Academic Council Meeting No. 09, **Date: July 02, 2024**
Agenda Number: 03 **Resolution Number: 41,42/ 3.14, 3.24**

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science
(Autonomous), Thane

Syllabus for

Programme: Master of Science

Specific Programme: BPPH

Programme: Master of Science Specific Programme: Physics

[M.Sc. Physics II (Semester III and IV)]

Level 6.5

CHOICE BASED GRADING SYSTEM

Revised under NEP 2020

From academic year 2024-25

Preamble

The systematic and planned curricula of the M.Sc. Physics degree is a unique and multidisciplinary Programme that provides theoretical and applied knowledge in a range of subjects, including physics, Statistical mechanics, Nuclear Physics, Experimental Physics, Atomic and Molecular Physics, Microcontrollers and interfacing, Embedded Systems, VHDL and ARM7, Python and Arduino Interfacing, laser and 3D PRINTING, electronics, optics, mathematics, classical and quantum etc

The curriculum for the M. Sc. (Physics) programs me is designed to cater to the requirement of Choice Based Credit System following the University Grants Commission (UGC) guidelines. In the proposed structure, due considerations given to Elective Courses (Discipline Specific-Physics).

Furthermore, continuous assessment is an integral part of the CBCS, which will facilitate systematic and thorough learning towards better understanding of the subject. The systematic and planned curricula divided into one years (comprised of two semesters)

Dr. Sangita S. Meshram
Chairperson, BOS Physics
VPM's B. N. Bandodkar College of Science (Autonomous), Thane

PROGRAMME OUTCOMES (POs) OF MASTER OF SCIENCE (M.Sc.)

The Postgraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

- **PO1 – Domain Knowledge**

  Comprehend and demonstrate domain knowledge in specialized branch of science. Instil ability to apply it in upgrading professional, social and personal life.

- **PO2 – Development of Research Competence**

  Imbibe skills related to identification of research problem, formulating hypothesis, execution of research process, analysing data, interpreting the data, drawing conclusion and presenting research work. Encourage learners for doctoral studies.

- **PO3 - Digital Literacy**

  Enhance ability to access, select and use a variety of relevant information e-resources for creating new knowledge resources.

- **PO4 - Sensitization towards Environment**

  Build cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

- **PO5 - Individuality and Team work**

  Encourage learner to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

- **PO6 – Competence for Employment**

  Promote field work, internships, industrial training, research projects, research paper presentations and publications to develop competence for adapting towards dynamic socio-economic changes and make learner employable.

Eligibility: B.Sc. Physics Pass
Duration: 2 years (Syllabus for M.Sc. Second year semester III & IV)
Mode of Conduct: Offline lectures/ Online lectures
Discipline/Subject: Physics
Specific Programme: M.Sc. PHYSICS
Level: 6.5
Qualification Title: PG Degree

Discipline/Subject: PHYSICS

PROGRAM SPECIFIC OUTCOMES-PHYSICS		
1.	**PSO1 – Remember & Understand** Demonstrate in-depth understanding of **fundamental and advanced concepts of physics**.	L1
2.	**PSO2 – Apply** Apply theoretical and experimental physics principles to **solve physical problems and perform laboratory experiments**.	L2
3.	**PSO3 – Analyze** Analyze experimental and theoretical data using **mathematical, computational, and statistical tools**.	L3
4.	**PSO4 – Evaluate** Evaluate physical models, experimental results, and research literature **critically and scientifically**.	L4
5.	**PSO5 – Create** Design and execute **independent research projects**, including experimental design and scientific reporting.	L5
6.	**PSO6 – Professional & Ethical Practice** Demonstrate **ethical conduct, laboratory safety, teamwork, and effective scientific communication**.	L6
Specific Programme: M. Sc. (PHYSICS)		

Assessment: Weightage for assessments (in percentage) For Major

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40%	60%

B.N. Bandodkar College of Science, (AUTONOMOUS)-Thane										
Master program in Physics										
Year (2Yr)	**LEVEL**	**SEMESTER**	**Major**			**Research Methodology**	**On Job Training /Field project**	**Research project**	**Cum Credits**	**Degrees**
			Mandatory		**Electives anyone**					
I	**6.0**	SEM-I	**3*4 + 2 = 14**		Credits4	**Credits 4**	NA	NA	22	PG Diploma in Physics (After 3Yrs.degreeUG)
			Course 1	Credits 4	Course 1= Credits 4					
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 = Credits 4					
			Course 4	Credits 2	**OR**					
		SEM-II	Course 1	Credits 4	Course 1 = Credits 4	NA	**Credits 4**	NA	**22**	
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 = Credits 4					
			Course 4	Credits 2	**OR**					
CumCr.for1 Yr.PG Diploma			**28**		8	4	4		44	
II	**6.5**	SEM-III	Course 1	Credits 4	Course 1 Credits 4	NA	NA	**Credits 4**	22	Master programming Physics (After3 Yrs. Degree UG)
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 Credits 4					
			Course 4	Credits 2	**OR**					
		SEM IV	Course 1	Credits 4	Course 1 Credits 4	NA	NA	**Credits 6**	**22**	
			Course 2	Credits 4	**OR**					
			Course 3	Credits 4	Course 2 Credits 4					
					OR					
Cum Cr. for integrated 1Yr.PG Degree				**26**	**8**			**10**	**44**	
Cum Cr. for2 Yr.PG Degree				**44**	**16**	**4**	**4**	**10**	**88**	

