriculum:

Unit	Title	Learning Points
I	Deuteron theory And Nuclear models	**(Overview of Nuclear Physics:** - All static properties of nuclei, Measurement of Nuclear size and estimation of R_0) **Deuteron Theory: -** Deuteron Problem and its ground state properties, Estimate the depth and size of (assume) square well potential, Tensor force as an example of non-central force, nucleon-nucleon scattering-qualitative discussion on results, Spin-orbit strong interaction between nucleon, double scattering experiment. **Nuclear Models:** Shell Model (extreme single particle), Collective model - Introduction to Nilsson Model. **Reference: - KK, SNG, SBP**
II	Radioactive decay and nuclear reactions	**Alpha decay: -** Review of alpha decay **Beta decay: -** Introduction to Beta decay and its energetic, Fermi theory: derivation of Fermi's Golden rule, Information from Fermi–curie plots, Comparative half-lives, selection rules for Fermi and G -T transitions. **Gamma decay**: Multipole radiation, Selection rules for gamma ray transitions, Gamma ray interaction with matter, and Charge-particle interaction with matter. **Nuclear Reactions:** Kinematics, scattering and reaction cross sections, energy release in fusion and fission reaction. Reference: SBP, KK
III	Elementary Particle Physics	**Elementary Particle Physics**: - Introduction to the elementary particle Physics, The Eight-fold way, the Quark Model, the November revolution and aftermath, The standard Model, Revision of the four forces, cross sections, decays and resonances, Introduction to Quantum Electrodynamics, Introduction to Quantum Chromodynamics. Weak interactions and Unification Schemes (Qualitative description), 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. Reference: - DG

Note: - A good number of numerical examples are expected to be covered on all topics covered.

Learning Resources recommended:

A. Main References:

1. KK: - Introductory Nuclear Physics, Kenneth Krane, Wiley India Pvt. Ltd
2. DG: -Introduction to Elementary Particles, David Griffith, John Wiley and sons.
3. SBP: - Nuclear Physics An Introduction, S. B. Patel, New age international publication, second edition.
4. SNG: - Nuclear Physics, S. N. Ghoshal.

B. Other References:

1. HAE: - Introduction to Nuclear Physics, H. A. Enge, Eddison Wesley.

2. ES: - Nuclei and Particles, E. Segre, W. A. Benjamin.
3. BLC: - Concepts of Nuclear Physics, B. L. Cohen.
4. FH: - Subatomic Particles, H. Fraunfelder and E. Henley, Prentice Hall.
5. HSH: - Nuclear Physics: Experimental and Theoretical, H. S. Hans, New Age International.
6. DF: - Introduction to Nuclear and Particle Physics, A. Das & T. Ferbel, World Scientific
7. DHP: - Introduction to high energy physics, D. H. Perkins, Addison Wesley.
8. BJ: - Nuclear and Particle Physics, W. E. Burcham and M. Jones, Addison Wesley.
9. SMW: - Introductory Nuclear Physics, S. M. Wong, Prentice Hall.
10. RE & RR: - Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, Robert Eisberg and Robert Resnick, Wiley (2006)

Teaching Plan

Unit	Title	Teaching methods	Total No. of lectures
I	Deuteron theory And Nuclear models	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	10
II	Radioactive decay and nuclear reactions	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	10
III	Elementary Particle Physics	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	10

Evaluation Pattern

A. Continuous Internal Evaluation (20 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	10
02	Assignment	5
03	Active participation in class room and attendance	5

B. Semester End Evaluation (Paper Pattern): (30 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 03

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2024-2025

Name of the Course	8, 16 – bit Microprocessors and Microcontrollers
Course Code	PSPH302
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Theory
Type	Core

Nomenclature: 8, 16 – bit Microprocessors and Microcontrollers

Course Outcomes:

On successful completion of this course learners will:

CO-1 Understand microprocessor 8085 interrupt structure and Serial I/O of data with the processor.
CO-2 Understand functioning of programmable peripheral chips: 8255A, 8259A, 8237 and 8279 and write assembly language programs for the same.
CO-3 Understand 8086 microprocessor, its architecture, interrupt structure and its Instruction set.
CO-4 Be able to write assembly language programs for 8086 microprocessors.
CO-5 Understand Timer/Counter, interrupts and serial I/O Programming for 8051 microcontrollers
CO-6 Understand architecture of 16C61/71 PIC microcontrollers.
CO-7 Be able to write assembly language programs for16C61/71PIC microcontroller.

Curriculum:

Unit	Title	Learning Points
I	8085 Microprocessor and programmable peripheral devices	**8085 Interrupts**: The 8085 Interrupt, 8085 Vectored Interrupts, Restart as Software Instructions, Additional I/O Concepts and Processes. **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 **Programmable Peripheral 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), 8279 (Programmable Keyboard/Display Interface). Reference: RSG
II	8086 microprocessors	**8086 microprocessor hardware**: Register organization of 8086, Architecture, Pin 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. **8086 Instruction set and assembler directives:** Machine Language Instructions Formats, addressing modes of 8086, Instruction set of 8086. **The Art of Assembly Language Programming with 8086:** A few machine level programs, Machine coding the programs, Programming with an assembler (only using Debug), Assembly language example programs. **Special architectural features and related programming**: Introduction to Stack, Stack structure of 8086, Interrupts and Interrupt Service Routines, Interrupt cycle of 8086, non-maskable interrupt, Maskable interrupt (INTR). Reference: AB
III	8051 Microcontroller	**8051 microcontrollers: Timer/Counters, Interrupts, Serial communication**: Programming 8051 Timers, Counter Programming, Basics of Serial Communication, 8051 Connection to RS232, 8051 Serial Port Programming in assembly language, 8051 Interrupts, Programming Timer Interrupts, Programming External hardware Interrupts, Programming the Serial Communication Interrupt, Interrupt Priority in 8051/52. Reference: MMM
IV	PIC Microcontroller	**16C61/71PIC Microcontrollers:** Overview and Features, PIC 16C6X/7X, PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organization, PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71Timers, PIC 16C71 Analog-to-Digital Converter. Reference: AVD

Learning Resources recommended:

A. Main References:

1. RSG: Microprocessor Architecture, Programming and Applications with the 8085 by Ramesh S. Gaonkar, Fifth Edition, Penram International Publication (India) Pvt. Ltd.
2. AB: Advanced Microprocessors and Peripherals by A K Ray and K M Bhurchandi, Second edition, Tata McGraw Hill Publishing Company Ltd.

3. MMM: The 8051 Microcontroller and Embedded Systems by M A Mazidi, J G Mazidi and R D Mckinlay, Second Edition, Pearson.
4. AVD: Microcontrollers by Ajay V Deshmukh, Tata-Mcgraw Hill Publication.

