R. E. Society's

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

Department of Physics
UG Programme 2023-24
Courses & Syllabus

Under Choice Based Credit System (CBCS)

R. E. SOCIETY'S,
R. P. GOGATE COLLEGE OF ARTS & SCIENCE
AND
R. V. JOGALEKAR COLLEGE OF COMMERCE
(AUTONOMOUS),
RATNAGIRI

SYLLABI OF COURSES OFFERED BY DEPARTMENT OF PHYSICS OF THE COLLEGE FOR UNDERGRADUATE AND POSTGRADUATE STUDIES

UNDER
CHOICE BASED CREDIT SYSTEM (CBCS)

WITH THE EFFECT FROM ACADEMIC YEAR 2023-24

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R. E. SOCIETY'S,
R. P. GOGATE COLLEGE OF ARTS & SCIENCE
AND
R. V. JOGALEKAR COLLEGE OF COMMERCE
(AUTONOMOUS),
RATNAGIRI

SYLLABI OF COURSES OFFERED BY DEPARTMENT OF PHYSICS OF THE COLLEGE IN THE SUBJECT PHYSICS FOR THE FIRST YEAR (SEMESTER I & II) OF PROGRAM BSc AS PER NEP 2020

UNDER
CHOICE BASED CREDIT SYSTEM (CBCS)

WITH THE EFFECT FROM ACADEMIC YEAR 2023-24

Program Outcomes of BSc with Physics Major

Name of Program	BSc
Level	UG
Number of Semesters	08
Year of Implementation	2023-24
Program Specific Outcomes (PSO)	After successful completion of this program, learners will: 1. Understand fundamental physics concepts and will be able to apply physics principles to real world problems. 2. Be able to think critically and develop the ability to apply theoretical and mathematical principles to solve complex problems in various areas of physics. 3. Acquire hands-on experience in conducting experiments, using laboratory equipments, analyzing experimental data and will be able to draw meaningful conclusions of experiment and to interpret results. 4. Recognize the interconnections between physics and other disciplines, such as, mathematics, chemistry and engineering and will be able to work effectively in those interdisciplinary fields. 5. Possess basic programming skills, will be introduced to the field of automation and will be equipped with essential knowledge and skills to work with basic automation systems. 6. Develop the ability to work individually as well as in collaboration. 7. Be able to pursue higher studies and will be able to take research opportunities.
Relevance of PSOs to the local, regional, national and global developmental needs	Science graduates with Physics major can go for higher studies and pursue careers directly related to physics, like, research, academics, etc. Other than this, Science graduates with Physics major can also pursue careers in other fields, such as, data science, engineering, IT, automation, government jobs, medical physics and healthcare industry, national security, etc., due to their analytical, problem solving and critical thinking abilities. BSc program with Physics major produces graduates with a diverse skill set capable of addressing various challenges. This can lead to improve research and innovation, economic growth

	and sustainable development from local to global level. The relevance of BSc program with Physics major to developmental needs enhances its overall impact on society and makes it more responsive to the evolving demands of the scientific, technological and societal landscape.

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Scheme of Evaluation

Course Evaluation:

Each course of BSc in the subject Physics will be assessed with Continuous Evaluation and Semester End Evaluation. Continuous Evaluation of each course will be of 40% and Semester End Evaluation of each course will be of 60%.

Passing Scheme:

For each course of BSc in the subject Physics, there will be separate head of passing for Continuous Evaluation and for Semester End Evaluation. Course grade points and course grade will be decided by the aggregate marks obtained by a learner.

$$\textit{Aggregate Marks} = \begin{matrix} \textit{Marks Obtained by a learner in Continuous Evaluation} \\ + \\ \textit{Marks obtained by a learner in Semester End Evaluation} \end{matrix}$$

In order to earn credits of this course, a learner is required to secure a minimum of 40% marks in Continuous Evaluation and 40% marks in Semester End Evaluation.

Conversion of Marks:

The Continuous Evaluation for any course of FYBSc 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 any course of FYBSc 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.

Credit and Grade Scheme:

% of Aggregate Marks Obtained	Course Grade Point	Course Grade	Performance Indicator	Credits Earned
90.0 to 100	10	O	Outstanding	2
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	

Note:

For any course,

Aggregate Marks = *Marks Obtained by a learner in Continuous Evaluation* + *Marks obtained by a learner in Semester End Evaluation*

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Scheme of Courses Offered by Department of Physics for FYBSc

Semester I			Semester II		
Course Code	**Nomenclature**	**Credits**	**Course Code**	**Nomenclature**	**Credits**
Discipline Specific Course (DSC)			***Discipline Specific Course (DSC)***		
Major/Minor			***Major/Minor***		
USPH101	Classical Physics	**02**	USPH201	Optics & Acoustics	**02**
USPH102	Modern Physics	**02**	USPH202	Electricity & Electronics	**02**
USPH103	Physics Lab - I	**02**	USPH203	Physics Lab - II	**02**
Vocational Skill Course (VSC)					
USPH104	Experimental Skills in Physics	**02**			

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Syllabi of Courses Offered in the Subject Physics for Semester I

Name of the Course	**Classical Physics**
Course Code	USPH101
Class	FYBSc
Semester	I
Number of Credits	02
Nature	Theory
Type	Major/Minor
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The course includes topics like, Newton's laws of motion, friction, work and energy, elasticity, viscosity, fluid mechanics, behavior of real gases and thermodynamics. In addition to above, the syllabus also focuses on practical problem-solving exercises that require learner to apply these classical physics theories and principles to real world scenarios. This will emphasize skill development among learners and will encourage learners to think critically and to analyze physics concepts from different perspectives. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learners' theoretical understanding to real world applications.

Nomenclature: Classical Physics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Apply Newton's laws for the calculation of the motion of simple systems.
2. Be able to use Work and Energy equivalence and its applications through suitable numericals.
3. Be able to use the concepts of Elasticity, Viscosity and Fluid dynamics in daily life.
4. Understand the concept of real gases and validity of the laws of thermodynamics.
5. Demonstrate quantitative problem-solving skills in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min)
I	Newton's Laws of Motion, Friction, Work and Energy	**1. Newton's Laws of Motion**: Newton's first, second and third laws of motion, interpretation and applications, pseudo forces, inertial and non-inertial frames of reference, Worked out examples (with friction present) Reference: HCV **2. Friction**: Advantages & disadvantages of friction in daily life, Friction as the component of Contact force, Kinetic Friction, Static friction, laws of friction, Understanding friction at atomic level Reference: HCV **3. Work and Energy**: Kinetic Energy, Work and Work-energy theorem, Potential Energy, Conservative and Non-Conservative Forces, Different forms of Energy, Mass-Energy Equivalence, Worked out Examples Reference: HCV	**10**
II	Elasticity, Viscosity, Fluid Mechanics	**1. Elasticity:** An introduction to Elasticity, Stress, Strain, Hooke's Law and Modulus of Elasticity and relation between them	**10**

		Reference: HCV **2. Viscosity**: An introduction to Viscosity, Flow through a Narrow Tube: Poiseuille's Equation, Stoke's Law, Terminal velocity, Measuring Coefficient of Viscosity by Stoke's method, Critical velocity and Reynolds number Reference: HCV **3. Fluid Mechanics:** Streamline and Turbulent flow, Equation of Continuity, Bernoulli's equation, Applications of Bernoulli's equation Reference: HCV	
III	Behavior of Real Gases and Laws of Thermodynamics	**1. Behavior of Real Gases**: An introduction, Van der Waals equation of state Reference: BSH **2. Laws of Thermodynamics**: Thermodynamic Systems, Zeroth law of thermodynamics, Concept of heat, Thermodynamic Equilibrium, Work: A Path dependent function, Internal energy, First law of Thermodynamics, Internal Energy as a state function, Specific heat of gases, Applications of First Law of thermodynamics, The indicator diagram, Work done during Isothermal and Adiabatic processes Reference: BSH	**10**

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. HCV: H. C. Verma, Concepts of Physics– Part I, Second Reprint of 2020, Bharati Bhavan Publishers and Distributers
2. BSH: Brij Lal, Subrahmanyam and Hemne, Heat Thermodynamics and Statistical Physics, Revised, Multi-coloured Reprint 2019, S. Chand

Additional References:

1. Halliday, Resnick and Walker, Fundamental of Physics (extended), 2007, 6th

Edition, John Wiley & Sons
2. D. S. Mathur, P. S. Hemne, Mechanics, 2012, S. Chand
3. M. W. Zemansky and R. H. Dittman, Heat and Thermodynamics, 8th Edition, McGraw Hill
4. Thornton and Marion, Classical Dynamics, 5th Edition, 2007, Brooks/Cole, Cengage Learning
5. D. S. Mathur, Element of Properties of Matter, S. Chand & Co.
6. R. Murugeshan and K. Shivprasath, Properties of Matter and Acoustics, S. Chand
7. D. K. Chakrabarti, Theory and Experiments on Thermal Physics, 2006 Edition, Central books
8. Hans and Puri, Mechanics, 2nd Edition, Tata McGraw Hill

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.

2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Modern Physics**
Course Code	USPH102
Class	FYBSc
Semester	I
Number of Credits	02
Nature	Theory
Type	Major/Minor
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum includes topics like, properties of nuclei, radioactivity, radiation detectors, various types of nuclear reactions, X-rays, historical development of quantum theory, etc. Modern Physics often overlaps with other scientific disciplines. The syllabus is so designed that it emphasizes on interdisciplinary approach which will help learner to understand the interconnections of those fields, will provide basics about these research fields and will encourage learners to work in these fields.