Sr. No	Heading	Particulars
1	Title of the Course	**M.Sc. Physics**
2	Eligibility for Admission	**B.Sc. Physics** or equivalent qualification from other universities as may have been allowed by the relevant ordinances of This university
3	Passing Marks	40%
4	No. of Years/ Semesters	Two
5	Level	PG
6	Level	PG
7	Pattern	Semester
8	i) Cum Cr. for integrated 1Yr.PG Degree ii) PG Diploma in Physics (After 3Yrs.degree UG) and Cum Cr. for 2 Yr. PG Degree iii) Master programming Physics (After 3 Yrs. degree UG)	

SYLLABUS STRUCTURE

YEAR	COURSE TYPE	COURSE CODE	COURSETITLE	CREDITS
M.Sc. II Sem-III	Mandatory Course-I	24BPPH3T01	Statistical Mechanics	04
	Mandatory Course-II	24BPPH3T02	Nuclear Physics	04
	Mandatory Course-III	24BPPH3T03	Python and Introduction to Arduino	04
	Mandatory Course Practical	24BPPH3P01	Practical LAB-I based on 24BPPH3T03	02
	Elective 1	24BPPH3T04	Microcontrollers and Interfacing	02
		24BPPH3P02	Practical LAB-EI-1 based on 24BPPH3T04	02
	OR			
	Elective 2	24BPPH3T05	C++ Language And Embedded Systems	02
		24BPPH3P03	Practical LAB-EI-2 based on 24BPPH3T05	02
	RP	24BPPH3RP2	Research Project in Physics I	04
	Total			**22**
M.Sc. II Sem-IV	Mandatory Course-I	24BPPH4T01	Experimental Physics	04
	Mandatory Course-II	24BPPH4T02	Atomic and Molecular Physics	04
	Mandatory Course-III	24BPPH4T03	Laser and Introduction of 3D printing	04
	Elective1	24BPPH4T04	ARM 7	02
		24BPPH4P01	Physics LAB-EI-1 based on 24BPPH4T04	02
	OR			
	Elective2	24BPPH4T05	VHDL	02
		24BPPH4P02	Physics LAB-EI-2 based on 24BPPH4T05	02
	RP	24BPPH4RP2	Research Project in Physics II	06
	Total			**22**

SEMESTER–III

Course Paper-I	Course Code: 24BPPH3T01	Course Title: Statistical Mechanics	Credit: 4	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-40)	Semester End Examination (Marks-60)
04	NA	–	04	40	60

Learning Objectives

Course Outcomes:

CO1	Summarize macroscopic thermodynamic properties from microscopic states	L2
CO2	Apply canonical ensemble theory to classical and magnetic systems.	L3
CO3	Apply grand canonical ensemble concepts to systems in contact with a particle-energy reservoir.	L3
CO4	Summarize ensembles of indistinguishable particles.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	1	0	0	0	0	0
CO3	1	0	0	0	0	0
CO4	2	0	0	0	0	0

UNITI	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	**15**
UNIT II	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, statistic of paramagnetism, thermodynamics of magnetic systems	**15**

UNIT III	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.	**15**
UNIT 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	**15**

Main Reference:

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

Additional references:

1. Thermodynamics and Statistical Mechanics, Greiner, Neise and Stocker, Springer 1995.
2. Introduction to Statistical Physics, Kerson Huang , Taylor and Francis 2001.
3. Thermal and Statistical Physics, F Reif.
4. Statistical Physics, D Amit and Walecka.
5. Statistical Mechanics, Kerson Huang.
6. Statistical Mechanics, J.K. Bhattacharjee.
7. Non-equilibrium Statistical Mechanics, J.K. Bhattacharjee.
8. Statistical Mechanics, Richard Feynman.
9. Statistical Mechanics, Landau and Lifshitz.
10. Thermodynamics, H.B.Callen

Course: Paper- II	Course Code: 24BPPH3T02	Course Title: Nuclear Physics	Credit=4	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment(CA) Internal(Marks-40)	Semester End Examination (Marks-60)
04	NA	–	04	40	60

Learning Objectives

Course Outcomes:

CO1	Explain the Nuclear properties, nuclear interactions, and energy release in fusion and fission reactions.	L2
CO2	Summarise the principles of alpha, beta, and gamma decay and interactions of radiation with matter	L2
CO3	Illustrate the nuclear models and mechanisms of nuclear reactions.	L2
CO4	Explain the fundamental concepts of elementary particle physics.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNITI	All static properties of nuclei (charge, mass, binding energy, size, shape, angular momentum, magnetic dipole momentum, electric quadrupole momentum, statistics, parity, isospin), Measurement of Nuclear size and estimation of R0 (mirror nuclei and mesonic atom method) Q-value equation, energy release in fusion and fission reaction. 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. **Tutorials should include 3 problem solving session based on above mentioned topics**	**15**

UNIT II	Review of alpha 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. **Tutorials should include 4 problem solving session based on above mentioned topics**	**15**
UNIT III	1. Nuclear Models: Shell Model (extreme single particle): Introduction, Assumptions, Evidences, Spin-orbit interactions, Predictions including Schmidt lines, limitations, Collective model - Introduction to Nilsson Model. 2. Nuclear Reactions: Kinematics, scattering and reaction cross sections, Compound nuclear reaction, direct nuclear reaction. **Tutorials should include 4 problem solving session based on above mentioned topics**	**15**
UNIT IV	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 Chromo dynamics. Weak interactions and Unification Schemes (qualitative description), 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. **Tutorials should include 4 problem solving session based on above mentioned topics**	**15**

Main Reference:

1. Introductory Nuclear Physics, Kenneth Krane, Wiley India Pvt. Ltd.
2. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, Robert Eisberg
3. and Robert Resnick, Wiley (2006)
4. Introduction to Elementary Particles, David Griffith, John Wiley and sons.