B. Additional References:

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

Teaching plan:

Unit	Title	Teaching methods	Total No. of lectures
I	8085 Microprocessor	Lecture, Visual Aids, Hands-On Activities, simulation, Interactive Discussions	15
II	8086 Microprocessor	Lecture, Visual Aids, Hands-On Activities, simulation, Interactive Discussions	15
III	Microcontroller	Lecture, Visual Aids, Hands-On Activities, simulation, Interactive Discussions	15
IV	PIC Microcontroller	Lecture, Visual Aids, Hands-On Activities, simulation, Interactive Discussions	15

Evaluation Pattern

A. Continuous Internal Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2024-2025

Name of the Course	Programming Using C++, Python, Embedded Systems and RTOS
Course Code	PSPH303
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Theory
Type	Core

Nomenclature: Programming Using C++, Python, Embedded Systems and RTOS

Course Outcomes:

On successful completion of this course learners will:

CO-1 Be able to write C++ program using decision making, Looping, Function, Arrays, Pointers, classes, Inheritance, polymorphism, virtual functions.

CO-2 Be able to write Python programs using conditional statement, Looping, array, Function.

CO-3 Understand the basics, classification, purpose and applications of embedded systems.

CO-4 Understand basic concept of multitasking, types of scheduling under Real Time Operating System.

Curriculum:

Unit	Title	Learning Points
I	Programming Using C++	**Programming Using C++**: - Introduction to Computers and programming, Introduction to C++, Expressions and interactivity, Making decisions, Looping, Functions, Arrays, Sorting arrays, Pointers. **Introduction to classes**: - Classes, Inheritance, polymorphism, virtual functions. Reference: - TG
II	Python programming language	**Python programming language**: - Introduction, data-types, Variables and constant, typecasting, Operators user input(console), conditional Statements (if else, nested if else and elif() and Loop in python- for loop, while loop and nested loops, String Manipulation, Array (List, Tuple, sets and Dictionaries), Functions, Modules, Exception Handling. Reference: - AKG,CHS
III	Embedded systems	**Introduction to Embedded Systems:** What is an embedded system, Embedded System v/s General Computing System, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Smart Running Shoes. **A Typical Embedded system**: Core of the embedded system. **Characteristics and quality Attributed of Embedded Systems:** Characteristics of an Embedded System, Quality Attributes of Embedded Systems. **Embedded Systems-Application and Domain–Specific:** Washing Machine, Automatic-Domain Specific examples of embedded system. **Design Process and design Examples:** Automatic Chocolate Vending machine (ACVM), Smart Card, Digital Camera, Mobile Phone, A Set of Robots. Reference: - SKV
IV	Real–Time Operating System based Embedded System Design	**Real–Time Operating System based Embedded System Design: -** Operating system Basics, Types of Operating Systems, Tasks, Process and Threads, Multi-processing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, task Communication, task Synchronizations, Device Drivers, how to choose an RTOS. Reference: - SKV

Learning Resources recommended:

A. Main reference: -

1. TG: -Starting out with C++ from control structure through objects by Tony Gaddis, sixth edition, Penram international publications, India.
2. SKV: - Introduction to embedded system by Shibu K. V., Sixth Reprint 2012,Tata McGraw Hill.
3. RK: - "Embedded Systems" Architecture, Programming and Design, by Raj Kamal, Second Edition, The McGraw-Hill Companies.
4. AKG: - Scientific Computing in Python,2nd Edition, Abhijit Kar Gupta
5. https:WWW.iuac.res.in/phoenix/python4schools/Python-for-Education.pdf
6. CHS: - A Byte of Python by C. H. Swaroop.

B. Additional references:

1. EB: - Object Oriented Programming with C++, By E. Balagurusamy, 2nd ed. TMH.
2. NRP: - OOPS with C++ from the Foundation, By N. R. Parsa, Dream Tech Press India Ltd.

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Programming Using C++	Lecture, Visual Aids, Hands-On Activities, simulation, Interactive Discussions.	15
II	Python programming language	Lecture, Visual Aids, Hands-On Activities, simulation, Interactive Discussions.	15
III	Embedded systems	Lecture, Visual Aids, Hands-On Activities, simulation, Interactive Discussions.	15
IV	Real–Time Operating System based Embedded System Design	Lecture, Visual Aids, Hands-On Activities, simulation, Interactive Discussions.	15

Evaluation Pattern

A. Continuous Assessment (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	Long questions with 100% Internal option. Short questions with 100% Internal option.	10 05
2	II	Long questions with 100% Internal option. Short questions with 100% Internal option.	10 05

3	III	Long questions with 100% Internal option. Short questions with 100% Internal option.	10 05
4	IV	Long questions with 100% Internal option. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2024-2025

Name of the Course	Physics Lab -I
Course Code	PSPH304
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Practical
Type	Core

Nomenclature: Physics Lab-I

Course Outcomes:

On successful completion of this course, learners will:

CO-1 Be able to write and execute assembly language programmes for 8085 interrupts and 8086 microprocessors.

CO-2 Be able to write and execute simple and interfacing type assembly language programmes based on 8051 microcontroller and PIC 16F84A.

CO-3 Be able to write, debug and execute C++ and Python programmes.

Curriculum:

Unit	Title	Learning Points
Group A	8085/8086 Microprocessor and 8051 based experiments	**A1: 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) (**Note**: Assembly language programming of 8086 may be done by operating PC in real mode by using 'Debug' program. A separate 8086 study kit is not needed.) **A2: 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 LED's, 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.
Group B	PIC microcontroller, C++ and Python based experiments	**B1: (16F84 or 16FXXX) PIC Micro-controller-based experiments (Using assembly language only): (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, depending on recognizing of corresponding push buttons. **B2: C++ and Python experiments:** (Any two experiments from 1, 2, & 3. Experiment no. 4 is compulsory 1.a) C++ Program (Conversion from decimal system to binary, octal, hexadecimal system). 1.b) C++ Program (Program on mean, variance, standard deviation for a set of numbers). 2. a) C++ Program (Sorting of data in ascending or

		descending order). 2.b)C++ experiment (Programs on class, traffic lights). 3. C++ experiment (Programs on inheritance, over loading). 4. Python experiments: - 1. Print all odd integers from 1 to 100. 2. Python program to convert temperature in Celsius to Fahrenheit. 3. Find the largest among ten numbers 4. Python Program to print the Fibonacci sequence, 5. Define a list of size 10 containing integral values and write a program to find and print sum of cubes of odd integers divisible by 3 in that list. 6. Using function write program to calculate area, perimeter of rectangle

Note:

1. Minimum number of experiments to be performed and reported in the journal = 10
2. Journal should be certified by the laboratory in-charge and Head of the Department only if the learner performs satisfactorily the minimum number of experiments as stipulated above.
3. Learner will be allowed to appear for the semester end practical examination of this course only if learner submits a certified journal of this course or a certificate from the head of the Physics Department that learner has completed this practical course as per minimum requirements.