Nomenclature: Modern Physics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand nuclear properties, nuclear behavior and various types of nuclear reactions.
2. Understand the concept of radioactivity, its applications and different types of equilibria, radioactive elements.
3. Understand various types of nuclear detectors and their applications.
4. Understand concepts of quantum mechanics.
5. Demonstrate quantitative problem-solving skills in all topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Basic properties of nuclei, Radioactivity	**1. Basic properties of nuclei**: Composition, Charge, Size, Density, Spin and Magnetic dipole moment, Rutherford's experiment and estimation of nuclear size, Mass defect and binding energy, BE/A vs A plot and its interpretation, Stability of nuclei (N vs Z plot) Reference: SBP **2. Radioactivity**: (Review: Properties of α, β and γ-rays) Law of Radioactive decay, Half-life and mean life (derivation required), Units of radioactivity, Statistical nature of radioactivity, Successive radioactive disintegration - A to B to C (stable) type, Natural radioactive series, Radioactive equilibriums, Artificial radioactivity, Determination of the age of the Earth, Carbon dating, Radio isotopes and its applications, Radiation hazards Reference: SBP	10
II	Radiation Detectors, Nuclear Reactions	**1. Radiation Detectors**: Interaction between particles and matter, Plot of variation of ionization current with applied voltage, Gas filled radiation detectors- Ionization chamber (qualitative),	10

		Proportional Counter and GM Counter Reference: SNG **2. Nuclear Reactions**: Introduction, Types of nuclear reactions, Conservation laws (mass, energy and charge), Concept of compound and direct reaction, Q value equation and solution of the Q equation, Threshold energy Reference: SBP	
III	Origin of Quantum Theory, X-Rays	**1. Origin of Quantum Theory**: (Review: Photoelectric effect, Black body, Black body spectrum, Wien's displacement law) Matter waves: de Broglie waves, Concept of wave packet, Phase velocity, Group velocity and relation between them, Wave particle duality, Davisson-Germer experiment, Heisenberg's Uncertainty Principle Reference: AB **2. X-Rays**: Production and properties, X-Ray spectra, X-Ray Diffraction, Bragg's Law, Compton Effect, Pair production, Photons and Gravity, Gravitational Red Shift, Black holes Reference: AB	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. AB: Arthur Beiser, Concepts of Modern Physics, 6th Edition
2. SBP: S.B. Patel, Nuclear Physics: An Introduction, New Age International Publishers, 2nd Edition
3. SNG: S. N. Ghoshal, Nuclear Physics, S. Chand

Additional References:

1. S. L. Kakani and Shubhra Kakani, Nuclear and Particle Physics, Viva Books, 2nd Edition
2. Kenneth S. Krane, Modern Physics, 4th Edition, Wiley

3. Ronald Gautreau, Schaum's Outline of Modern Physics, 2nd Edition, McGraw Hill
4. D. C. Tayal, Nuclear Physics, Himalaya Publishing House, 5th Edition

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test - (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Physics Lab – I**
Course Code	USPH103
Class	FYBSc
Semester	I
Number of Credits	02
Nature	Practical
Type	Major/Minor
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. After completion of this course, learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Physics Lab – I

Eligibility: --

Course Outcomes:

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

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. To learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, all 4 skill experiments and minimum 8 experiments (4 from 'General Physics' group and 4 from 'Electricity and Electronics' group) should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Physics practical journal of first semester).
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A 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 the learner has completed this practical course as per minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 2 experiments (1 from 'General Physics' group and 1 from 'Electricity and Electronics' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on all skill experiments, experiments done from 'General Physics' group and experiments done from 'Electricity and Electronics' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of clock hours
A	Skill Experiments	1. Use of Vernier Callipers, Micrometer Screw Gauge and Travelling Microscope 2. Graph plotting (straight line, curve) 3. Preliminary adjustments and use of spectrometer 4. To determine the resistance using colour code and capacitance using number code and use of digital multimeter for voltage and resistance measurement	10
B	General Physics	1. Torsional Oscillation: To determine modulus of rigidity η of a material of wire by torsional oscillations 2. Moment of inertia of Flywheel 3. Constant volume air thermometer 4. Spectrometer: To determine angle of prism 5. Bifilar Pendulum: Determination of moment of inertia of rectangular and cylindrical bar about an axis passing through its centre of gravity 6. J By electrical method: To determine mechanical equivalent of heat (Radiation correction by graph method) 7. To determine coefficient of viscosity of a given liquid by Poisseuli's method 8. Constant pressure air thermometer	25
C	Electricity and Electronics	1. To study Ex-OR Gate and verification of its truth table 2. To study NOR Gate and verification of its truth table 3. To study Thermistor characteristics: Resistance vs. Temperature 4. To study load regulation of a Bridge Rectifier 5. To study Zener Diode as Regulator 6. To determine frequency of AC mains (Sonometer wire) 7. To verify De Morgan's theorems	25

		8. Transistor configuration: CE (study of input – output characteristics)	

Learning Resources recommended:

1. D. Chattopadhya, P. C. Rakshit & B. Saha, Advanced course in Practical Physics, 6th Edition, Book and Allied Pvt. Ltd.
2. B.Sc. Practical Physics – Harnam Singh, S. Chand & Co. Ld., 2001
3. A test book of advanced practical Physics - Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics – C. L. Arora (1st Edition) -2001, S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition), Cambridge University
6. University Practical Physics – D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (60 Marks - 4 hours):

Question No.	Group	Title	Method	Marks
1	B	General Physics	Experiment performance as per practical slip	30
2	C	Electricity and Electronics	Experiment performance as per practical slip	30

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Name of the Course	**Experimental Skills in Physics**
Course Code	USPH104
Class	FYBSc
Semester	I
Number of Credits	02
Nature	Practical
Type	Vocational Skill Course
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. After completion of this course, learners will enhance their ability to apply physics principles to real world scenarios, especially in the field of mechanics, electricity and electronics. The course also equips learners the necessary skills to use measuring instruments and basic physics laboratory equipments effectively. The course also encourages learners to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Experimental Skills in Physics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.
5. Apply skills, knowledge, physics principles effectively to real world situations.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, all 4 skill experiments and minimum 8 experiments (4 from 'Applied Physics - I' group and 4 from 'Applied Physics - II' group) should be completed compulsorily and learners are required to report all these experiments in the journal of this course.
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A 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 the learner has completed this practical course as per the minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 2 experiments (1 from 'Applied Physics - I' group and 1 from 'Applied Physics - II' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on all skill experiments, experiments done from 'Applied Physics - I' group and experiments done from 'Applied Physics - II' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of clock hours
A	Skill Experiments	1. Use of Vernier Calliper, Micrometer Screw Gauge and Travelling Microscope 2. Graph plotting (straight line, curve) 3. Preliminary adjustments and use of spectrometer 4. To determine the resistance using colour code and capacitance using number code and use of digital multimeter for voltage and resistance measurement	10
B	Applied Physics – I	1. Helmholtz resonator 2. Young's modulus of metal bar by the method of vibration 3. Torsional Oscillation: To determine modulus of rigidity η of a material of wire by torsional oscillations 4. Spectrometer: To determine angle of prism 5. Flat spiral spring: Determination of Young's modulus 6. Flat spiral spring: Determination of modulus of rigidity 7. Moment of inertia of flywheel 8. Constant volume air thermometer	25
C	Applied Physics – II	1. To study NAND Gate and verification of its truth table 2. To study Ex-OR Gate and verification of its truth table 3. To study Thermistor characteristics: Resistance vs. Temperature 4. Transistor configuration: CC (study of input – output characteristics) 5. UJT characteristics 6. To study load regulation of a Bridge Rectifier 7. To study Zener Diode as Regulator 8. Frequency of ac mains: To determine frequency of ac mains (Sonometer wire)	25

Learning Resources recommended:

1. D. Chattopadhya, P. C. Rakshit & B. Saha, Advanced course in Practical Physics, 6th Edition, Book and Allied Pvt. Ltd.
2. B.Sc. Practical Physics – Harnam Singh, S. Chand & Co. Ld., 2001
3. A test book of advanced practical Physics - Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics – C. L. Arora (1st Edition) -2001, S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition), Cambridge University
6. University Practical Physics – D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (60 Marks – 4 hours):

Question No.	Group	Title	Method	Marks
1	B	Applied Physics - I	Experiment performance as per practical slip	30
2	C	Applied Physics - II	Experiment performance as per practical slip	30

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Syllabi of Courses Offered in the Subject Physics for Semester II

Name of the Course	Optics and Acoustics
Course Code	USPH201
Class	FYBSc
Semester	II
Number of Credits	02
Nature	Theory
Type	Major/Minor
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that along with learning basic concepts in optics, learners will develop the skill - to predict the characteristics of image formed by lens and to apply lens formula to calculate focal length, object distance, image distance, etc., for various lens configurations. Learners will also develop skill to identify various lens aberrations that can affect image quality and will be able to use different methods to reduce them. Learners will also become familiar with basic principles of common optical instruments and will be able to draw and interpret ray diagrams for those systems and will learn the skill to use these instruments. The curriculum equips learners with a comprehensive understanding of interference in thin films and its wide ranging applications in science and technology. This will provide a basic foundation for further research and practical work related to thin films and their optical properties. The curriculum also equips learners with necessary knowledge to work with lasers safely and effectively in various industries and research fields. Learners will also be equipped with foundational understanding of fibre optics, including basic principles of light propagation through optical fibres and will develop a skill to use the optical fibre for the applications like, communication and temperature measurement. Learners will also gain comprehensive understanding of how sound interacts with buildings and how to create acoustically

	comfortable and functional spaces. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Optics and Acoustics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the concept of lens, lens defects and their minimization.
2. Understand the significance of combination of lenses implied to eyepiece of optical instrument.
3. Understand interference of light with few well known daily life examples.
4. Understand Lasers and Optical fibers, their applications in day to day life.
5. Understand acoustics of building and will be able to apply it.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Geometrical Optics	**1. Lenses and Lens Maker's Equation:** Introduction to lenses, Terminology and sign conventions, Introduction to Thin lenses and Lens equation for single convex lens, Lens maker's equation: Positions of the Principal Foci and Newton's Lens equation Reference: SBA **2. Magnification by a lens and power of lens**: Lateral, Longitudinal and Angular magnification, Deviation by a thin lens and its power, Necessity to combine the lenses & equivalent focal length & power of two thin lenses, Concept of cardinal points and their significance Reference: SBA **3. Introduction to Aberration in lenses**: Spherical aberration & reduction, chromatic aberration & reduction Reference: SBA	10
II	Introduction to Optical Instruments and	**1. Optical Instruments and Eyepieces:** Human Eye as an optical instrument, Camera and Lenses of Camera, Simple Microscope & Compound Microscope, Concept of eyepiece & its significance: Huygens'	10