Additional references:

1. Introduction to Nuclear Physics, H. A. Enge, Eddison Wesley
2. Nuclei and Particles, E. Segre, W. A. Benjamin
3. Concepts of Nuclear Physics, B. L. Cohen
4. Subatomic Particles, H. Fraunfelder and E. Henley, Prentice Hall
5. Nuclear Physics : Experimental and Theoretical, H. S. Hans, New Age International
6. Introduction to Nuclear and Particle Physics, A. Das & T. Ferbel, World Scientific
7. Introduction to high energy physics, D. H. Perkins, Addison Wesley
8. Nuclear and Particle Physics, W. E. Burcham and M. Jones, Addison Wesley
9. Introductory Nuclear Physics, S. M. Wong, Prentice Hall.
10. Nuclear Physics: An Introduction, S. B. Patel, New Age International.
11. Nuclear Physics : S. N. Ghoshal
12. Nuclear Physics: Roy and Nigam

Course: Paper-III	Course Code: 24BPPH3T03	Course Title: Python and Introduction to Arduino	Credit: 4	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-40)	Semester End Examination (Marks-60)
04	NA	–	04	40	60

Course Outcomes:

CO1	Develop Python programs to solve computational problems effectively	L3
CO2	Develop Python programs to efficiently store, manipulate, and process data for solving computational problems.	L3
CO3	Build an interface of Arduino with various sensors and motors.	L3
CO4	Develop interactive display and communication-based embedded systems using Arduino.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNITI	**Introduction to Python Programming:** The Python Programming Language. What Is a Program? What Is Debugging? Formal Natural Languages, The First Program. Variables, **Expressions Statements:** Values Types, Variables, Variable Names Keywords, Statements, Evaluating Expressions, Operators Operands, Order of Operations, Composition. Conditionals The Modulus Operator, Boolean Expressions, Logical Operators, Conditional Execution, Alternative Execution, Chained Conditionals, Nested Conditionals, The Return Statement, Recursion, Stack Diagrams for Recursive Functions, Infinite Recursion, Keyboard Input. **Functions:** Function Calls, Type Conversion, Type Coercion, Math Functions, Composition, Definitions Use, Flow of Execution, Parameters Arguments, and Variables Parameters Are Local, Stack Diagrams, and Functions with Results.Recursion **WP:Ch:**1,2,3	**15**

UNIT II	**Strings, Lists, Tuples, Dictionaries:** **Strings**: A Compound Data Type, Length, Traversal the for Loop, String Slices, String Comparison, Strings Are Immutable, a Find Function, Looping Counting, The String Module, Character Classification. **Lists:** List Values, Accessing Elements, List Length, List Membership, Lists for Loops, List Operations, List Slices, Lists Are Mutable, List Deletion, Objects Values, Aliasing, Cloning Lists, List Parameters, Nested Lists, Matrices, Strings Lists. **Tuples:** Mutability Tuples, Tuple Assignment, Tuples as Return Values, Rom Numbers, List of Rom Numbers, Counting, Many Buckets, a Single Pass Solution, Dictionaries: Dictionary Operations, **Dictionary** Methods, Aliasing Copying, Sparse Matrices, Long Integers, Counting Letters. **WP:Ch:4,6**	**15**
UNIT III	**Introduction to Arduino Interfacing to sensors:** Sensors- Definition, Types. **Interfacing Arduino to different sensors-** light sensor, temperature sensor, humidity sensor, pressure sensor, sound sensor, distance ranging sensor, water/detector sensor, smoke, gas, alcohol sensor, ultrasonic range finder. **Motor control:** DC motors- Speed control, spin direction control. Servo motors- Speed control, direction control, Steppers **Ref:** MR:Ch:05; Ch 7 Proj 19; Ch -9 Proj- 25; Ch – 10 Proj-28; Ch -11 Proj- 31; Ch -13 Proj 36,37; ch-14 Proj-38.	**15**
UNIT IV	**Displays:** Basics of LED's and LCD's. Interfacing Arduino to LED's- blinking single LED, blinking multiple LED's, 7 segment display , traffic light ,LED flashes ,LED dot matrix ,pulsating lamp. **Interfacing to LCD's**- Basic LCD control, LCD temperature control, display a message on LCD screen, scrolling of text Touch screens, Reading and writing to SD card. **Communication over Ethernet:** Ethernet shield, internet weather, display, e-mails alert system, twitter bot, RSS weather reader. **Ref:** MR: Ch- 08 Proj. 23, 24; Ch- 5 Proj.42; Ch.17 Proj 46. 47 48 and 49,50	**15**

Main Reference:

1. WP:Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015,
2. MR: Michal Mc Roberts “Beginning Arduino” Second Edition, Technology in Action.