Learning Resources recommended:

1. RSG: Microprocessor Architecture, Programming and Applications with the 8085 by Ramesh S. Gaonkar, Fifth Edition, Penram International Publication (India) Pvt. Ltd.
2. AB: Advanced Microprocessors and Peripharals by A K Ray and K M Bhurchandi, Second edition, Tata MacGraw Hill Publishing Company Ltd.
3. MMM: The 8051 Microcontroller and Embedded Systems by M A Mazidi, J G Mazidi and R D Mckinlay, Second Edition, Pearson.
4. AVD: Microcontrollers by Ajay V Deshmukh, Tata-Mcgraw Hill Publication.
5. CHS: - A Byte of Python by C. H. Swaroop.

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
Group A	8085/8086 Microprocessor and 8051 based experiments	Presentation, Discussion, Experimentation	60
Group B	PIC microcontroller, C++ and Python experiments	Presentation, Discussion, Experimentation	60

Evaluation Pattern

A. Continuous Internal Evaluation: (40 Marks)

Method	Marks
Journal	20
Lab performance	10

Seminar	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No.	Group	Title	Method	Marks
1	Group A	8085/8086 Microprocessor and 8051 based experiments	Experiment performance as per the practical slip	30
2.	Group B	PIC microcontroller, C++ and Python experiments	Experiment performance as per the practical slip	30

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2024-2025

Name of the Course	Statistical Mechanics
Course Code	PSPH305
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Theory
Type	Elective

Nomenclature: Statistical Mechanics

Course Outcomes:

On successful completion of this course learners will:

CO-1 Understand the concept of microstates and macrostates of a system.
CO-2 Understand need of using statistical approach to study thermodynamic system.
CO-3 Understand the concept of Liouville's theorem and its consequences.
CO-4 Be able to identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, and partition functions.
CO-5 Be able to use of micro canonical, canonical and grand canonical ensembles to derive the properties of various classical and quantum thermodynamic systems.
CO-6 Understand the basic of formulation of Quantum Statistics.

Curriculum:

Unit	Title	Learning Points
I	Statistical Thermodynamics and Ensemble	**The Statistical Basis of Thermodynamics**: - The macroscopic and the microscopic states, contact between statistics and thermodynamics, the classical ideal gas, The entropy of mixing and the Gibbs paradox, the enumeration of the microstates. **Elements of Ensemble Theory** - Phase space of a classical system, Liouville's theorem and its consequences. **The microcanonical ensemble** - Examples Quantum states and the phase space. Reference: - PB
II	Canonical Ensemble	**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, expressions of the partition function, the classical systems, energy fluctuations in the canonical ensemble, correspondence with the microcanonical ensemble, the equipartition theorem and the virial theorem, system of harmonic oscillators, statistics of paramagnetism, thermodynamics of magnetic systems. Reference: - PB
III	Grand Canonical Ensemble	**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, Density and energy fluctuations in the grand canonical ensemble, correspondence with other ensembles. Reference: - PB
IV	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. Reference: - PB

Note: A good number of numerical examples are expected to be covered on all topics covered.

Learning Resources recommended:

A. Main Reference:

1. PB: - Statistical Mechanics - R. K. Pathria & Paul D. Beale (Third Edition), Elsevier 2011 – Chap. 1 to 5

B. Additional References:

1. NG: - Thermodynamics and Statistical Mechanics, Greiner, Neise and Stocker, Springer 1995.
2. KH: - Introduction to Statistical Physics, Kerson Huang, Taylor and Francis 2001.
3. FR: - Thermal and Statistical Physics, F Reif.
4. JKB: - Statistical Mechanics, J.K. Bhattacharjee.
5. RF: - Statistical Mechanics, Richard Feynman.
6. LL: - Statistical Mechanics, Landau and Lifshitz.
7. HBC: - Thermodynamics, H.B. Callen.

Teaching plan:

Unit	Title	Teaching methods	Total No. of lecture
I	Statistical Thermodynamics and Ensemble	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
II	Canonical Ensemble	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
III	Grand Canonical Ensemble	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
IV	Formulation of Quantum Statistics	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15

Evaluation Pattern

A. Continuous Assessment (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2024-2025

Name of the Course	Laser Physics
Course Code	PSPH306
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Theory
Type	Elective

Nomenclature: Laser Physics

Course Outcomes:

On successful completion of this course learners will:

CO-1 Understand Laser characteristics.
CO-2 Recall a basic knowledge of Laser Characteristic.
CO-3 understand Einstein coefficient
CO-4 solve Problems based on Einstein coefficient.
CO-5 study different techniques of Q switching.
CO-6 Understand concept of harmonic generation.
CO-7 Understand Laser base spectroscopic instrumentation
CO-8 Understand Optical Holography
CO-9 Understand Application of Laser in medical field

Curriculum:

Unit	Title	Learning Points
I	Laser characteristics and Resonators	Principles, Properties of laser radiation, Einstein Coefficients, Light amplification, Threshold condition for laser oscillations, Homogeneous and inhomogeneous broadening, Laser rate equations for 2,3 and 4 level, variation of laser power around threshold, optimum output coupling, Open planar resonator, Quality Factor, ultimate line width of the laser, Transverse and Longitudinal mode selection.
II	Nonlinear optics	Techniques for Q-switching, Mode Locking, Hole burning and Lamb dip in Doppler broadened Gas laser, Nonlinear oscillator model, Nonlinear polarization and wave equation, perturbative solution of the Nonlinear oscillator equation, Hormonic generation, Second harmonic generation, Phase matching third harmonic generation. Optical wave mixing, parametric generation of light, parametric oscillation, tuning of parametric oscillators. Non-Linear susceptibilities, non-linear susceptibility tensor, non-linear materials
III	Laser Systems	Solid State Laser, Gas lasers, liquid lasers, Eximer lasers. Semiconductor Laser. Liquid–Dye and chemical lasers, high power laser systems and industrial applications.
IV	Spectroscopic Instrumentation and applications	Raman scattering, photo-acoustic Raman Spectroscopy. Raman Amplification and Raman laser, special techniques in nonlinear spectroscopy, polarization spectroscopy, multi-photon spectroscopy, photo fluorescence excitation spectroscopy. Holographic Optical Element: HOE, Design aspects, resolution, vibration and motion analysis by Holographic techniques, holography, Spatial Frequency filtering, optical Communication, optical computers. Laser ablation, Laser in Biomedicine.