	Interference in Thin Films	Eyepiece and Ramsden Eyepiece (Principle, Construction, Expression for Equivalent Focal Length, Merits and Demerits), Comparison of Huygens' Eyepiece and Ramsden Eyepiece, Gauss Eyepiece, Refracting Astronomical Telescope (Construction and Working), Reflecting Telescope (Qualitative) Reference: SBA **2. Interference in Thin Films:** Interference due to reflected and transmitted light in plane thin films, Conditions for Maxima and Minima, Interference pattern in wedge shaped film & Newton's rings Reference: SBA	
III	Lasers, Fiber Optics, Acoustics of Building	**1. An Introduction to LASERS:** Absorption and Emission, Spontaneous and Stimulated Emission, Components of laser, Laser beam properties, Ruby laser, He-Ne Laser, Applications of Laser Reference: SBA **2. An Introduction to Optical Fiber**: Fiber geometry, Total Internal Reflection, Propagation of light through an Optical fiber, Numerical Aperture, Classification of Optical fibers, Single Mode Step Index Fiber, Multimode Step Index Fiber, Graded Index Fiber, Optical Fiber applications: Optical fiber-based communication system & Optical Fiber based Temperature sensor Reference: SBA **3. Acoustics of Buildings:** Reverberation, Explanation of Sabine's formula & Importance of Sabine's Formula, Absorption Coefficient, Acoustics of Buildings, Factors Affecting Acoustics of Buildings, Sound Distribution in an Auditorium Reference: RK	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. SBA: Dr. N. Subrahmanyam, Brij lal and Dr. M. N. Avadhanulu, A Textbook of Optics, 25th Revised Edition 2012 (Reprint2016), S. Chand & Company Pvt. Ltd.
2. RK: Properties of matter and Acoustics – R Murugeshan and K. Shivaprasath, S Chand & Co. Ltd. (2005-Ed)

Additional References:

1. Jenkins and White, Fundamentals of Optics by (4th Ed.), McGraw Hill International
2. Ajoy Ghatak, Optics, 6th Edition, McGraw Hill Education (India) Private Limited

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	Electricity and Electronics
Course Code	USPH202
Class	FYBSc
Semester	II
Number of Credits	02
Nature	Theory
Type	Major/Minor
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. Learners will understand the principles, concepts and applications related to alternating current electrical circuits including resistors, capacitors and inductors, will learn the skill to analyze these circuits and will be able to apply them to actual ac circuits. Learners will also develop skill to analyze various ac bridges and will be able to use them to determine unknown electrical parameters. Learners will also develop skill to effectively apply and simplify electrical circuits using various circuit theorems. Learners will understand different types of power supply configurations and their respective advantages and limitations and learners will develop a skill to design, operate and troubleshoot dc power supplies for variety of applications. Learners will understand various number systems and their representations and will develop skill to convert them from one form to another and will be able to perform their arithmetic operations. Learners will also gain knowledge to use NAND and NOR gates to implement all other logic gates and will also develop a skill to design and analyze logic circuits using derived gates. Additionally, most of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Electricity and Electronics

Eligibility: --

Course Outcomes:

On successful completion of this course, learner will:

1. Understand the basic concepts of Alternating current theory, AC bridges and Circuit theorems and apply them in real life situations.
2. Understand the basics of Analog and Digital Electronics and apply them in real life situations.
3. Demonstrate quantitative problem-solving skills in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (60 min.)
I	Electricity	**1. Alternating current theory:** (Review: Concept of L, R and C) AC circuit containing pure R, pure L and pure C, Representation of sinusoids by complex numbers, Series LR, CR and LCR circuits, Resonance in LCR circuit (both series and parallel), Power in ac circuit, Q-Factor Reference: CR **2. AC bridges**: General AC Bridge, Inductance Comparison Bridge, Maxwell's L/C Bridge, De Sauty's Bridge, Wien Bridge (Bridge diagram, balancing condition derivation, applications) Reference: CR	10
II	Analog Electronics	**1. Circuit Theorems**: (Review: Ohm's law, Kirchhoff's laws) Ideal Current and Voltage Sources, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Problems related to circuit analysis using the above theorems Reference: TT **2. DC Power Supply**: Block diagram of a dc power supply– Concept of a transformer, (Review: Half wave rectifier, Full wave rectifier) Bridge rectifier, PIV, Efficiency and Ripple factor of full wave rectifier,	10

		Capacitor Filter, Need for voltage regulation - Zener diode as voltage stabilizer, Clipper and Clampers (Basic diode based circuits) Reference: BN, AD	
III	Digital Electronics	**1. Number Systems** – Binary number system: Binary to decimal and Decimal to binary conversion, Hexadecimal number system: Hexadecimal to decimal Conversion, Decimal to hexadecimal conversion, Hexadecimal to binary conversion, Binary to hexadecimal conversion Reference: LMS **2. Derived Gates:** (Review: Basic logic gates) NAND and NOR as Universal Building blocks, Ex-OR gate: logic expression, logic symbol, truth table, Implementation using basic gates and its applications– Parity generator and checker, Half adder and Full adder Reference : LMS, T	10

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. CR: D. Chattopadhyay and P. C. Rakshit, Electricity and Magnetism, New Central Book Agency (P) Ltd.
2. LMS: Leach, Malvino, Saha, Digital Principles and Applications – 6th Edition.Tata McGraw Hill
3. AD: Albert Malvino, David Bates, Electronic Principles, 8th Edition,Tata McGraw Hill
4. TT: B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology Vol. I, S. Chand Publication
5. T: Tokheim, Digital Electronics, Principles and Applications, 6th Edition, McGraw Hill Edition
6. BN: R. L. Boylestad and L. Nashelsky, Electronic devices and Circuit Theory- 10th Edition, Pearson

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Physics Lab – II**
Course Code	USPH203
Class	FYBSc
Semester	II
Number of Credits	02
Nature	Practical
Type	Major/Minor
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. After completion of this course, learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Physics Lab - II

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, 4 demonstration experiments and minimum 8 experiments (4 from 'General Physics' group and 4 from 'Electricity and Electronics' group) should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Physics practical journal of second semester).
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A 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 the learner has completed this course as per the minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 2 experiments (1 from 'General Physics' group and 1 from 'Electricity and Electronics' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on demonstration experiments, experiments done from 'General Physics' group and experiments done from 'Electricity and Electronics' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of clock hours
A	General Physics	1. LDR Characteristics: To study the dependence of LDR resistance on intensity of light 2. Spectrometer: To determine refractive index of prism material 3. Combination of Lenses: To determine equivalent focal length of a lens system by magnification method 4. Newton's Rings: To determine radius of curvature of a given convex lens using Newton's rings 5. Determination of diameter of thin wire using Wedge Shaped Film	25
B	Electricity and Electronics	1. To study NAND/NOR gates as Universal Building Blocks 2. LR Circuit: To determine the value of given inductance and phase angle 3. CR Circuit: To determine value of given capacitor and Phase angle 4. LCR series Resonance: To determine resonance frequency of LCR series circuit 5. Transistor configurations: CE (study of input-output characteristics) 6. To study half adder and full adder and verification of their truth table	25
C	Demonstration Experiments	1. Use of software for graph plotting 2. Study of I-V Characteristics of LED 3. Study of I-V characteristics of solar cell 4. Angular momentum conservation (Rotating platform) 5. Clipper and clamper circuits 6. Use of Oscilloscope: Observation of Waveforms at output of half wave, bridge rectifiers with and without capacitor filter, ripple	10

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, P. C. Rakshit & B. Saha. (6th Edition), Book and Allied Pvt. Ltd.
2. B.Sc. Practical Physics – Harnam Singh S. Chand & Co. Ld., 2001
3. A test book of advanced practical Physics - Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics – C. L. Arora (1st Edition) -2001, S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition), Cambridge University
6. University Practical Physics – D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (60 Marks – 4 hours):

Question No.	Group	Title	Method	Marks
1	A	General Physics	Experiment performance as per practical slip	30
2	B	Electricity and Electronics	Experiment performance as per practical slip	30

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R. E. Society's

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

Syllabus of Open Elective Courses Offered by Department of Physics for the First Year (Semester I & II) of Bachelor's Programme as per NEP 2020

Under
Choice Based Credit System (CBCS)

With effect from Academic Year 2023-24

Open Elective Courses Offered by Department of Physics for FYBA / FYBCom / FYBSc / FYBMS / FYBAF / FYBSc IT / FYBSc BT / FYBSc CS

Semester I			Semester II		
Course Code	**Nomenclature**	**Credits**	**Course Code**	**Nomenclature**	**Credits**
Generic/Open Elective (OE)			***Generic/Open Elective (OE)***		
USOE101	Astronomy for Beginners	**02**	USOE201	Observational Astronomy	**02**

Syllabus of Open Elective Course Offered for Semester I

Name of the Course	**Astronomy for Beginners**
Course Code	USOE101
Class	FYBA / FYBCom / FYBSc / FYBMS / FYBAF / FYBSc IT / FYBSc BT / FYBSc CS
Semester	I
Number of Credits	02
Nature	Theory / ~~Practical~~ / ~~Project~~ / ~~any other~~
Type	Elective
Revision of syllabus specific to employability/ entrepreneurship/ skill development	This course inculcates ability to do mathematical calculation, critical thinking and scientific visualization in the context of astronomy. The course develops ability to differentiate between true facts and superstitions in daily life. The course will help to enhance skill of communication of astronomical facts which may give employability in the field of astronomy popularization and outreach.

Nomenclature: Astronomy for Beginners /खगोलशास्त्राची ओळख

Eligibility: -- Candidate who has passed 10+2 examination in Arts/ Science/ Commerce or equivalent.

Course Outcomes:

On successful completion of this course, a learner will / सदर अभ्यासक्रम पूर्ण केल्यानंतर विद्यार्थ्याला:

1. Be able to understand importance of astronomy/ खगोलशास्त्राचे महत्त्व समजेल.
2. Be able to describe the physical universe and its evolution/ विश्वाविषयी आणि विश्वाच्या उत्क्रांतीविषयी वर्णन करता येईल.
3. Be able to describe our solar system/ आपल्या सूर्यमालेचे वर्णन करता येईल.
4. Be able to identify the structure of galaxy, properties of galaxies and classify galaxies / दीर्घिकांची रचना, वैशिष्ट्ये ओळखता येतील आणि दीर्घिकांची वर्गवारी करता येईल.
5. Be able to distinguish between planets, stars and other celestial objects/ ग्रह, तारे आणि इतर खगोलीय वस्तूंमधील फरक ओळखता येईल.
6. Be able to identify and classify types of stars/ ताऱ्याचा प्रकार ओळखून वर्गीकरण करता येईल.
7. Be able to identify and classify the astronomical events / खगोलीय घटना ओळखून त्याचे वर्गीकरण करता येईल.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Introduction to Astronomy / खगोलशास्त्राची ओळख	History of Astronomy: Ancient to Modern खगोलशास्त्राचा प्राचीन ते अर्वाचीन इतिहास	02
		Measurements in Astronomy (distance, time etc.) / खगोलशास्त्रातील मोजमापे (अंतर, काळ...इ)	01
		Activity/ उपक्रम : Power of Ten / कमाल दहाची	
		The Sun and various objects in Solar system (Planets, Asteroid belt) / सूर्य आणि सूर्यमालेतील घटक (ग्रह, लघुग्रहांचा पट्टा)	04
		Activity / उपक्रम: Model Making of our Solar System / आपल्या सूर्यमालेची प्रतिकृती बनवणे	
		The Earth / आपली पृथ्वी	03
		The moon / आपला चंद्र	
		Activity / उपक्रम: Book review / पुस्तक परीक्षण	
II	Galaxy and Universe / दीर्घिका आणि विश्व	The milky way galaxy / आकाशगंगा	02
		Galaxy and types of galaxies (Hubble fork)/ दीर्घिका आणि दीर्घिकांचे प्रकार (हबल फोर्क) Introductory study of structure of the universe /	04