Additional references:

1. ISBN: 978-1593275990.
2. Official Python Web Site: Https://Www.
3. Python.Org. Think Python by Allen Downey.
4. Python Programming Fundamentals - a Beginner's Hbook by Nischay Kumar Hegde.
5. Python Programming by M Radhika Mani B N Jagadesh Ch Satyanarayana
6. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, 2nd Edition,Green Tea Press, 2015, ISBN: 978-9352134755.
7. Charles Dierbach, "Introduction to Computer Science Using Python", 1st Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014.
8. Wesley J Chun, “Core Python Applications Programming”, 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365.
9. “Beginning Arduino”, Michal Mc Roberts, Second Edition.
10. Massimo Banzi, “Getting started with Arduino” 2 nd Edition, Orelly 2011

Course:	Course Code: 24BPPH3P01	Course Title: Practical LAB-I based on 24BPPH3T03	Credit = 2	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-40)	Semester End Examination (Marks-50)
-	4	–	02	-	50

Course Outcomes:

CO1	Develop Python programs to manipulate the data structures.	L3
CO2	Develop Arduino-based environmental monitoring and control systems.	L3
CO3	Develop sensor-based safety and alert systems.	L3
CO4	Develop actuators and display modules with Arduino	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

1.	Write a function to reverse a string without using built-in string reversal methods.
2.	Create a program that takes a string as input and counts the frequency of each character, ignoring case sensitivity.
3.	Implement a function to find the maximum and minimum elements in a list without using built-in functions like max() and min().
4.	Write a program that removes duplicates from a given list while preserving the order of elements.
5.	Create a function that takes a dictionary of student grades and returns the names of students who have passed (grade >= 60).
6.	Write a recursive function to calculate the factorial of a given number.
7.	Write a program to generate a list of squares of numbers from 1 to 10 using list comprehension.
8.	Design and implement a simple calculator program that supports basic arithmetic operations (addition, subtraction, multiplication, division) and handles division by zero and invalid

	inputs.
9.	Light Sensor Interfacing: I. Reading ambient light intensity. II. Controlling LEDs based on light intensity.
10.	Temperature Sensor Interfacing: I. Reading temperature values. II. Displaying temperature on LCD. III. Controlling a fan or heater based on temperature. IV. Design a cooling system for electronic equipment.
11.	Humidity Sensor Interfacing: I. Reading humidity values. II. Displaying humidity on LCD. III. Indicate the different level of humidity.
12.	Water/Fluid Detector Sensor Interfacing: I. Detecting water presence. II. Activating a pump or alarm when water is detected.
13.	Gas/Smoke/Alcohol Sensor Interfacing: I. Detecting gas/smoke/alcohol presence. II. Triggering an alarm or sending an alert message.
14.	Stepper Motors: I. Controlling stepper motor for precise movements. II. Implementing motion sequences for robot control.
15.	LCD Interfacing: I. Basic control of LCD. II. Displaying sensor data (temperature, humidity) on LCD, Scrolling text on LCD.

Course Paper-IV	Course Code: 24BPPH3T04	Course Title: Microcontrollers and Interfacing	Credit=2	No. of lecture Hrs. in (30)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal(Marks-20)	Semester End Examination (Marks-30)
02	02	–	04	20	30

Course Outcomes:

CO1	Summarise the utilization of PIC microcontroller	L2
CO2	Build an interface of 8051 and PIC microcontrollers with peripheral devices.	L3
CO3	Develop the assembly programs using 8051 microcontroller I/O ports.	L3
CO4	Analyse the performance of various input/output devices and sensors with microcontrollers.	L4

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	5	0
CO4	2	0	0	0	5	0

UNIT I	**16C61/71 PIC Microcontrollers:** Overview and Features, PIC 16C6X/7X, PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organization, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71Timers, PIC 16C71 Analog-to-Digital Converter. **Ref:** AVD – Ch 9. **PIC 16F8XX Flash Microcontrollers:** Introduction, Pin Diagram, STATUS Register, Power Control Register (PCON), OPTION_REG Register, Program memory, Data memory, I/O Ports **Ref:** AVD – Ch 10: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.10 Capture/Compare/PWM (CCP) Modules in PIC 16F877, Analog-to-Digital Converter. **Ref:** AVD – Ch 11: 11.1, 11.2, 11.5	**15**

UNIT II	**8051 microcontroller: (Review of 8051), Timer/Counters, Interrupts, Serial communication:** Programming 8051 Timers, Counter Programming Basics of Serial Communication, 8051 Interrupts, Programming Timer Interrupts, Page 41 of 112 Programming External hardware Interrupts, Programming the Serial Communication Interrupt, Interrupt Priority in 8051/52. **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 (For DC motor interfacing and PWM refer Sec 17.3 of MMM) **Ref:** AVD: ch.12, 13. **Ref:** MMM: Sec 17.3	**15**

References:

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

Course:	Course Code: 24BPPH3P02	Course Title: Practical LAB-EI-1 based on 24BPPH3T04	Credit = 2	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-40)	Semester End Examination (Marks-50)
-	4	–	02	-	50

Course Outcomes:

CO1	Develop visual output systems with microcontroller.	L3
CO2	Build input devices and analog-to-digital converters with microcontrollers.	L3
CO3	Develop assembly language program to control stepper motors using microcontrollers.	L3
CO4	Develop assembly language programs for arithmetic, data manipulation and interrupt handling.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

	1. Interfacing LED's: flashing LED's, to display bit pattern, 8-bit counter.
	2. Interfacing of 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) to the PIC micro-controller.
	4. Interfacing Push Buttons: to increment and decrement the count value at the output by recognizing of push buttons.
	5.Interfacing stepper motor with 8031/51 to control direction, speed and number of steps.
	6. Study of 8051 assembly language programming (Addition, subtraction, multiplication division of 8 bits)
	7.Study of 8051 assembly language programming (00 To FF Display ,32 bit rotation , 00 – 99 display, cube of 01 to 08, find the largest no & multiply).