Learning Resources recommended:

A. Main References: -

1. BL: - B. Laud, Laser and Non-linear optics, Wiley Eastern Ltd., (1991).
2. GT: - A.K. Ghatak and K. Thyagarajan, optical electronics, Cambridge University Press (1991).
3. SCG: - S.C Gupta Optoelectronic devices and systems, Prentice Hall of India. (WH) Wilson and Hawkes: Optoelectronics, Prentice Hall of India.
4. Yariv, Optical Electronics in Modern Communications, Oxford University Press (1997),
5. Laser Spectroscopy- Basic concepts and instrumentation by Demtroder (ed. 3,Springer)

B. Additional Reference:

1. Laser: Svelto.
2. Optical electronics: Wariv.
3. Non-linear spectroscopy: Etekhov.
4. Introduction to modern optics: G.R.Flowles.

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Laser characteristics and Resonators	Lecture, Problem solving, Visual aid, computer simulation, seminar,	15
II	Nonlinear optics	Lecture, Problem Solving, Video lecture, Group discussion, simulation.	15
III	Laser Systems	Lecture, Problem Solving, Video lecture, group discussion	15
IV	Spectroscopic Instrumentation and applications	Lecture, Problem Solving, Video lecture, Group discussion	15

Evaluation Pattern

A. Continuous Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2024-2025

Name of the Course	Project-I
Course Code	PSPH307
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Research Project
Type	Compulsory

Nomenclature: Project-I

Course Outcomes:

On successful completion of this course, learners will be able to:

CO-1 Understand the ethics and research methodology.
CO-2 Do a literature review.
CO-3 Identify research problem and do research.
CO-4 Analyze the research work data.
CO-5 Write research article.

Curriculum:

Unit	Title	Learning Points	No of Lectures
-	Project-I	Identifying problem for project work, literature survey, deciding methodology, practical implementation of the Project, data analysis and conclusions, preparing project report (a dissertation).	120

Learning Resources recommended:

1. Research Papers
2. Internet
3. Books and journals

Teaching plan:

Title	Teaching methods	Total No. of Lecture
Identifying problem for project work, literature survey	Discussion, literature review.	15
Deciding methodology and practical implementation of the Project	Discussion, Experimental work.	25
Data analysis (if any) and conclusions, preparing project report (a dissertation).	Presentation and discussion.	20

Evaluation Pattern

A. Continuous Internal Evaluation: (40 Marks)

Method	Marks
Lab performance	30
Presentation	10

B. Semester End Evaluation (Evaluation Pattern): (60 Marks)

Sr No	Criteria	Marks
1	Experimental/Theoretical methodology/Working condition of project or model	15
2	Significance of the study/Society application and Inclusion of recent References	10
3	Depth of knowledge in the subject / Results and Discussions	10
4	Project Report	10
5	Presentation	15

Project guidelines:

1. Every learner will have to complete one project in Semester III with four credits (100 marks) and Semester IV with six credits (150 marks) .
2. Learners can take one long project or two short projects.
3. 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.
4. 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.
5. Maximum three learners can do a joint project. Each one of them will submit a separate project report with details.
6. In case of electronic projects, use of readymade electronic kits available in the market should be avoided.
7. The electronics project / models should be demonstrated during presentation of the project.
8. In case a learner 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.
9. Each project will be evaluated with a 40% continuous evaluation and a 60% semester-end evaluation.
10. The project report should be file bound/spiral bound/hard bound

Format of Project Report:

a) **Title Page:**

Mentioning the title of the report, name of the learner, program, institution, and the project.

b) **Certificate of Completion:**

A certificate issued by guide confirming the successful completion of the project.

c) **Declaration:**

A statement by the learner declaring that the report is the original work and acknowledging any assistance or references used.

d) **Acknowledgments:**

Recognizing individuals or organizations that provided support, guidance, or resources during the training/project.

e) **Table of Contents:**

Providing a clear outline of the report's sections and page numbers.

f) **Abstract:**

A bird’s eye view of learner’s entire presentation has to be precisely offered under this category. A brief overview of the project, its objectives and key findings should be mentioned.

g) **Introduction:**

Background information about the project and its significance. Objectives and scope of the project.

h) **Literature Review:**

Overview of relevant literature and studies related to the chosen field and development issues.

i) **Methodology:**

Description of: Planning of experimental procedure as per the need of the project. Designing and implementation of the project as per the objectives through theoretical, experimental or computational methods.

j) **Observations and data analysis:**

Details of Testing, debugging, troubleshooting as per the need. Data collection and analysis.

k) **Conclusion:**

Summary of the key findings and outcomes of the project.

l) **References** & **Appendices:**

List of all sources cited in the project report. Additional supporting materials.

The project report shall be prepared as per the broad guidelines given below:

- Font type: Times New Roman.
- Font size: 12-For content, 14-for Title.
- Line Space: 1.5-for content and 1-for in table work, Justified format.
- Page Size: A4.
- Margin: in Left-1.5, Up-Down-Right-1.
- The Project Report shall be hard bounded.

Format 1st page (Main Page)

Title of the problem of the Project

A Project Submitted

to

R. P. Gogate College of Arts & Science and

R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri

under

University of Mumbai

for partial completion of the degree

of

Master in Science

Under the Faculty of science

By

Name of Learner

Under the Guidance of

Name of the Guiding Teacher

R. P. Gogate College of Arts & Science and

R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri

<Month and Year>

On separate page

Index

On separate page

Declaration by learner

I the undersigned Miss/Mr. _____ [Name of the learner] here by, declare that work embodied in this project work titled _____ forms my own contribution to the research work carried out under the guidance of [Name of the guiding teacher] _____ is a result of my own project / research work and has not been previously submitted to any other University for any other Degree/ Diploma to this or any other University.

Wherever reference has been made to previous works of others, it has been clearly indicated as such and included in the bibliography.

I, here by further declare that all information of this document has been obtained and presented in accordance with academic rules and ethical conduct.

Name and Signature of the learner

Certified by

Name and signature of the Guiding Teacher

On separate page

Acknowledgment

(To be written by learner)

SEMESTER-IV

No. of Courses	Semester IV	Credits
	Major: Mandatory	
PSPH401	32-bit microprocessor and interfacing of microcontrollers	4
PSPH402	VHDL, Understanding USB and Communication Interface.	4
PSPH403	Physics lab-2	4
	Major: Elective (Any one from below)	
PSPH404	Atomic and Molecular Physics	4
PSPH405	Experimental Physics	4
PSPH406	Project-2	6
Total Credits		22

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2024-2025

Name of the Course	32-bit microprocessor and interfacing of microcontrollers
Course Code	PSPH401
Class	M.Sc.-II
Semester	IV
No of Credits	4
Nature	Theory
Type	Core

Nomenclature: 32-bit microprocessor and interfacing of microcontrollers

Course Outcomes:

On successful completion of this course learners will:

CO-1 Understand PIC 16F8XX Flash Microcontrollers.
CO-2 Be able to interface Microcontroller /PIC with hardware like LED, Switch, ADC, DAC.
CO-3 Understand Industrial application of microcontrollers/PIC.
CO-4 Understand architecture, development tools,3-stage pipeline organization of ARM.
CO-5 Understand instruction set of ARM7.
CO-6 Understand thumb instruction set of ARM7.
CO-7 Be able to write assembly language programs for ARM7.