		विश्वरचनेचा प्राथमिक अभ्यास	
		Activity / उपक्रम : Galaxy Classification / दीर्घिका वर्गीकरण	
		Activity / उपक्रम : Your Galactic Address / तुमचा विश्वातला पत्ता	
		Birth of the universe (The Big Bang)/ विश्वरचनेची सुरुवात	02
		The future of universe/विश्वाचे भविष्य	02
III	Evolution of stars and Astronomical events / तार्‍यांची जीवनगाथा आणि अवकाशीय घटना	Study of Life cycle of stars: from red giants to Black hole, properties of stars, /तार्‍यांचे जीवनचक्र: राक्षसी तारा ते कृष्णविवर, तार्‍यांचे गुणधर्म **Activity / उपक्रम : HR diagram**	05
		Eclipses and types / ग्रहणे आणि ग्रहणांचे प्रकार **Activity / उपक्रम** : Drawings of eclipses / ग्रहणाचे रेखाटन	05
		Comet , Meteor and Meteor Shower , Aurora borealis / धूमकेतू, उल्का आणि उल्कावर्षाव, ध्रुवीय प्रकाश Retrograde, Conjunction, Opposition, Occultation, Transits ग्रहांचे वक्री होणे, युती, प्रतियुती, पिधान, अधिक्रमण **Activity / उपक्रम** : Listing of recent astronomical events / नजीकच्या काळातील खगोलीय घटनांची नोंद	

Learning Resources recommended:

1. आकाशाशी जडले नाते: डॉ. जयंत नारळीकर, राजहंस प्रकाशन
2. मला उत्तर हवंय ! : खगोलशास्त्र, मोहन आपटे, राजहंस प्रकाशन
3. सूर्यमालेतील सृष्टीचमत्कार: मोहन आपटे, राजहंस प्रकाशन
4. A Textbook of Astronomy and Astrophysics: Suresh Chandra, Mohit Kumar Sharma, Dream tech Press, Distributed by WILEY
5. https://avakashvedh.com/
6. https://csa.pkc.org.in/
7. https://imagine.gsfc.nasa.gov/science/objects/milkyway1.html

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Course Evaluation:

The course will be assessed with Continuous Evaluation and Semester End Evaluation. Continuous Evaluation of the course will be of 40% and Semester End Evaluation of the course will be of 60%.

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Activity Completion	30
Attendance and active participation in classroom	10

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

Question No.			Type of Questions	Unit	Marks
1		Attempt any **THREE** out of Six	Descriptive question which may include Short note / Short answer /Drawing labeled diagram / Numerical problems	I	15
2		Attempt any **THREE** out of Six	Descriptive question which may include Short note / Short answer /Drawing labeled diagram / Numerical problems	II	15
3		Attempt any **THREE** out of Six	Descriptive question which may include Short note / Short answer /Drawing labeled diagram / Numerical problems	III	15
4	A	Attempt **ALL SIX**	Multiple Choice Questions	I, II, III	12
4	B	Attempt **ALL THREE**	Answer in one- two lines.	I, II, III	03

Passing Scheme:

In order to earn credits of the course, a learner has to secure minimum 40% marks in Continuous Evaluation and 40% marks in Semester End Evaluation.

Course grade points and course grade will be decided by the aggregate marks (Continuous Evaluation plus Semester End Evaluation) secured by a learner.

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Syllabus of Open Elective Course Offered for Semester II

Name of the Course	Observational Astronomy
Course Code	USOE201
Class	FYBA / FYBCom / FYBSc / FYBMS / FYBAF / FYBSc IT / FYBSc BT / FYBSc CS
Semester	II
Number of Credits	02
Nature	~~Theory~~ /Practical / ~~Project~~ / ~~any other~~
Type	Generic / Open Elective
Revision of syllabus specific to employability/ entrepreneurship/ skill development	This course imparts skills like sky observation, telescope handling, use of telescope and software for sky observation. Learner may become resource person for sky observation sessions; may conduct sessions on telescope and software handling. Learner completing this course may find suitable employment in newly emerging astro tourism industry.

Nomenclature: Observational Astronomy / निरीक्षणात्मक खगोलशास्त्र

Eligibility: Candidate who has passed 10+2 examination in Arts/ Science/ Commerce or equivalent.

Course Outcomes:

On successful completion of this course, a learner will / सदर अभ्यासक्रम पूर्ण केल्यानंतर विद्यार्थ्याला:

1. Be able to identify constellations / तारकासमूह ओळखता येतील.
2. Be able to read the sky map and determine position of star and planet / आकाशाचा नकाशा वापरता येऊन ग्रह आणि तारे यांचे स्थान शोधता येईल.
3. Be able to handle telescope / दुर्बिण हाताळता येईल.
4. Be able to use software for sky observation / आकाश निरीक्षणासाठी software वापरता येईल.
5. Be able to conduct sky observation sessions / आकाश निरीक्षण सत्र घेता येतील.

Group	Title	Learning Points	No. of Lectures
A	Astronomical Coordinate Systems and Sky Maps / खगोलीय निर्देश पद्धत आणि आकाशाचा नकाशा	Introduction to astronomical coordinates/ खगोलीय निर्देशकांची ओळख 1. Horizon system / क्षितीज पद्धत 2. Equatorial system / वैषुव वृत्त पद्धत 3. Ecliptic system / आयनिक वृत्त पद्धत	20
		The Solar Path/ सुर्यभ्रमणाचा मार्ग, Equinox (Vernal, Autumnal)/ संपात बिंदू(वसंत, शरद), Summer Solstice, Winter Solstice and Seasons / उत्तरायण, दक्षिणायन आणि ऋतु	
		Use of Sky map / आकाशाच्या नकाशाचा वापर	
		Methods of determining the position of planets and stars / ग्रह आणि तारे यांचे स्थान निश्चित करण्याच्या पद्धती	
		Locating Pole star and identifying geographical directions on the map (East/West/North/South) using Pole star / नकाशात ध्रुव ताऱ्याचे स्थान निश्चित करणे आणि त्यावरून भौगोलिक दिशा निश्चित करणे	
		Identifying star patterns: constellations /नकाशामध्ये ताऱ्यांच्या रचनाकृती: तारकासमुह ओळखणे	
B	Naked Eye Sky Observation / उघड्या डोळयांनी आकाश निरीक्षण	Introduction to naked eye sky observation/ उघड्या डोळयांनी केल्या जाणाऱ्या आकाश निरीक्षणाची ओळख	20
		Locating visible planets in the sky / आकशातील दृश्यमान ग्रह ओळखणे	
		Locating Pole star in the sky / आकाशात ध्रुव ताऱ्याचे स्थान ओळखणे	

		Locating constellations such as Ursa Major / Cassiopeia in the sky आकाशातील सप्तर्षी / शर्मिष्ठा तारकासमूह ओळखणे Locating constellation Orion in the sky / आकाशातील मृग तारकासमूह ओळखणे Locating constellation Pleiades in the sky/ आकाशातील कृत्तिका तारकासमूह ओळखणे	
		The moon phase log book: Observe and record phases of moon / चंद्राच्या कलांचे निरीक्षण आणि नोंदी ठेवणे	
		Moon Phases Calendar / चंद्र कला दिनदर्शिका	
C	Telescopes and Softwares / दुर्बिणी आणि Softwares	Telescopes and types of telescopes / दुर्बिणी आणि दुर्बिणीचे प्रकार	20
		Observation of surface of the moon through telescope / दुर्बिणीच्या सहाय्याने चंद्राच्या पृष्ठभागाचे निरीक्षण करणे	
		Observation of visible planets through telescopes / दृश्यमान ग्रहांचे दुर्बिणीतून निरीक्षण	
		Use of astronomy software *Stellarium*/ *Stellarium* software चा वापर	
		Solar analemma	
		Moon analemma	

Learning Resources recommended:

1. आकाशाशी जडले नाते: डॉ. जयंत नारळीकर, राजहंस प्रकाशन
2. A Textbook of Astronomy and Astrophysics: Suresh Chandra, Mohit Kumar Sharma, Dream tech Press, Distributed by WILEY
3. https://avakashvedh.com/
4. Joy of Starwatching,: Biman Basu, National Book Trust, India
5. https://stellarium.org/
6. http://www.skymaponline.net/
7. कथारूपी खगोलशास्त्र: मेहता हाउस पब्लिकेशन
8. A Handbook on Telescope: Dr. Sarmistha Basu, First edition, B K Publications Private Limited
9. EDMUND MAG 5 STAR ATLAS: Edmund Scientific

Course Evaluation:

The course will be assessed with Continuous Evaluation and Semester End Evaluation. Continuous Evaluation of the course will be of 40% and Semester End Evaluation of the course will be of 60%.

Evaluation Pattern:

A. Continuous Evaluation: (40 marks)

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to use sky maps, to locate or identify astronomical objects, to locate or identify star patterns, to handle telescopes, to use softwares and to record proper observations • Submission of journal within a week after every practical session, wherever applicable. Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (60 marks)

Exam Pattern

Question No.	Group	Method	Marks
1	A, B, C	Experiment performance as per examination slip	60

Passing Scheme:

In order to earn credits of the course, a learner has to secure minimum 40% marks in Continuous Evaluation and 40% marks in Semester End Evaluation.

Course grade points and course grade will be decided by the aggregate marks (Continuous Evaluation plus Semester End Evaluation) secured by a learner.

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R. E. Society's

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

Syllabus of Skill Enhancement Course Offered by Department of Physics for the First Year (Semester II) of B Sc Programme as per NEP 2020

Under

Choice Based Credit System (CBCS)

With effect from Academic Year 2023-24

Syllabus of Skill Enhancement Course Offered for Semester II

Name of the Course	Basic Measurement Skills and Data Analysis
Course Code	USPH204
Class	FYBSc
Semester	II
Number of Credits	02
Nature	~~Theory~~ /Practical / ~~Project~~ / ~~any other~~
Type	Elective
Revision of syllabus specific to employability/ entrepreneurship/ skill development	This course helps to develop ability to do measurement, uncertainty calculation and error analysis using statistical techniques. Course is designed to impart skills like graph plotting, critical thinking and mathematical calculations.