	8.Study of IN & OUT port of 8051 by interfacing.
	9.Study of External interrupts (INTO0/INT1) of 8051.

References :

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

Course Paper-V	**Course Code: 24BPPH3T05**	**Course Title: C++ Language And Embedded Systems**		**Credit=2**	**No. of lecture Hrs. in (30)**
Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-20)	Semester End Examination (Marks-30)
02	02	–	04	20	30

Course Outcomes:

CO1	Develop C++ programs using control structures, functions, arrays, pointers, and object-oriented concepts.	L3
CO2	Develop practical solutions for real-world devices using Embedded systems.	L3
CO3	Develop C++ programs applying fundamental programming.	L3
CO4	Develop GUI-based application development using Visual C++.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	**Programming Using C++:** Expressions and interactivity , Making decisions, Looping , Functions , Arrays , Sorting arrays , Pointers **Ref:** TG - Ch 3,4,5,6,7,8,9 **Introduction to classes:** More about classes, Inheritance, polymorphism, virtual functions. **Ref:** TG – Ch 13: 13.1 to 13.11, Ch 14: 14.1 to 14.5, Ch 15: 15.1 to 15.6 **Introduction to VC++** **Ref:** YK – Ch 1, 2, 3	**15**

UNIT II	**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 **Ref:** SKV – Ch 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7 **Characteristics and quality Attributed of Embedded Systems:** Characteristics of an Embedded System, Quality Attributes of Embedded Systems **Ref:** SKV – Ch 3: 3.1, 3.2 **Embedded Systems-Application and Domain–Specific:** Washing Machine, Automatic- Domain, Specific examples of embedded system **Ref:** SKV – Ch 4: 4.1, 4.2 **Design Process and design Examples:** Automatic Chocolate Vending machine (ACVM), Smart Card, Digital Camera, Mobile Phone, A Set of Robots **Ref:** RK - Ch 1: 1.10.2, 1.10.3, 1.10.4, 1.10.5, 1.10.6, 1.10.7	**15**

Reference:

1. TG: - Starting out with C++ from Control structures through objects, by Tony Gaddis, Sixth edition Penram International Publications, India
2. YK: - Introduction to Visual C++ by Yashwant Kanetkar
3. SKV:- Introduction to embedded systems, by Shibu K. V. ,Sixth Reprint 2012, Tata McGraw Hill
4. RK:- “Embedded Systems” Architecture, Programming and Design, by Raj Kamal, Second Edition, The McGraw-Hill Companies

Course:	Course Code: 24BPPH3P03	Course Title: Practical LAB-EI-2 based on 24BPPH3T05		Credit = 2	No. of lecture Hrs. in (60)
Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-40)	Semester End Examination (Marks-50)
-	4	–	02	-	50

Course Outcomes:

CO1	Develop C++ programs using structured programming concepts.	L3
CO2	Apply object-oriented programming principles to design modular and reusable C++ programs.	L3
CO3	Develop Visual C++ programme to enhance user interaction and program usability.	L3
CO4	Develop C++ for reliable software development.	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

1. C++ Program: Base conversion
2. C++ Program: Roots of quadratic equation
3. C++ Program: Mean variance, standard, deviation.
4. C++ Program: Operator & Function overloading.
5. C++ Program: Class, Inheritance.
6. Visual C++ Programming

References:

1. Ref: YK: - Introduction to Visual C++ by Yashwant Kanetkar
2. Ref: TG: - Starting out with C++ from Control structures through objects, by Tony Gaddis, Sixth

edition Penram International Publications, India.

Course: Paper-I	**CourseCode:2 4BPPH3RP2**	**Course Title: Research Project in Physics- I**		**Credit = 4**	**No of lecture Hrs. in (120)**
Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment(CA) Internal (Marks-40)	Semester End Examination (Marks-60)
08	-	–	04	40	60

Course Outcomes:

CO1	Analyse the research problem.	L4
CO2	Choose a Scientific methodology.	L5
CO3	Develop a research technique.	L6
CO4	Demonstrate an innovative and evidence-based solution.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

Learning Objectives

- Students will learn various research methodologies including qualitative, quantitative, and mixed methods approaches.
- Students will develop the skills to formulate clear and concise research questions that address a gap in the existing literature.
- Students will develop critical thinking skills to evaluate research findings, identify limitations, and suggest areas for future research.
- Understand the significance of the research project within the broader academic or practical context of the field of study.
- Learn to manage time, resources, and deadlines to ensure the successful completion of the research project within the allotted timeframe.