Curriculum:

Unit	Title	Learning Points
I	PIC 16F8XX Flash Microcontrollers	**PIC 16F8XX Flash Microcontrollers**: - Introduction, Pin Diagram, STATUS Register, Power Control Register (PCON), OPTION_REG Register, Program memory, Data memory, I/O Ports, Capture/Compare/PWM (CCP) Modules in PIC 16F877, Analog-to-Digital Converter. Reference: AVD
II	Interfacing microcontroller/ PIC microcontroller and Industrial Applications of microcontrollers:	**Interfacing microcontroller/PIC microcontroller and Industrial Applications of microcontrollers:** 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. Introduction and Measurement Applications. Reference: -AVD, MMM
III	32-bit ARM Processor	**The ARM Architecture**: The Acorn RISC Machine, Architectural inheritance, The ARM Programmer's model, ARM development tools. ARM **Organization and Implementation**: 3 – stage Pipeline ARM organization, ARM instruction execution, ARM implementation. ARM Processor Cores: ARM7TDM. Reference: - SF
IV	ARM 7 Instruction set and program	**ARM Assembly language Programming**: Data processing instructions, Data transfer instructions, Control flow instructions, Writing simple assembly language programs. **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. **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. Reference: SF

Learning Resources recommended:

A. Main Reference: -

1. AVD: - Microcontrollers by Ajay V. Deshmukh, Tata-Mcgraw Hill Publication.
2. MMM: - The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, Second Edition, Pearson.
3. SF: - ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson Page 59 of 86.

B. Additional Reference:

1. DVH: - Microprocessors and interfacing, programming and hardware, By Douglas V. Hall (TMH)
2. KJA: - 8086 Microprocessor: Programming and Interfacing K.J.Ayala, Penram International.

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	PIC 16F8XX Flash Microcontrollers	Lecture, Visual Aids, computer, Hands-On Activities, simulation, Interactive Discussions	15
II	Interfacing microcontroller/PIC microcontroller and Industrial Applications of microcontrollers:	Lecture, Visual Aids, computer, Hands-On Activities, simulation, Interactive Discussions.	15
III	32-bit ARM Processor	Lecture, Visual Aids, computer, Hands-On Activities, simulation, Interactive Discussions.	15
IV	ARM 7 Instruction set and program	Lecture, Visual Aids, computer, Hands-On Activities, simulation, Interactive Discussions, Formative Assessment.	15

Evaluation Pattern

A. Continuous Internal Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2024-2025

Name of the Course	VHDL, Understanding USB and Communication Interface.
Course Code	PSPH402
Class	M.Sc-II
Semester	IV
No of Credits	4
Nature	Theory
Type	Core

Nomenclature: VHDL, Understanding USB and Communication Interface.

Course Outcomes:

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

CO-1 Understand the IEEE Standard 1076 Hardware Description Language (VHDL).
CO-2 Understand the concept of architecture, data types of VHDL.
CO-3 Understand entity, operators, Signal and generate statements, sequential statements, loops and decision-making statements, package and component statements in VHDL.
CO-4 Understand hardware details of USB.
CO-5 Understand USB communication through Transfer Basics, Elements of a Transfer, USB 2.0 Transactions, Ensuring Successful Transfers, Super Speed Transactions.
CO-6 Understand USB protocols for data transfer.
CO-7 Understand block diagram and operation of various communication interfaces like, I2C, SPI, UART, Wire Interface, Parallel Interface, RS-232, RS-485, USB, IEEE 1394 (Fire wire), Infrared (IrDA), Bluetooth, WiFi, ZigBee, GPR.

Curriculum:

Unit	Title	Learning Points
I	VHDL-I	**Introduction to VHDL**: VHDL Terms, Describing Hardware in VHDL, Entity, Architectures, Concurrent Signal Assignment, Event Scheduling, Statement concurrency, Structural Designs, Sequential Behavior, Process Statements, Process Declarative Region, Process Statement Part, Process Execution, Sequential Statements, Architecture Selection, Configuration Statements, Power of Configurations. **Behavioral Modeling**: Introduction to Behavioral Modeling, 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. **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. Reference: - DLP
II	VHDL-II	**Data Types**: Object Types, Signal, Variables, Constants, Data Types, Scalar Types, Composite Types, Incomplete Types, File Types, File Type Caveats, Subtypes. **Subprograms and Packages:** Subprograms Function, Conversion Functions, Resolution Functions, Procedures, Packages, Package Declaration, Deferred Constants, Subprogram Declaration, Package Body. **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. **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. Reference: - DLP
III	Understanding USB and USB Protocols	**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 Successful Transfers,

		SuperSpeed Transactions. **A Transfer Type for Every Purpose**: Control transfers, Bulk Transfers, Interrupt Transfers, Isochronous Transfers, More about time-critical transfers. **Enumeration: How the Host learns about devices**: The Process, Descriptors. **Control Transfers**: Structured Requests for Critical Data: Elements of a Control Transfer, Standard Requests, Other Requests. **Chip Choices**: Components of USB device. **How the Host Communicates**: Device Drivers, Inside the Layers, Writing Drivers, Using GUIDs. Reference: - JA
IV	Communication Interface	**On board Communication Interface**: Inter Integrated Circuit (I2C), Serial Peripheral Interface (SPI), Universal Asynchronous Receiver Transmitter (UART), Wire Interface, Parallel Interface. **External Communication Interfaces**: RS-232 & RS-485, USB, IEEE 1394 (Firewire), Infrared (IrDA), Bluetooth, Wi-Fi, ZigBee, GPRS. **Detailed studies of I2C Bus refer**: I2C Bus Specification Version 2.1 by Philips The I2C-Bus Benefits designers and manufacturers. Introduction to the I2C-Bus Specification. The I2C-Bus Concept. General Characteristics. Bit Transfer, Data validity, START and STOP conditions. Transferring Data Byte format, Acknowledge. Arbitration and Clock Generation Synchronization, Arbitration, Use of the clock synchronizing mechanism as a handshake. Formats with 7-Bit Addresses. 7-Bit Addressing, Definition of bits in the first byte. 10-Bit Addressing, Definition of bits in the first two bytes, Formats with 10-bit addresses. **Detailed study of Bluetooth**: Overview, Radio Specifications, FHSS Reference: - SKV, WS, www.nxp.com