Nomenclature: Basic Measurement Skills and Data Analysis

Eligibility: -- Candidate who has passed 10+2 examination in Science or equivalent.

Course Outcomes:

On successful completion of this course a learner will:

1. Be able to do measurements.
2. Be able to use systems of units.
3. Be able to calculate uncertainty in measurements.
4. Be able to do basic statistical calculations.
5. Be able to plot graphs.
6. Be able to use graph for uncertainty calculations.

Curriculum:

Group	Title	Learning Points	No. of Lectures
A	Introduction to measurement and Uncertainties in measurements	Measurements and systems of units	20
		Uncertainty in measurement, expressing uncertainty in measurement, Error vs uncertainty, Importance of study of uncertainty in measurement	
		Origins of errors and uncertainties	
		Error analysis- Experiment I	
		Error analysis- Experiment II	
B	Basic statistics, distributions and uncertainty calculation	Basic statistical calculations- mean, median, mode, standard deviation	20
		Types of Distributions: Normal, rectangular, other	
		The general kinds of uncertainty in any measurement: Random or systematic, Calculation of uncertainty in measurements	
		Error analysis- Experiment III	
		Error analysis- Experiment IV	
C	Graphing technique & Uncertainty	Basic layout of graph, Curve fitting	20
		Uncertainties and graph	
		Error analysis- Experiment VI	
		Error analysis- Experiment VII	

Learning Resources recommended:

Measurement Good Practice Guide No. 11 (Issue 2), A Beginner's Guide to Uncertainty of Measurement: Stephanie Bell, Centre for Basic, Thermal and Length Metrology, National Physical Laboratory

Course Evaluation:

The course will be assessed with Continuous Evaluation and Semester End Evaluation. Continuous Evaluation of the course will be of 40% and Semester End Evaluation of the course will be of 60%.

Evaluation Pattern:

A. Continuous Evaluation (40 marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph, to draw meaningful conclusions of experiments, to do error analysis • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (60 marks):

Exam Pattern

Question No.	Group	Method	Marks
1	A, B, C	Experiment performance as per examination slip	60

Passing Scheme:

In order to earn credits of the course, a learner has to secure minimum 40% marks in Continuous Evaluation and 40% marks in Semester End Evaluation.

Course grade points and course grade will be decided by the aggregate marks (Continuous Evaluation plus Semester End Evaluation) secured by a learner.

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R. E. SOCIETY'S,
R. P. GOGATE COLLEGE OF ARTS & SCIENCE
AND
R. V. JOGALEKAR COLLEGE OF COMMERCE
(AUTONOMOUS),
RATNAGIRI

SYLLABI OF COURSES OFFERED BY DEPARTMENT OF PHYSICS OF THE COLLEGE IN THE SUBJECT PHYSICS FOR THE SECOND YEAR (SEMESTER III & IV) OF PROGRAM BSc

UNDER
CHOICE BASED CREDIT SYSTEM (CBCS)

WITH THE EFFECT FROM ACADEMIC YEAR 2023-24

Program Outcomes of BSc with Subject Physics

Name of Program	BSc
Level	UG
Number of Semesters	06
Year of Implementation	2023-24
Program Specific Outcomes (PSO)	After successful completion of this program, learners will: 1. Understand fundamental physics concepts and will be able to apply physics principles to real world problems. 2. Be able to think critically and develop the ability to apply theoretical and mathematical principles to solve complex problems in various areas of physics. 3. Acquire hands-on experience in conducting experiments, using laboratory equipments, analyzing experimental data and will be able to draw meaningful conclusions of experiment and to interpret results. 4. Recognize the interconnections between physics and other disciplines, such as, mathematics, chemistry and engineering and will be able to work effectively in those interdisciplinary fields. 5. Possess basic programming skills, will be introduced to the field of automation and will be equipped with essential knowledge and skills to work with basic automation systems. 6. Develop the ability to work individually as well as in collaboration. 7. Be able to pursue higher studies and will be able to take research opportunities.
Relevance of PSOs to the local, regional, national and global developmental needs	Science graduates with the subject Physics can go for higher studies and pursue careers directly related to physics, like, research, academics, etc. Other than this, Science graduates with the subject Physics can also pursue careers in other fields, such as, data science, engineering, IT, automation, government jobs, medical physics and healthcare industry, national security, etc., due to their analytical, problem solving and critical thinking abilities. BSc program with the subject Physics produces graduates with a diverse skill set capable of addressing various challenges. This

	can lead to improve research and innovation, economic growth and sustainable development from local to global level. The relevance of BSc program with the subject Physics to developmental needs enhances its overall impact on society and makes it more responsive to the evolving demands of the scientific, technological and societal landscape.

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Scheme of Evaluation

Course Evaluation:

Each course of BSc in the subject Physics will be assessed with Continuous Evaluation and Semester End Evaluation. Continuous Evaluation of each course will be of 40% and Semester End Evaluation of each course will be of 60%.

Passing Scheme:

For each course of BSc in the subject Physics, there will be separate head of passing for Continuous Evaluation and for Semester End Evaluation. Course grade points and course grade will be decided by the aggregate marks obtained by a learner.

Aggregate Marks = *Marks Obtained by a learner in Continuous Evaluation* + *Marks obtained by a learner in Semester End Evaluation*

In order to earn credits of this course, a learner is required to secure a minimum of 40% marks in Continuous Evaluation and 40% marks in Semester End Evaluation.

Conversion of Marks:

There will be no conversion of marks for SYBSc.

Credit and Grade Scheme:

% of Aggregate Marks Obtained	Course Grade Point	Course Grade	Performance Indicator	Credits Earned
90.0 to 100	10	O	Outstanding	As mentioned in Course Syllabus
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	

Note:

For any course,

$$\textit{Aggregate Marks} = \begin{array}{c} \textit{Marks Obtained by a learner in Continuous Evaluation} \\ + \\ \textit{Marks obtained by a learner in Semester End Evaluation} \end{array}$$

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Scheme of Courses Offered by Department of Physics for SYBSc

Semester III			Semester IV		
Course Code	**Nomenclature**	**Credits**	**Course Code**	**Nomenclature**	**Credits**
USPH301	Mechanics and Thermodynamics	**02**	USPH401	Optics and Material Science	**02**
USPH302	Electronics	**02**	USPH402	Quantum Physics	**02**
USPH303	Mathematical Methods in Physics	**02**	USPH403	Applied Physics	**02**
USPH304	Physics Lab - III	**03**	USPH404	Physics Lab - IV	**03**

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Syllabi of Courses Offered for Semester III

Name of the Course	**Mechanics and Thermodynamics**
Course Code	USPH301
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum is so designed that it equips learners with a strong foundation in mechanics and thermodynamics, enables them to apply their knowledge to various scientific, engineering and practical situations. Learner will develop the skill to analyze and solve mechanics problems, particularly related to compound pendulum, center of mass and oscillations, using appropriate mathematical and analytical techniques. The course equips learners with a comprehensive understanding of various thermodynamic processes, principles that govern energy conversion, limitations of conversion of energy into work, Carnot's cycle, Carnot's theorems, entropy, second and third law of thermodynamics, Maxwell's thermodynamic relations and their applications. The course also equips learners with basic understanding of heat engines including ideal and practical engines, internal and external combustion engines, such as, Carnot's ideal heat engine, Steam engine, Petrol engine, Diesel engine and learners will be able to assess the performance of these engines through efficiency calculations. The course equips learners with a comprehensive understanding of low temperature physics, as well as, principles, processes and techniques involved in converting gases into liquids. The learners will understand principle, design and operation of refrigeration systems. The learners will also understand properties, behavior and applications of liquid helium at extremely low temperature. This knowledge will prepare the learners for careers in research and engineering fields. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Mechanics and Thermodynamics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH101: Classical Physics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the concepts of mechanics & properties of matter & to apply them to problems.
2. Comprehend the basic concepts of thermodynamics & its applications in physical situations.
3. Learn about situations in low temperature.
4. Demonstrate tentative problem solving skills in all above areas.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Mechanics	**1. Compound pendulum:** Expression for period, Maximum and minimum time period, Centre of suspension and oscillations, Reversible compound pendulum, Kater's reversible pendulum, Compound pendulum and simple pendulum - a relative study Reference: HP **2.** Center of Mass, Motion of the Center of Mass, Linear momentum of a Particle Linear momentum of a System of Particles, Linear momentum w.r.t. CM coordinate (i.e., shift of origin from Lab to CM), Conservation of Linear Momentum, Some Applications of the Momentum Principle, System of Variable Mass, Torque acting on a Particle, Angular Momentum of a Particle, Angular Momentum of System of Particles, Total angular momentum w.r.t. CM coordinate, Conservation of Angular Momentum Reference: HP **3.** Oscillations, The Simple Harmonic Oscillator, Relation between Simple Harmonic Motion and Uniform Circular Motion, Two Body Oscillations,	15

		Damped Harmonic Motion, Forced Oscillations and Resonance Reference: HP	
II	Thermodynamics - I	**1.** (Review: Zeroth and first law of thermodynamics) Conversion of heat into work, heat engine, Carnot's ideal heat engine, Carnot's cycle: its efficiency Reference: AH **2.** Second law of thermodynamics - Statements, Equivalence of Kelvin-Plank and Clausius statement, Carnot's theorem, Reversible and irreversible process, Absolute scale of temperature Reference: AH **3.** Clausius theorem, Entropy, Entropy of a cyclic process, Reversible process, Entropy change, Reversible heat transfer, Principle of increase in entropy, Generalized form of first and second law, Entropy change of an ideal gas, Entropy of steam, Entropy and unavailable energy, Entropy and disorder, Absolute entropy Reference: AH	15
III	Thermodynamics – II	**1.** Third law of thermodynamics, Nernst heat theorem, Consequences of the third law, Maxwell's thermodynamic relations, Clausius – Clapeyron equation, Thermal Expansion Reference: AH **2.** **Heat Engines:** Rankine cycle, Steam engine, Otto engine, Efficiency of Otto cycle, Diesel cycle, Efficiency of Diesel cycle, Otto and Diesel cycle comparison Reference: AH, BSH **3.** **Low Temperature Physics:** Different methods of liquefaction of gases, Methods of freezing mixture, Cooling by evaporation, Cooling by adiabatic expansion, Joule - Thompson effect, JT	15

		effect of Van der Waal's gas, Liquefaction of helium, Properties and uses of liquid Helium Reference: BSH	