SEMESTER – IV

Course: Paper- I	Course Code: 24BPPH4T01	Course Title: Experimental Physics	Credit=4	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment(CA) Internal(Marks-40)	Semester End Examination (Marks-60)
04	NA	–	04	40	60

Course Outcomes:

CO1	Interpret experimental data using statistical and probabilistic methods	L3
CO2	Explain the principles of vacuum science	L2
CO3	Illustrate the working principles and applications of nuclear detectors and particle accelerators.	L2
CO4	Explain the principles and applications of spectroscopic and microscopic techniques used for material characterization	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	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, Random errors, Uncertainty in measurement.	**15**
UNIT II	Vacuum Techniques: Fundamental processes at low pressures, Mean Free Path, Time to form monolayer, Number density, Materials used at low pressures, vapor 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	**15**

UNIT III	Nuclear Detectors: Gamma ray spectrometer using NaI scintillation detector, High Purity Germanium detector, Multi-wire Proportional counters Accelerators: Cockroft Walton Generator. Van de Graff Generator, Sloan and Lawrence type Linear Accelerator, Proton Linear Accelerator, Cyclotron and Synchrotron.	**15**
UNIT IV	Characterization techniques for materials analysis: 1. Spectroscopy: XRD, XRF, XPS, EDAX, Raman, UV Visible spectroscopy, FTIR spectroscopy. 2. Microscopy: SEM, TEM, AFM	**15**

Main Reference:

1. Data Analysis for Physical Sciences (Featuring Excel®) Les Kirkup, 2nd Edition, Cambridge University Press (2012), Chapters 1-6 and 9
2. Vacuum Technology, A. Roth, North Holland Amsterdam
3. Ultra High Vacuum Techniques, D. K. Avasthi, A. Tripathi, A. C. Gupta, AlliedPublishers Pvt. Ltd (2002)
4. Nuclear Radiation Detection- William James Price , McGraw Hill
5. Techniques for Nuclear and Particle Physics Experiments, W.R. Leo, Springer-Verlag
6. Radiation Detection and Measurement, Glenn F. Knoll, John Wiley and sons,Inc.
7. Particle Accelerators, Livingston, M. S.; Blewett, J.
8. Introduction to Nuclear Physics, HA Enge, pp 345-353
9. An Introduction to Materials Characterization, Khangaonkar P. R., Penram International Publishing
10. Rutherford Backscattering Spectrometry, W. K. Chu, J. W. Mayer, M. A. Nicolet, Academic Press
11. A Guide to Materials Characterization and Chemical Analysis, John P. Sibilia, Wiley- VCH; 2 edition

Course: Paper- II	Course Code: 24BPPH4T02	Course Title: Atomic and Molecular Physics	Credit=4	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment(CA) Internal(Marks-40)	Semester End Examination (Marks-60)
04	NA	–	04	40	60

Course Outcomes:

CO1	Explain atomic energy levels and spectral effects using quantum mechanical principles.	L2
CO2	Illustrate the structure and spectral characteristics of multi-electron atoms using quantum mechanical principles.	L2
CO3	Summarise the interaction of atoms with electromagnetic radiation to evaluate transitions, spectral lines, and related atomic properties.	L2
CO4	Explain the principles of molecular spectroscopy and magnetic resonance techniques to interpret molecular and atomic properties.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	Review of one-electron eigenfunction and energy levels of bound states, Probability density, Virial theorem. Fine structure of hydrogenic atoms, Lamb shift. Hyperfine structure and isotope shift. (ER 8-6) Linear and quadratic Stark effect in spherical polar coordinates. Zeeman effect in strong and weak fields, Paschen-Back effect. (BJ, GW) Schrodinger equation for two electron atoms: Identical particles, The Exclusion Principle. Exchange forces and the helium atom (ER), independent particle model, ground and excited states of two electron atoms. (BJ)	**15**
UNIT II	The central field, Thomas-Fermi potential, the gross structure of alkalis (GW). The Hartree theory, ground state of multi-electron atoms and the periodic table (ER), 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 (GW)	**15**

UNIT III	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. (BJ)	**15**
UNIT IV	Born-Oppenheimer approximation - rotational, vibration 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 (GA, IL) 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: vibration energy levels of diatomic molecules, simple harmonic and an harmonic oscillators, diatomic vibrating rotator and vibration-rotational spectra. c) Electronic spectra of diatomic molecules: vibration and rotational structure of electronic spectra. (GA, IL) Quantum theory of Raman effect, Pure rotational Raman spectra, Vibration 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. (GA, IL)	**15**

Main Reference:

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

Additional references:

1. Leighton, Principals of Modern Physics, McGraw hill
2. Igor I. Sobelman, Theory of Atomic Spectra, Alpha Science International Ltd. 2006
3. C. N. Banwell, Fundamentals of molecular spectroscopy, Tata McGraw-Hill, 3rd ed

Course Paper- III	Course Code: 24BPPH4T03	Course Title: Laser and Introduction of 3D printing	Credit=4	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment(CA) Internal(Marks-40)	Semester End Examination (Marks-60)
04	NA	–	04	40	60

Course Outcomes:

CO1	Illustrate the principles and working of different types of lasers.	L2
CO2	Explain the principles and applications of nonlinear optical mixing techniques.	L2
CO3	Explain the principles, processes, and applications of 3D printing	L2
CO4	Explain the principles, processes, and applications of liquid-based 3D printing technologies	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT I	**Basic Principle and Different Lasers:** Principle and Working of CO2 laser and Qualitative Description of Longitudinal and TE laser systems. Threshold condition for Oscillation in Semiconductor Laser. Homo structure and Hetero structure p–n junction lasers, Nd-YAG lasers. Principle of Excimer Laser. Principle and Working of Dye Laser. Free Electron Laser. 1:WD5:ch 9 and ch10	**15**
UNIT II	**Nonlinear Optical Mixing Techniques** Physical Background Phase Matching Second-Harmonic Generation Quasi Phase Matching XVI Contents Sum-Frequency and Higher-Harmonic Generation X-Ray Lasers Difference-Frequency Spectrometer Optical Parametric Oscillator Tunable Raman Lasers. 2:WD4 :ch 5 : 5.8	**15**