Learning Resources recommended:

A. Main reference: -

1. DLP: - VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw-Hill.
2. JA: - The Developers Guide "USB Complete", by Jan Axelson, Fourth Edition, Penram International Publishing (India) Pvt Ltd.
3. SK: - Introduction to embedded systems, by Shibu K. V. Sixth Reprint 2012, Tata Mcgraw Hill.
4. WS: -Wireless Communications and Networks, by William Stallings, 2nd edition Pearson.
5. www.nxp.com

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	VHDL-I:	Lecture, Visual Aids, computer, Hands-On Activities, simulation, Interactive Discussions.	15
II	VHDL-II	Lecture, Visual Aids, computer, Hands-On Activities, simulation, Interactive Discussions.	15
III	Understanding USB and USB Protocols	Lecture, Visual Aids, computer, Hands-On Activities, simulation, Interactive Discussions.	15
IV	Communication Interface	Lecture, Visual Aids, computer, Hands-On Activities, simulation, Interactive Discussions.	15

Evaluation Pattern

A. Continuous Internal Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2024-2025

Name of the Course	Physics Lab-2
Course Code (refer to learner handbook)	PSPH403
Class	M.Sc. -II
Semester	IV
No of Credits	4
Nature	Practical
Type	Core

Nomenclature: Physics Lab-2

Course Outcomes:

On successful completion of this course learners will:

CO-1 Be able to draw and write flowcharts, assembly language programs for 8051 microcontrollers.
CO-2 Be able to Interface stepper motor, ADC with 8051.
CO-3 Be able to draw and write flowcharts, assembly language programs for PIC 16F84A.
CO-4 Be able to Interface seven segment display, optocoupler with 16F84A.
CO-5 Be able to draw and write flowcharts, assembly language programs for ARM7 processor.
CO-6 Execute programs on ARM7 kit.
CO-7 Draw and write flowcharts, assembly language programs (basic and interfacing) in VHDL.
CO-8 Implement logic on an FPGA and a CPLD kit.

Curriculum:

Unit	Title	Learning Points
Group A	8051 microcontroller and PIC microcontroller:	**A1: Interfacing 8031/8051 based experiments**: (Any two experiments from 1, 2 & 3) 1. Interfacing 8-bit DAC with 8031/51 to generate waveforms: square, sawtooth, 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. **A2: Interfacing (16F84 or 16FXXX) PIC Micro-controller-based experiments (Using assembly language only):** (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 Interface an 8-bit ADC 0804 to the PIC micro-controller and convert an analog signal into its binary equivalent.
Group B	VHDL and ARM 7	**B1: Basic VHDL experiments: (Any two experiments from 1, 2, & 3.)** 1. a) Write VHDL programs to realize: logic gates, half adder and full adder. 1. b) 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 demultiplexer. 2. Write VHDL programs to realize the following: SR – Flip Flop, JK – Flip Flop, T – Flip Flop. 3. 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)** 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.

Learning Resources recommended:

1. SF: - ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson.
2. DLP: - VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw-Hill.
3. Manual of VHDL kit.
4. MMM: The 8051 Microcontroller and Embedded Systems by M A Mazidi, J G Mazidi and R D Mckinlay, Second Edition, Pearson.
5. AVD: Microcontrollers by Ajay V Deshmukh, Tata-Mcgraw Hill Publication.

Teaching plan:

Unit	Title	Teaching methods	Total No of Lecture
Group A	8051 microcontroller and PIC microcontroller:	Presentation, Discussion, Experiment,	60
Group B	VHDL and ARM 7	Presentation, Discussion, Experiment,	60

Evaluation Pattern

A. Continuous Internal Evaluation (40 Marks)

Method	Marks
Journal	20
Lab performance	10
PPT presentation	10

B. Semester End Evaluation (Paper Pattern) (60 Marks)

Question No.	Group	Title	Method	Marks
1	Group A	8051 microcontroller and PIC microcontroller	Experiment performance as per the practical slip	30
2.	Group B	VHDL and ARM 7	Experiment performance as per the practical slip	30

Note:

1. Minimum number of experiments to be performed and reported in the journal = 10
2. Journal should be certified by the laboratory in-charge and Head of the Department only if the learner performs satisfactorily the minimum number of experiments as stipulated above.
3. Learner will be allowed to appear for the semester end practical examination of this course only if learner submits a certified journal of this course or a certificate from the head of the Physics Department that learner has completed this practical course as per minimum requirements.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2024-2025

Name of the Course	Atomic and Molecular Physics
Course Code	PSPH404
Class	M.Sc.-II
Semester	IV
No of Credits	4
Nature	Theory
Type	Elective

Nomenclature: Atomic and Molecular Physics

Course Outcomes:
On successful completion of this course learners will be able to:

CO-1 Understand the energy eigen values and eigen functions of one electron atom.
CO-2 Understand fine structure and hyperfine structure of Hydrogen atom.

CO-3 Understand Linear and quadratic Stark effect , Zeeman effect in strong and weak fields, Paschen-Back effect.
CO-4 Understand the exchange degeneracy and how this affects the excited states of helium.
CO-5 Understand the Periodic table from the viewpoint of the electronic structure.
CO-6 Understand spin-orbit coupling for multi-electron atoms.
CO-7 Understand and interpret Schrodinger equation for two electron atoms.
CO-8 Understand interaction of one electron atoms with electromagnetic radiation.
CO-9 Understand concept of Born Oppenheimer approximation for molecular structure.
CO-10 Understand Rotational, Vibrational, Rotational-Vibrational spectra.
CO-11 Understand Raman Spectroscopy.
CO-12 Understand principle of ESR and NMR.