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. HP: Mechanics, H. S. Hans and S. P. Puri, Tata McGraw Hill (2nd ED.)
2. AH: Thermal Physics, A. B. Gupta and H. Roy, Book and Allied (P) Ltd, Reprint 2008-09
3. BSH: Heat, Thermodynamics and Statistical Physics, Brij lal, N. Subramanyam, P. S. Hemne, S. Chand, edition 2007

Additional reference:

1. Resnick and Halliday, Physics – I
2. Mechanics, K. R. Symon
3. Classical Dynamics of particles and systems, Thornton and Marian, CENGAGE Learning
4. Basic Thermodynamics, Evelyn Guha, Narosa Publications
5. Classical mechanics, Kleppener, Kollenkov
6. A treatise on heat, Meghanad Saha and B. N. Srivastava, 1969, India Press.
7. Mechanics and Electrodynamics, Rev. Edn. 2005, Brij lal and N. Subramanyam and Jeevan Seshan

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Electronics**
Course Code	USPH302
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. Learners will develop a basic understanding of variations of transistor parameters and their impact on circuit performance. Learners will develop the skill to analyze and design various transistor biasing circuits, general amplifier circuits and oscillator circuits. Learners will also attain a basic understanding of the fundamental principles of operational amplifiers, including its structure, operation and its versatile applications in electronics. These skills will empower learners to contribute effectively in the field of analog electronics, signal generation, signal processing, frequency control, circuit design, etc. Learners will also develop the skill to handle binary data and to perform arithmetic operations. Learners will develop the skill to analyze and optimize sequential circuits using flip-flops for a variety of digital applications. Learners will also understand types of digital registers and data transfer mechanisms that these registers allow for a wide range of digital applications. Learners will also develop a basic understanding of the fundamental principles of digital counters and will be able to analyze and design asynchronous and synchronous counters for a variety of digital applications. These skills will empower learners to contribute effectively in the field of digital systems, computer architecture and digital signal processing. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Electronics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH202: Electricity and Electronics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the basics of transistor biasing, operational amplifiers, their applications.
2. Understand the basic concepts of oscillators and be able to perform calculations using them.
3. Understand the working of digital circuits.
4. Demonstrate quantitative problem solving skill in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Analog Electronics - I	**1. Transistor Biasing**: Inherent Variations of Transistor Parameters, Stabilization, Essentials of a Transistor Biasing Circuit, Stability Factor, Methods of Transistor Biasing, Base Resistor Method, Emitter Bias Circuit, Circuit analysis of Emitter Bias, Biasing with Collector Feedback Resistor, Voltage Divider Bias Method, Stability factor for Potential Divider Bias Reference: MM **2. General amplifier characteristics:** Concept of amplification, amplifier notations, current gain, Voltage gain, power gain, input resistance, output resistance, phase reversal, frequency response, Decibel gain and Band width Reference: AM **3. Feedbacks in Amplifiers:** General theory of feedback, reasons for negative feedback, loop gain, Practical circuit of transistor amplifier with and without feedback Reference: MM	15

II	Analog Electronics - II	**1. Oscillators:** Introduction, effect of positive feedback. Requirements for oscillations, Phase shift oscillator, Wien Bridge Oscillator, Colpitt's Oscillator, Hartley Oscillator Reference: AM **2. Operational Amplifiers:** Introduction, Schematic symbol of OPAMP, Output voltage from OPAMP, AC analysis, Bandwidth of an OPAMP, Slew rate, Frequency Response of an OPAMP, OPAMP with Negative feedback, Inverting Amplifier, Non - Inverting Amplifier, Voltage Follower, Summing Amplifier, Applications of Summing amplifier, OPAMP Integrator and Differentiator, Comparator Reference: MM	15
III	Digital Electronics	**1.** Digital IC signal levels, Binary addition, Unsigned binary numbers, Sign magnitude numbers, 1's complement, 2's complement, Converting to and from 2's complement representation, 2's complement arithmetic, adder-subtractor (Ignore IC specific diagrams) Reference: LMS **2.** RS Flip-Flops (only NOR gate latch, NAND gate latch), Gated Flip-Flops, Edge- Triggered RS Flip-Flop, Edge-Triggered D Flip-Flop, Edge-Triggered JK Flip-Flop, JK Master- Slave Flip-Flops, Bounce elimination switch Reference: LMS **3.** Types of registers: SISO, SIPO, PISO, PIPO (general description) Reference: LMS **4.** Asynchronous counter - 3 bit (Ignore IC specific diagrams), Synchronous counter only Mod 8, Decade Counters, Mod 5 and Mod 10 Reference: LMS	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. MM: Principles of Electronics, V. K. Mehta and Rohit Mehta, S. Chand – Multicoloured illustrative edition
2. AM: Electronic devices and circuits, An introduction Allan Mottershead, PHI Pvt. Ltd.– EEE – Reprint – 2013
3. LMS: Digital Principles and Applications, Leach, Malvino, Saha - 6^{th} edn.

Additional References:

1. Digital Fundamentals, Thomas L. Floyd, 10^{th} edn.
2. Modern Digital Electronics, R. P. Jain, 4^{th} edn.

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Mathematical Methods in Physics**
Course Code	USPH303
Class	SYBSc
Semester	III
Number of Credits	02
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum focuses on providing basic understanding of various mathematical methods to learners that are essential for solving complex problems in physics. Curriculum covers various mathematical methods commonly used in physics, such as, vector algebra, vector calculus, differential equations, etc. This will empower learners to contribute effectively to the field of experimentation, research and theoretical developments. The curriculum is so designed that along with learning various mathematical methods, learners are also introduced to some of the real world examples, where they can find direct applications of these methods to analyze real world scenarios, e.g., the curriculum equips learners to analyze transient response of series LR, CR, LCR circuits. The curriculum also equips learners with basic understanding of curvilinear coordinate systems, particularly cylindrical and spherical coordinates and this will help learners to visualize systems geometrically.

Nomenclature: Mathematical Methods in Physics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the basic concepts of mathematical physics and applications of them in physical situations.
2. Learn mathematical skills and tools for studying physics.
3. Demonstrate quantitative problem solving skills in all topics covered

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Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Vector Algebra	**1.** Vectors, Scalars, Vector algebra, Laws of vector algebra, Unit vector, Rectangular unit vectors, Components of a vector, Scalar fields, Vector fields, Problems based on vector algebra, Dot or scalar product, Cross or vector product, Commutative and distributive laws, Scalar triple product (omit proof), Vector triple product (omit proof), Problems and applications based on dot, cross and triple products Reference: DJG **2.** The ∇ operator, Definition and physical significance of gradient, divergence and curl (omit proofs), Problems based on gradient, divergence and curl Reference: DJG	15
II	Vector Calculus	**1.** Line, Surface and Volume Integrals, The Fundamental Theorem of Calculus, The Fundamental Theorem of Gradient, The Fundamental Theorem of Divergence, The Fundamental Theorem of Curl (Statement and Geometrical interpretation is included, Proof of these theorems are omitted). Problems based on these theorems are required to be done	15

		Reference: DJG **2. Curvilinear Coordinates:** Cylindrical Coordinates, Spherical Coordinates Reference: DJG	
III	Differential Equations	**1.** Introduction, ordinary differential equations, First order homogeneous and non-homogeneous equations with variable coefficients, Exact differentials, General first order Linear Differential Equation, Second order homogeneous equation with constant coefficients, Problems, depicting physical situations like LC and LR circuits, Simple harmonic motion (Spring mass system) Reference: CH **2. Transient response of circuits:** Series LR, CR, LCR circuits (Growth and decay of current/charge) Reference: CR	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. DJG: D. J. Griffith, Introduction to Electrodynamics, 3rd Ed
2. CH: Charlie Harper, Introduction to Mathematical Physics, 2009 (EEE) PHI Learning Pvt. Ltd.
3. CR: D. Chattopadhyay, P. C. Rakshit, Electricity and Magnetism, 7th Edition, New Central Book Agency

Additional References:

1. Brij Lal, N. Subrahmanyam, Jivan Seshan, Mechanics and Electrodynamics, S. Chand (Revised and Enlarged Edition 2005)
2. A. K. Ghatak, Chua, Mathematical Physics, 1995, MacMillan India Ltd.
3. Ken Riley, Michael Hobson and Stephan Bence, Mathematical methods for Physics and Engineering, Cambridge (Indian Edition)
4. H. K. Dass, Mathematical Physics, S. Chand & Co.

5. Jon Mathews & R. L. Walker, Mathematical Methods of Physics, W. A. Benjamin Inc.
6. Murray R. Spiegel, Schaum's ouline of theory and problems of vector analysis, Asian Student Edition

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Physics Lab – III**
Course Code	USPH304
Class	SYBSc
Semester	III
Number of Credits	03
Nature	Practical
Type	Core
Revision specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Physics Lab – III

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, all 5 skill experiments from this course and minimum 12 experiments (4 from 'Mechanics' group, 4 from 'Electricity and Electronics' group and 4 from 'General Physics' group) from this course, should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Physics practical journal of third semester).
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A 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 the learner has completed this practical course as per the minimum requirements.
6. For Semester End Practical Examination, the learner will be examined in 3 experiments (1 from 'Mechanics' group, 1 from 'Electricity and Electronics' group and 1 from 'General Physics' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on all skill experiments, experiments done from 'Mechanics' group, experiments done from 'Electricity and Electronics' group and experiments done from 'General Physics' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (50 min.)
A	Skill Experiments	1. Wiring of simple circuit using breadboard 2. Use of Oscilloscope 3. Spectrometer: mean μ of yellow doublet of mercury source 4. Drawing of graph on semi logarithmic / logarithmic scale 5. Radius of ball bearings (single pan balance)	**15**
B	Mechanics	1. Y by bending 2. Searle's experiment: determination of Y 3. Searle's experiment: determination of η 4. Determination of acceleration due to gravity by using bar pendulum 5. Concept of beats 6. Resonance Pendulum	**40**
C	Electricity and Electronics	1. Passive low pass filter 2. Passive high pass filter 3. Passive band pass filter 4. Verification of Thevenin;s theorem for dc circuits 5. Verification of Norton's Theorem for dc circuits 6. Phase shift oscillator	**40**
D	General Physics	1. Figure of merit of a mirror galvanometer 2. Determination of absolute capacitance using BG 3. Measurement of resistance of galvanometer (G by shunting) 4. Charging and discharging of capacitor in series CR dc circuit 5. LCR parallel resonance 6. Surface tension of liquid 7. Coupled oscillations and resonance	**40**