UNIT III	**Introduction to 3D Printing :** Introduction to Design, Prototyping fundamentals. Introduction to 3D printing, its historical development, advantages. Commonly used terms, process chain, 3D modeling, Data Conversion, and transmission, Checking and preparing, Building, Post processing, RP data formats, Classification of 3D printing process, Applications to various fields. **CLL:**ch: 1:1.1 to 1.6, 2.1 to2.6	**15**
UNIT IV	**Liquid Based3DPrinting :** **Stereo lithography apparatus (SLA):** Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. **Solid ground curing (SGC):** Models and specifications, process, working, principle, applications, advantages and disadvantages, case studies. **Solid Based 3D Printing:** **Laminated object manufacturing (LOM) and Fused Deposition Modeling(FDM):** Models and specifications, Process, Working principle, Applications, Advantages and disadvantages, Case studies, practical demonstration Ref: KGC: Ch:1: 8.1 to 8.5, Ch:9: 9.1 to 9.6 and Ch:10:10.1 to 10.5	**15**

Main Reference:

1. WD5:Laser Spectroscopy and Instrumentation: "W. Demtroder" 5th Edition.
2. WD4: Laser Spectroscopy and Instrumentation: "W. Demtroder" 4th Edition.
3. CLL: Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010
4. KGC: Kenneth G. Cooper " Rapid Prototyping Technology Selection and Application"

Additional references:

1. **1**Principles of Lasers : O. Svelto
2. Laser Cooling and Trapping: P.N. Ghosh.
3. Frontiers in Atomic, Molecular and Optical Physics : S.P. Sengupta
4. D.T. Pham and S.S. Dimov, "Rapid Manufacturing", Springer, 2001
5. Terry Wohlers, " Wholers Report 2000", Wohlers Associates, 2000
6. Paul F. Jacobs, " Rapid Prototyping and Manufacturing"–, ASME Press, 1996
7. Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

Course Paper-IV	Course Code: 24BPPH4T04	Course Title: ARM 7	Credit=2	No. of lecture Hrs. in (30)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-20)	Semester End Examination (Marks-30)
02	02	–	04	20	30

Course Outcomes:

CO1	Explain the architecture, organisation, and instruction execution of ARM processors	L2
CO2	Illustrate the Arm assembly language programming.	L2
CO3	Develop and test basic ARM7 programs	L3
CO4	Develop peripheral interfacing with ARM7 microcontroller	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	0	0
CO4	2	0	0	0	0	0

UNIT 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 **ARM Organization and Implementation:** 3 – stage Pipeline, ARM organization, ARM instruction execution, ARM implementation. SF - Ch 4: 4.1, 4.3, 4.4 **ARM Processor Cores:** ARM7TDMI SF – Ch 9: 9.1 only	**15**
UNIT II	**ARM Assembly language Programming:** Data processing instructions, Data transfer instructions, Control flow instructions, Writing simple assembly language programs. SF – Ch 3: 3.1, 3.2, 3.3, 3.4 **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,	**15**

	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, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15 Page 82 of 112 **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, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11 Ref. SF: - ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson	

Main reference :

1. Ref. SF: - ARM System-on-Chip Architecture, by Steve Furber, Second Edition, Pearson

Course:	Course Code: 24BPPH4P01	Course Title: Practical LAB-EI-1 based on 24BPPH4T04	Credit = 2	No. of lecture Hrs. in (60)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-40)	Semester End Examination (Marks-50)
-	4	–	02	-	50

Course Outcomes:

CO1	Develop and test basic ARM7 programs	L3
CO2	Develop peripheral interfacing with ARM7 microcontroller	L3
CO3	Develop I2C-based communication to interface ADC and DAC modules	L3
CO4	Develop VHDL-based control systems to operate motors and relays	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

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.
5. Interfacing relays: write ARM 7code to control ac bulbs (at least two) using relays.
6. Interfacing buzzer: write ARM 7 code
7. Interfacing dc motor: write VHDL code to control direction and speed using PWM.
8. Interfacing relays: write VHDL code to control ac bulbs (at least two) using relays.

Course Paper-V	Course Code: 24BPPH4T05	Course Title: VHDL	Credit=2	No. of lecture Hrs. in (30)

Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-20)	Semester End Examination (Marks-30)
02	02	–	04	20	30

Course Outcomes:

CO1	Illustrate digital hardware using VHDL	L2
CO2	Explain the use of data types, subprograms, attributes, and configuration concepts in VHDL	L2
CO3	Build basic combinational and sequential circuits using VHDL	L3
CO4	Develop VHDL programs to interface VHDL with electromechanical devices	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	0	0	0	0
CO2	2	0	0	0	0	0
CO3	2	0	0	0	2	0
CO4	2	0	0	0	2	0

UNIT I	**VHDL 1** **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. DLP - Ch 1 **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. DLP - Ch 2 **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	**15**