Curriculum:

Unit	Title	Learning Points
I	One electron and two electron atoms	**One electron atom**:- Review* of one-electron eigenfunctions and energy levels of bound states, Probability density, Virial theorem, Fine structure of hydrogenic atoms, Lamb shift. Hyperfine structure and isotope shift, Linear and quadratic Stark effect in spherical polar coordinates, Zeeman effect in strong and weak fields, Paschen-Back effect. **Schrodinger equation for two electron atoms:** Identical particles, The Exclusion Principle, Exchange forces and the helium atom, independent particle model, ground and excited states of two electron atoms. Reference: - ER, BJ, GW
II	Central field and coupling	**Central field and coupling**: - The central field, Thomas-Fermi potential, the gross structure of alkalis, The Hartree theory, ground state of multi-electron atoms and the periodic table, The L-S coupling approximation, allowed terms in LS coupling, fine structure in LS coupling, relative intensities in LS coupling, j-j coupling approximation and other types of coupling. Reference: - GW, ER
III	Interaction of one electron atoms with electromagnetic radiation	**Interaction of one electron atoms with electromagnetic radiation:** Electromagnetic radiation and its interaction with charged particles, absorption and emission transition rates, dipole approximation. Einstein coefficients, selection rules, Line intensities and life times of excited state, line shapes and line widths. X-ray spectra. **Reference: - BJ**
IV	Molecular Physics	**Born-Oppenheimer approximation** - rotational, vibrational and electronic energy levels of diatomic molecules, Linear combination of atomic orbitals (LCAO) and Valence bond (VB) approximations, comparison of valence bond and molecular orbital theories A) **Rotation of molecules**: rotational energy levels of rigid and non-rigid diatomic molecules, classification of molecules, linear, spherical, symmetric and asymmetric tops. B) **Vibration of molecules**: vibrational energy levels of diatomic molecules, simple harmonic and anharmonic oscillators, diatomic vibrating rotator and vibrational-rotational spectra. C) **Electronic spectra of diatomic molecules**: vibrational and rotational structure of electronic spectra. Quantum theory of Raman effect, Pure rotational Raman spectra, Vibrational Raman spectra, Polarization of light and the Raman effect, Applications General theory of Nuclear Magnetic Resonance (NMR). NMR spectrometer, Principle of Electron spin resonance ESR. ESR spectrometer. Reference: - GA, IL

Learning Resources recommended:

A. Main Reference:

1. ER: - Robert Eisberg and Robert Resnick, Quantum physics of Atoms, Molecules, Solids, Nuclei and Particles, John Wiley & Sons, 2nded, (ER)
2. BJ: - B.H. Bransden and G. J. Joachain, Physics of atoms and molecules, Pearson Education 2nded, 2004 (BJ)
3. GKW: - G. K. Woodgate, Elementary Atomic Structure, Oxford university press, 2nd ed.
4. GA: - G. Aruldhas, Molecular structure and spectroscopy, Prentice Hall of India 2nded, 2002.
5. IL: - Ira N. Levine, Quantum Chemistry, Pearson Education, 5th edition, 2003.

B. Additional Reference:

1. Leighton, Principals of Modern Physics, McGraw hill.
2. Igor I. Sobelman, Theory of Atomic Spectra, Alpha Science International Ltd. 2006
3. N. Banwell, Fundamentals of molecular spectroscopy, Tata McGraw-Hill, 3rd ed.
4. Wolfgang Demtröder, Atoms, molecules & photons, Springer-Verlag 2006
5. Sune Svanberg, Atomic and Molecular Spectroscopy Springer, 3rd ed 2004
6. C.J. Foot, Atomic Physics, Oxford University Press, 2005 (CF)

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	One electron and two electron atoms	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
II	Central field and coupling	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
III	Interaction of one electron atoms with electromagnetic radiation	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
IV	Molecular Physics	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15

Evaluation Pattern

A. Continuous Assessment (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10

03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2024-2025

Name of the Course	Experimental Physics
Class	M.Sc.-II
Semester	IV
Course Code	PSPH405
No of Credits	4
Nature	Theory
Type	Core

Nomenclature: Experimental Physics

Course Outcomes:

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

CO-1 Understand the basics of different probability distributions and central limit theorem.
CO-2 Understand types of errors and carry out error analysis.
CO-3 Understand basics of kinetic theory of gases, pressure, particle collisions, velocity and free trajectory, flow of gases and its types.
CO-4 Understand fundamentals and technology of vacuum systems.
CO-5 Understand the classification, basic types, operation, range of application of most common instrumentation used for vacuum production and measurement.
CO-6 Understand block diagram, construction, operation and applications of various types of nuclear detectors and accelerators.
CO-7 Understand various characterization techniques (spectroscopic and microscopic) used for materials analysis.

Curriculum:

Unit	Title	Learning Points
I	Data Analysis for Physical Sciences	**Data Analysis for Physical Sciences**: 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, Assessing the normality of data, Population mean and continuous distributions, Population mean and expectation value, The binomial distribution, The Poisson distribution, Experimental Error, Measurement, error and uncertainty, The process of measurement, True value and error, Precision and accuracy, Random and systematic errors, Uncertainty in measurement. Reference: - LK
II	Vacuum Techniques	**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 and systems, Ultra High Vacuum Pumps and System, Measurement of pressure, Leak detections. Reference: - AR
III	Nuclear Detectors and accelerators	**Nuclear Detectors**: Gamma ray spectrometer using NaI scintillation detector, High Purity Germanium detector, Multi-wire Proportional counter. **Accelerators**: CockroftWalten Generator, Van de Graaff Generator, Sloan and Lawrence type Linear Accelerator, Proton Linear Accelerator, Cyclotron and Synchrotron. Reference: - GK, EP & SEG, WRL
IV	Characterization techniques for material analysis	**Spectroscopy:** XRD, XRF, XPS, EDAX, Raman, UV Visible spectroscopy, FTIR spectroscopy. **Microscopy:** SEM, TEM, AFM Reference: - KPR

Learning Resources recommended:

A. Main Reference: -

1. LK: - Data Analysis for Physical Sciences (Featuring Excel®) Les Kirkup, 2nd Edition, Cambridge University Press (2012), Chapters 1-6 and 9.
2. AR: - Vacuum Technology, A. Roth, North Holland Amsterdam.
3. WRL: - Techniques for Nuclear and Particle Physics Experiments, W.R. Leo, Springer- Verlag.
4. GK: - Radiation Detection and Measurement, Glenn F. Knoll, John Wiley and sons, Inc.
5. EP & SEG: - Principles of Particle Accelerators, E. Persico, E. Ferrari, S.E. Segre.
6. KPR: - An Introduction to Materials Characterization, Khangaonkar P. R., Penram International Publishing.

B. Additional Reference: -

1. Statistical Methods in Practice for scientist's ad Technologists, Richard Boddy and Gordon Smith, John Wiley & Sons (2009)
2. DKA, AT & ACG: - Ultra-High Vacuum Techniques, D. K. Avasthi, A. Tripathi, A. C. Gupta, Allied Publishers Pvt. Ltd (2002)
3. VVR, TBG & KLC: - Vacuum Science and Technology, V. V. Rao, T. B. Ghosh, K. L. Chopra, Allied Publishers Pvt. Ltd (2001)
4. WJ: -Nuclear Radiation Detection- William James Price, McGraw Hill.
5. MSL: - Particle Accelerators, Livingston, M. S.; Blewett, J.
6. HAE: - Introduction to Nuclear Physics, HA Enge, pp 345-353
7. JY: - Electricity & Magnetism and Atomic Physics Vol. II, J. Yarwood.
8. CNB: - Fundamentals of Molecular Spectroscopy, C. N. Banwell, Tata-McGraw Hill.
9. WL: - Techniques for Nuclear & Particle Physics Experiment- William Leo.
10. WKC: - Rutherford Backscattering Spectrometry, W. K. Chu, J. W. Mayer, M. A. Nicolet, Academic Press.
11. JPS: - A Guide to Materials Characterization and Chemical Analysis, John P. Sibilia, Wiley- VCH; 2 editions.
12. LCF: - Fundamentals of Surface and Thin Film Analysis, L.C. Feldman and J.W. Mayer North Holland Amsterdam Page 49 of 86
13. CBD: - Elements of X-ray diffraction, Cullity, B. D Addison-Wesley Publishing Company, Inc.
14. TP: - Nano: The Essentials: T. Pradeep, TMH Publications.