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, P. C. Rakshit & B. Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B.Sc. Practical Physics, Harnam Singh, S. Chand & Co. Ld. 2001
3. A test book of advanced practical Physics, Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics, C. L. Arora, 1st Edition, 2001 S. Chand and Co. Ltd.
5. Practical Physics, C. L. Squires, 3rd Edition, Cambridge University
6. University Practical Physics , D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics, Worsnop & Flint

Evaluation Pattern:

A. Continuous Evaluation (60 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	15
Viva	15

B. Semester End Evaluation (Exam Pattern) (90 Marks – 6 hours)

Question No	Group	Title	Method	Marks
1	B	Mechanics	Experiment performance as per practical slip	30
2	C	Electricity and Electronics	Experiment performance as per practical slip	30
3	D	General Physics	Experiment performance as per practical slip	30

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Syllabi of Courses Offered for Semester IV

Name of the Course	**Optics and Material Science**
Course Code	USPH401
Class	SYBSc
Semester	IV
Number of Credits	02
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that learners will develop a comprehensive understanding of the phenomena like, diffraction of light, polarization of light. After that, learners will be well-prepared to predict, analyze and interpret these phenomena and will be able to use it in various contexts, including optics, spectroscopy, material characterization, photography, imaging, etc. The study of these phenomena will empower learners to contribute effectively in the field of research, technology development and innovations. Learners will also gain the comprehensive knowledge about classification of materials based on their electrical, optical and magnetic properties and the application of dielectric materials. This will help learners to analyze and select materials for various applications, considering their electrical, magnetic and optical properties. These skills will help learners to contribute effectively in the field of research specifically in material science and in the field of engineering, manufacturing, product design, etc. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Optics and Material Science

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH202: Optics and Acoustics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the phenomenon like, diffraction of light, polarization of light and their applications in physical situations.
2. Understand the fundamental principles of material science and classification of materials.
3. Demonstrate quantitative problem solving skills in all topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Diffraction of Light	**1. Fresnel's Diffraction:** (Review: Introduction, Huygens' – Fresnel theory, Distinction between interference and diffraction, Fresnel and Fraunhoffer types of diffraction) Fresnel's assumptions, Rectilinear propagation (Half period zones) of light, Diffraction pattern due to straight edge, Positions of maxima and minima in intensity, Intensity at a point inside the geometrical shadow(straight edge), Diffraction due to a narrow slit, Diffraction due to a narrow wire Reference: BSA **2. Fraunhoffer Diffraction:** Introduction, Fraunhoffer diffraction at a single slit, Intensity distribution in diffraction pattern due to a single slit, Fraunhoffer diffraction at a double slit, Distinction between single slit and double slit diffraction pattern and missing orders, Plane diffraction Grating, Theory of plane transmission grating, Width of principal maxima Reference: BSA	15

II	Polarization of Light	**1.** Introduction to Polarization of light, Types of polarization, Plane polarized light, Circularly polarized light, Elliptically polarized light, Partially polarized light, Production of Plane polarized light, Polarization by reflection from dielectric surface, Brewster's law, Polarization by refraction – pile of plates, Polarization by scattering, Polarization by selective Absorption, Polarizer and Analyzer, Malus' Law Reference: BSA **2.** Polarization by double refraction, Anisotropic crystal, Calcite crystal, Optic Axis, Double refraction in calcite crystal, Huygens' explanation of double refraction, Ordinary and Extra ordinary rays, Positive and Negative crystals, Superposition of waves linearly polarized at right angles, Superposition of e-Ray and o-Ray, Retarders, Quarter wave plate, Half wave plate, Production of linearly polarized light, Production of elliptically polarized light, Production of circularly polarized light, Analysis of polarized light, Applications of polarized light Reference: BSA	15
III	Properties of Material	**1. Electrical properties of materials:** Energy band diagram for materials – conductors, semiconductors and insulators, Electrical conductivity in metals, semiconductors and insulators (dielectrics), Effect of temperature on conductivity Reference: WD **2. Optical properties of materials:** Reflection, refraction, absorption and transmission of electromagnetic radiation in solids Reference: WD **3. Magnetic properties of materials:** Origin	15

		of magnetism in solids (basic idea), Types of magnetic order (paramagnetism, diamagnetism, antiferromagnetism, ferromagnetism, ferrimagnetism), magnetic hysteresis Reference: WD **4. Applications:** Applications of dielectric materials: Piezoelectric, ferroelectric and pyroelectric materials Reference: WD	

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. BSA - A Text Book Of Optics, Dr. N. Subrahmanyam, Brij lal, Dr M. N. Avadhanulu (S. Chand, 25th Revised edition 2012 Reprint 2013)
2. WD – Material Science and Engineering, An Introduction, 10th edition, William D. Callister, Jr. David G. Rethwisch

Additional reference:

1. Ajoy Ghatak: Optics (5th edn)
2. Rolf E. Hummel, Electronic Properties of Materials
3. V. Raghavan, Materials Science and Engineering: A First Course

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Quantum Physics**
Course Code	USPH402
Class	SYBSc
Semester	IV
Number of Credits	02
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	This course focuses on Schrödinger's equation and its applications, which provide a strong foundation for developing skills, which are essential for understanding quantum mechanics, conducting research and pursuing careers in fields of theoretical physics. Curriculum focuses on development of skills to calculate expectation values, probabilities and uncertainties based on solutions to Schrödinger's equation. Curriculum also focuses on development of skills in applying Schrödinger's equation to various physical systems, including particle in a box, harmonic oscillator and hydrogen atom to determine energy levels and wave functions.

Nomenclature: Quantum Physics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the course 'USPH201: Modern Physics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the postulates of quantum mechanics and understand its importance in explaining significant phenomena in Physics.
2. Demonstrate quantitative problem solving skills in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
		Background reading for Unit I, II and III (Review): **1.** Origin of Quantum Mechanics: a) Review of Black body radiation b) Review of photoelectric effects **2.** Matter waves - De Broglie hypothesis, Davisson and Germer experiment **3.** Wave particle duality **4.** Concept of wave packet, phase velocity, group velocity and relation between them **5.** Heisenberg's uncertainty principle with thought experiment, different forms of uncertainty	
I	The Schrodinger wave equation	**1.** Concept of wave function, Born interpretation of wave function **2.** Concept of operator in quantum mechanics examples – position, momentum and energy operators **3.** Eigenvalue equations, expectation values of operators **4.** Schrodinger equation **5.** Postulates of Quantum Mechanics **6.** Analogy between Wave equation and Schrodinger equation	15

		7. Time dependent and time independent (Steady State) Schrodinger equation, Stationary State **8.** Superposition principle **9.** Probability current density, Equation of continuity and its physical significance Reference: AB	
II	Applications of Schrodinger steady state equation – I	**1.** Free particle **2.** Particle in infinitely deep potential well (one - dimension) **3.** Particle in finitely deep potential well (one - dimension) **4.** Step potential **5.** Particle in three dimensional rigid box, degeneracy of energy state Reference: AB	15
III	Applications of Schrodinger steady state equation - II	**1.** Potential barrier (Finite height and width) penetration and tunneling effect (derivation of approximate transmission probability) **2.** Theory of alpha particle decay from radioactive nucleus **3.** Harmonic oscillator (one-dimension), correspondence principle Reference: AB	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. AB – Arthur Beiser, Perspective of Modern Physics, McGraw Hill

Additional References:

1. Concepts of Modern Physics, A. Beiser (6th Ed.) Tata McGraw Hill.
2. Quantum Mechanics, S P Singh, M K Bagade, Kamal Singh, - S. Chand: 2004 Ed.
3. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles, R. Eisberg and

R. Resnik Published by Wiley.
4. Introduction to Quantum Mechanics. - By D. Griffiths Published by Prentice Hall.
5. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.
6. Quantum Mechanics. - By L. I. Schiff.
7. Quantum Mechanics. - By Powell and Crasemann, Addison-Wesley Pub. Co.

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.

4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Applied Physics**
Course Code	USPH403
Class	SYBSc
Semester	IV
Number of Credits	02
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The topics on geology included in curriculum provide a comprehensive understanding of Earth's history, Earth’s structure, Earth resources, internal processes and tectonic dynamics to learners. The topics on geophysics included in curriculum provide a comprehensive understanding of Earth's physical properties, subsurface structures and tectonic processes through the application of geophysical techniques. This will encourage learners for further studies or careers in geology, geophysics and related fields. The topics on microprocessor included in curriculum provide knowledge about hardware and software of microprocessor 8085 to learners. After that, learners will be able to write basic assembly language programs for microprocessor 8085. This will provide the foundation to learners to pursue careers in the field of embedded systems design, digital electronics, computer engineering, automation and related fields. Additionally, experiments with microprocessor 8085 included in following physics lab courses will reinforce learner’s theoretical understanding to practical applications. The topics on radio communication included in curriculum provide understanding about fundamental principles of radio communication, including modulation, demodulation, propagation, and signal processing in analog and digital communication. This will provide the foundation to learners to pursue careers in the field of telecommunication, wireless technology, networking and related fields.