	Expression, WAIT FOR time_ expression, Multiple WAIT Conditions, WAIT Time-Out, Sensitivity List Versus WAIT Statement, Concurrent Assignment Problem, Passive Processes.	
UNIT II	**Data Types:** Object Types, Signal, Variables, Constants, Data Types, Scalar Types, Composite Types, Incomplete Types, File Types, File Type Caveats, Subtypes. DLP - Ch 4 **Subprograms and Packages:** Subprograms Function, Conversion Functions, Resolution Functions, Procedures, Packages, Package Declaration, Deferred Constants, Subprogram Declaration, Package Body. DLP - Ch 5 **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 **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	**15**

Main Reference:

1. Ref. DLP: - VHDL programming by example by Douglas L. Perry, Fourth edition, Tata McGraw- Hill

Course:	Course Code: 24BPPH4P02	Course Title: Practical LAB-EI-2 based on 24BPPH4T05		Credit = 2	No. of lecture Hrs. in (60)
Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) Internal (Marks-40)	Semester End Examination (Marks-50)
-	4	–	02	-	50

Course Outcomes:

CO1	Build basic combinational and sequential circuits using VHDL	L3
CO2	Develop VHDL programs to interface VHDL with electromechanical devices	L3
CO3	Develop VHDL-based control logic to operate stepper and DC motors	L3
CO4	Develop VHDL programs to interface relays	L3

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0

1. Write VHDL programs to realize: logic gates, half adder and full adder
2. Write a VHDL program to realize a 2/3/4 - bit ALU (2- arithmetic,2-logical operations)
3. 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
4. Write VHDL programs to realize the following: SR – Flip Flop, JK – Flip Flop, T – Flip Flop
5. Interfacing stepper motor: write VHDL code to control direction, speed and number of steps.
6. Interfacing dc motor: write VHDL code to control direction and speed using PWM.
7. Interfacing relays: write VHDL code to control ac bulbs (at least two) using relays.

Course :	Course Code: 24BPPH4RP2	Course Title: Research Project - II		Credit = 6	No of lecture Hrs. in (120)
Teaching Scheme		Evaluation Scheme			
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment(CA) Internal (Marks-40)	Semester End Examination (Marks-60)
08	-	–	06	40	60

Course Outcomes:

CO1	Analyse the research problem.	L4
CO2	Choose a Scientific methodology.	L5
CO3	Develop a research technique.	L6
CO4	Evaluate the collected data and research findings	L5
CO5	Compose the research outcomes through written reports, presentations, or prototypes	L6
CO6	Demonstrate an innovative and evidence-based solution.	L2

Grading will be as 3: High(>60%), 2: Moderate(40%-60%), 1: Low(<40%), 0: No mapping

CO1	2	1	0	0	2	0
CO2	2	1	0	0	2	0
CO3	2	1	0	0	2	0
CO4	2	1	0	0	2	0
CO5	2	1	0	0	2	0
CO6	2	1	0	0	2	0

Learning Objectives

- Students will learn various research methodologies including qualitative, quantitative, and mixed methods approaches.
- Students will develop the skills to formulate clear and concise research questions that address a gap in the existing literature.
- Students will develop critical thinking skills to evaluate research findings, identify limitations, and suggest areas for future research.
- Understand the significance of the research project within the broader academic or practical context of the field of study.
- Learn to manage time, resources, and deadlines to ensure the successful completion of the research project within the allotted timeframe.

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

Curriculum Structure for the Undergraduate Degree Programme M.Sc. II Physics

	SEMESTER – I	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
24BPPH3T01	Statistical Mechanics	--	--	√	--	--	--	--
24BPPH3T02	Nuclear Physics	--	--	√	--	--	--	--
24BPPH3T03	Python and Introduction to Arduino	√	√	√	√	--	--	--
24BPPH3P01	Practical LAB-I based on 24BPPH3T03	√	√	√	√	--	--	--
Elective								
24BPPH3T04	Microcontrollers and Interfacing	√	√	√	√	--	--	--
24BPPH3P02	Practical LAB-EI-1 based on 24BPPH3T04	√	√	√	√	--	--	--
OR								
24BPPH3T05	C++ Language And Embedded Systems	√	√	√	√	--	--	--
24BPPH3P03	Practical LAB-EI-2 based on 24BPPH3T05	√	√	√	√	--	--	--
24BPPH3RP2	Research Project in Physics I	√	√	√	√	√	√	√
	Total	**07**	**07**	**09**	**07**	**01**	**01**	**01**

	SEMESTER – II	Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)			Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)			
Course Code	**Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
24BPPH4T01	Experimental Physics	√	--	√	--	--	--	--
24BPPH4T02	Atomic and Molecular Physics	--	--	√	--	--	--	--
24BPPH4T03	Laser and Introduction of 3D printing	√	√	√	√	--	--	--

Elective								
24BPPH4T04	ARM 7	√	√	√	√	--	--	--
24BPPH4P01	Physics LAB-EI-1 based on 24BPPH4T04	√	√	√	√	--	--	--
OR								
24BPPH4T05	VHDL	√	√	√	√	--	--	--
24BPPH4P02	Physics LAB-EI-2 based on 24BPPH4T05	√	√	√	√	--	--	--
23BPIT2P04	On Job Training in Physics / Field Project in Physics	√	√	√	√	√	√	√
	Total	**07**	**06**	**08**	**06**	**01**	**01**	**01**