Teaching plan:

Unit	Title	Teaching methods	Total No. of Lecture
I	Data Analysis for Physical Sciences:	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
II	Vacuum Techniques	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
III	Nuclear Detectors and accelerators	Lecture, Problem solving, Visual Aids, computer simulation, Interactive Discussions.	15
IV	Characterization techniques for material analysis	Lecture, Visual Aids, computer simulation, Interactive Discussions.	15

Evaluation Pattern

A. Continuous Internal Evaluation (40 Marks):

Sr. No.	Particulars	Marks
01	Unit Test	20
02	Assignment	10
03	Active participation in class room and attendance	10

B. Semester End Evaluation (Paper Pattern): (60 Marks)

Question No	Unit	Question Type	Marks
1	I	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 05

Guidelines for pattern for Semester End Evaluation:

1. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
2. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2024-2025

Name of the Course	Project-2
Class	M.Sc.-II
Semester	IV
Course Code	PSPH406
No of Credits	6
Nature	Research Project
Type	Mandatory

Nomenclature: Project

Course Outcomes: On successful completion of this course learners will be able to:

CO-1 Understand the ethics and research methodology.
CO-2 Do a literature review.
CO-3 Identify research problem and do research.
CO-4 Analyze the research work data.
CO-5 Write research article.

Curriculum:

Title	Learning Points
Project-2	Identifying problem for project work, literature survey, deciding methodology, practical implementation of the Project, data analysis and conclusions, preparing project report (a dissertation).

Learning Resources recommended:

1. Previous Project Literature.
2. Internet.
3. Research Publications.
4. Project related references

Teaching plan:

Title	Teaching methods	Total No. of lecture
Identifying problem for project work, literature survey	Discussion, literature review, Presentation	40
Deciding methodology and practical implementation of the Project	Discussion, Experimental work	80
Data analysis (if any) and conclusions, preparing project report (a dissertation).	Presentation and discussion	60

Evaluation Pattern

A. Continuous Internal Evaluation: (60 Marks)

Method	Marks
Lab performance	50
Presentation	10

B. Semester End Evaluation (Paper Pattern): (90 Marks)

Sr No	Criteria	Marks
1	Experimental/Theoretical methodology/Working condition of project or model	25
2	Significance of the study/Societal application and inclusion of recent References	15
3	Depth of knowledge in the subject / Results and discussions	15

4	Project Report	15
5	Presentation	20

Project guidelines:

1. Every learner will have to complete one project in Semester III with four credits (100 marks) and Semester IV with six credits (150 marks) .
2. Learners can take one long project or two short projects.
3. 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.
4. 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.
5. Maximum three learners can do a joint project. Each one of them will submit a separate project report with details.
6. In case of electronic projects, use of readymade electronic kits available in the market should be avoided.
7. The electronics project / models should be demonstrated during presentation of the project.
8. In case a learner 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.
9. Each project will be evaluated with a 40% continuous evaluation and a 60% semester-end evaluation.
10. The project report should be file bound/spiral bound/hard bound

Format of Project Report:

a) **Title Page:**

Mentioning the title of the report, name of the learner, program, institution, and the project.

b) **Certificate of Completion:**

A certificate issued by guide confirming the successful completion of the project.

c) **Declaration:**

A statement by the learner declaring that the report is the original work and acknowledging any assistance or references used.

d) **Acknowledgments:**

Recognizing individuals or organizations that provided support, guidance, or resources during the training/project.

e) **Table of Contents:**

Providing a clear outline of the report's sections and page numbers.

f) **Abstract:**

A bird’s eye view of learner’s entire presentation has to be precisely offered under this category. A brief overview of the project, its objectives and key findings should be mentioned.

g) **Introduction:**

Background information about the project and its significance. Objectives and scope of the project.

h) Literature Review:

Overview of relevant literature and studies related to the chosen field and development issues.

i) Methodology:

Description of: Planning of experimental procedure as per the need of the project. Designing and implementation of the project as per the objectives through theoretical, experimental or computational methods.

j) Observations and data analysis:

Details of Testing, debugging, troubleshooting as per the need. Data collection and analysis.

k) Conclusion:

Summary of the key findings and outcomes of the project.

l) References & **Appendices:**

List of all sources cited in the project report. Additional supporting materials.

The project report shall be prepared as per the broad guidelines given below:

- Font type: Times New Roman,
- Font size: 12-For content, 14-for Title
- Line Space: 1.5-for content and 1-for in table work, Justified format
- Page Size: A4
- Margin: in Left-1.5, Up-Down-Right-1
- The Project Report shall be hard bounded.

Format

1st page (Main Page)

Title of the problem of the Project

A Project Submitted

to

R. P. Gogate college of Arts & Science and

R.V. Jogalekar College of Commerce College (Autonomous)

under

University of Mumbai

for partial completion of the degree

of

Master in Science

Under the Faculty of science

By

Name of Learner

Under the Guidance of

Name of the Guiding Teacher

R. P. Gogate college of Arts & Science and

R.V. Jogalekar College of Commerce College (Autonomous),

Ratnagiri

<Month and Year>

On separate page

Index

Sr No	Title	Page No.
01		
02		
03		
04		
05		

On separate page

Declaration by learner

I the undersigned Miss/Mr. _____ [Name of the learner] here by, declare that work embodied in this project work titled _____ forms my own contribution to the research work carried out under the guidance of [Name of the guiding teacher] _____ is a result of my own project / research work and has not been previously submitted to any other University for any other Degree/ Diploma to this or any other University.

Wherever reference has been made to previous works of others, it has been clearly indicated as such and included in the bibliography.

I, here by further declare that all information of this document has been obtained and presented in accordance with academic rules and ethical conduct.

Name and Signature of the learner

Certified by

Name and signature of the Guiding Teacher

On separate page

Acknowledgment

(To be written by learner)

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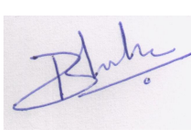

Chairperson
BoS Physics