Nomenclature: Applied Physics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand structure of earth including various layers, plate tectonics, interior of earth, processes in interior of earth.
2. Learn about geological features, geological timescale, evolution of life on earth and the interpretation of geological history through fossils and rock layers.
3. Learn about causes and effects of natural hazards/calamities.
4. Understand principles and components of radio communication system.
5. Understand various modulation techniques including analog and digital modulation.
6. Understand architecture, operation and basic assembly language programming of 8085 microprocessor.
7. Be able to write basic assembly language programming with 8085 microprocessor.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Introduction to Geology and Geophysics	**1. GEOLOGY:** Introduction to Geology its branches and relationship with other sciences, Earth and solar system: Meteorites and other extra-terrestrial materials, Age of Earth and various methods of determination, Planetary evolution of the Earth and its internal structure: Elastic waves and variation of physical and chemical properties in the interior of Earth, Major tectonic features of the ocean, oceanic and continental crust, Continental drift – geological and geophysical evidence: mechanisms, objections and present status, Geodynamics of the Indian plate Reference: BSJ **2. GEOPHYSICS:** Introduction to Geophysics,	15

		Gravity and magnetic anomalies at Mid-ocean ridges: deep sea trenches, continental shield areas and mountain chains, Geomagnetism, elements of Earth's magnetism: Internal, external fields and their causes, Palaeomagnetism, Polar wandering paths and reversals, Seafloor spreading and Plate tectonics, Seismic belts of the Earth: Seismicity and plate movements, Utility of the different geophysical techniques (discussed above) in exploration for academic as well as for harnessing resources. Geophysical potential fields: Principles of Gravity and Magnetic methods, Instrumentation, field procedures used in geophysical studies Reference: TLT	
II	Microprocessor	**1. Building Concept of Microprocessor:** Introduction, Study of Memory, Input Device, Output Device, Input/output Device Central Processing Unit Reference: RG **2. 8085 Microprocessor:** Introduction, Features of Inter 8085 , Pin Diagram of 8085 , 8085 CPU Architecture, Arithmetic and Logical Group (ALU), Accumulator, Temporary Register, Flag Register (PSW)), Register Group (Temporary Registers (W and Z), General purpose registers, Special Purpose registers), Interrupt Control, Serial I/O Control Group, Instruction Register, Decoder and Control Group (Instruction Register, Instruction Decoder, Timing and Control) Reference: RG **3. 8085 Instruction Set:** Introduction, Flowchart, Classification of Instruction Set (Data Transfer Group, Arithmetic Group, Logical Group, Branching Group, Stack and Machine Control Group), Notations used in Instructions and Opcode, Data Transfer Group, Program Examples for Data	15

		Transfer Group, Arithmetic Operation Group, Branch Group, Logical Group, Addressing Modes, 8085 Programmers Model Reference: RG	
III	Radio Communication	**1. Basics of Communication**: Electromagnetic spectrum, Block diagram of communication system, types of communication system: simplex, duplex, analog and digital communication, base band and broad band communication, Noise concept and types, signal to noise ratio, noise figure, noise temperature, Need of modulation, concept of modulation Reference: LF **2. Amplitude Modulation:** AM waveform, mathematical expression of AM, concept of sideband, demodulation principles, AM Receiver: TRF and super heterodyne receiver Reference: LF, VM **3. Frequency Modulation:** Definition, mathematical representation, frequency spectrum, bandwidth and modulation index Reference: LF, VM **4.** Concept of ASK, PSK, FSK, PAM, PWM, PPM, PCM Reference: LF	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. LF: Communication Electronics: Principles and applications by Louis E Frenzel 3rd edition TMH Publications.

2. RG: Microprocessor Architecture, programming and Applications with the 8085 by Ramesh Gaonkar, 5th Edition, Prentice Hall of India
3. VM: Principles of Electonics, V. K. Mehta, Rohit Mehta, S. Chand & Company, Multicolour Illustrative Edition
4. BSJ: Introduction to Applied Geophysics: Exploring the Shallow Subsurface. H.R. Burger, A.F. Sheehan and C.H. Jones. W.W. Norton, New York (2006)
5. TLT: Earth Science. E.J. Tarbuck, F.K. Lutgens and D. Tasa, Prentice & Hall (2005). 4. Mantle Plumes and Their Record in Earth History. K.C. Condie, Cambridge University Press, Cambridge, UK (2001)

Additional References:

1. Microprocessor and Applications by Vibhute and Borole, Technova Publications, Pune
2. Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH
3. Geomagnetism: Solid Earth and Upper Atmosphere Perspectives. Nathani Basavaiah, Springer (2011)
4. The Magnetic Field of the Earth: Paleomagnetism, the Core, and the Deep Mantle. R.T. Merrill, M.W. McElhinny and P.L. McFadden, International Geophysical Series 63, Academic Press (1996)
5. Applied Geophysics (Paperback). W.M. Telford, L.P. Geldart and R.E. Sheriff, Cambridge University Press, Cambridge (1990)
6. Electronics Communication Systems by Kennedy
7. Telecommunication Switching Systems and Network by Vishwanathan and Thiagarajan, PHI publication
8. Electronics Communication Systems by Denis Roddy and John Coolen, PHI publication.

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	07 08
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	07 08
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	07 08
4	Objective type of questions without internal option	I II III	05 05 05

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Physics Lab – IV**
Course Code	USPHP4
Class	SYBSc
Semester	IV
Number of Credits	03
Nature	Practical
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows learners to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results. Learner will also develop the skill to write and perform basic assembly language program with 8085 microprocessor.

Nomenclature: Physics Lab – IV

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. To learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.
5. Write and perform basic assembly language programming with 8085 microprocessor.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of performing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this course, 5 demonstration experiments and minimum 12 experiments (4 from 'Optics' group, 4 from 'Electricity and Electronics' group and 4 from 'Microprocessor' group) should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Physics practical journal of fourth semester).
4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Physics department and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A 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 the learner has completed this practical course as per minimum requirements.
6. For Semester End Examination, the learner will be examined in 3 experiments (1 from 'Optics' group, 1 from 'Electricity and Electronics' group and 1 from 'Microprocessor' group) from this course and each experiment will be of two hours duration.
7. Evaluation in viva voce will be based on demonstration experiments, experiments done from 'Optics' group, 'Electricity and Electronics' group, and 'Microprocessor' group, from this course.
8. While evaluating learner's performance at Semester End Practical Examination,

weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, flowchart, assembly language program, calculation and result, whichever applicable.

Curriculum:

Group	**Group Title**	**Learning Points**	**No. of lectures (50 min.)**
A	Optics	1. Optical lever: determination of μ 2. Single slit diffraction using LASER 3. Determination of Cauchy's constants 4. R.P. of telescope 5. R.P. of grating 6. Determination of wavelength of LASER using diffraction grating	**40**
B	Electricity and Electronics	1. Study of MS-JK flip flop 2. OPAMP: Inverting amplifier with different gains 3. OPAMP: Non-inverting amplifier with different gains and voltage follower 4. CE amplifier: determination of bandwidth 5. CE amplifier: variation of gain with load 6. Verification of Maximum Power Transfer Theorem for dc circuits	**40**
C	Microprocessor	1. Microprocessor 8085: addition, subtraction, multiplication of two 8-bit numbers 2. Microprocessor 8085: Two digit Decimal addition, subtraction 3. Microprocessor 8085: Memory block transfer from one location to another 4. Microprocessor 8085: Find largest/smallest number in given block 5. Microprocessor 8085: Find number of positive/negative, odd/even elements in given block 6. Microprocessor 8085: Arrange given numbers in ascending/descending order	**40**

		(Note: Use 8085 kit or any 8085 simulator to perform above experiments)	
D	Demonstration Experiments	1. Waveform generation using OPAMP 2. Fraunhoffer diffraction due to single slit, double slit, Missing orders of interference maxima in double slit diffraction pattern 3. Fraunhoffer diffraction – Grating Spectra 4. Total internal reflection 5. Double refraction 6. ac operations of a CE amplifier 7. First order active filter	**15**

Learning Resources recommended:

1. Advanced course in Practical Physics, D. Chattopadhya, P. C. Rakshit & B Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B. Sc. Practical Physics – Harnam Singh S. Chand & Co. Ld. 2001
3. A test book of advanced practical Physics, Samir Kumar Ghosh, New Central Book Agency (3rd edition)
4. B. Sc. Practical Physics – C. L. Arora (1st Edition) -2001 S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition) Cambridge University
6. University Practical Physics – D. C. Tayal, Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint.
8. Microprocessor Architecture, programming and Applications with the 8085 by Ramesh Gaonkar, 5th Edition, Prentice Hall of India
9. Microprocessor 8085 User Manual

Evaluation Pattern:

A. Continuous Evaluation (60 Marks):

Method	Marks
Performance and engagement during practical sessions throughout semester: • Skills, precision, accuracy, safety measures, collaborative and/or individual working while performing practical • Ability to record proper observations, to analyze data, to plot graph	30

and to draw meaningful conclusions of experiments • Submission of journal after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	
Overall performance (attendance, punctuality, sincerity for practical sessions)	15
Viva	15

B. Semester End Evaluation (Exam Pattern) (90 Marks – 6 hours):

Question No.	Group	Title	Method	Marks
1	A	Optics	Experiment performance as per practical slip	30
2	B	Electricity and Electronics	Experiment performance as per practical slip	30
3	C	Microprocessor	Experiment performance as per practical slip	30

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R. E. SOCIETY'S,

R. P. GOGATE COLLEGE OF ARTS & SCIENCE

AND

R. V. JOGALEKAR COLLEGE OF COMMERCE

(AUTONOMOUS),

RATNAGIRI

SYLLABI OF COURSES OFFERED BY DEPARTMENT OF PHYSICS OF THE COLLEGE IN THE SUBJECT PHYSICS FOR THE THIRD YEAR (SEMESTER V & VI) OF PROGRAM BSc

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

WITH THE EFFECT FROM ACADEMIC YEAR 2023-24

Program Outcomes of BSc with Subject Physics

Name of Program	BSc
Level	UG
Number of Semesters	06
Year of Implementation	2023-24
Program Specific Outcomes (PSO)	After successful completion of this program, learners will: 1. Understand fundamental physics concepts and will be able to apply physics principles to real world problems. 2. Be able to think critically and develop the ability to apply theoretical and mathematical principles to solve complex problems in various areas of physics. 3. Acquire hands-on experience in conducting experiments, using laboratory equipments, analyzing experimental data and will be able to draw meaningful conclusions of experiment and to interpret results. 4. Recognize the interconnections between physics and other disciplines, such as, mathematics, chemistry and engineering and will be able to work effectively in those interdisciplinary fields. 5. Possess basic programming skills, will be introduced to the field of automation and will be equipped with essential knowledge and skills to work with basic automation systems. 6. Develop the ability to work individually as well as in collaboration. 7. Be able to pursue higher studies and will be able to take research opportunities.
Relevance of PSOs to the local, regional, national and global developmental needs	Science graduates with the subject Physics can go for higher studies and pursue careers directly related to physics, like, research, academics, etc. Other than this, Science graduates with the subject Physics can also pursue careers in other fields, such as, data science, engineering, IT, automation, government jobs, medical physics and healthcare industry, national security, etc., due to their analytical, problem solving and critical thinking abilities. BSc program with the subject Physics produces graduates with a diverse skill set capable of addressing various challenges. This can lead to improve research and innovation, economic growth

	and sustainable development from local to global level. The relevance of BSc program with the subject Physics to developmental needs enhances its overall impact on society and makes it more responsive to the evolving demands of the scientific, technological and societal landscape.

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Scheme of Evaluation

Course Evaluation:

Each course of BSc in the subject Physics will be assessed with Continuous Evaluation and Semester End Evaluation. Continuous Evaluation of each course will be of 40% and Semester End Evaluation of each course will be of 60%.

Passing Scheme:

For each course of BSc in the subject Physics, there will be separate head of passing for Continuous Evaluation and for Semester End Evaluation. Course grade points and course grade will be decided by the aggregate marks obtained by a learner.

Aggregate Marks = *Marks Obtained by a learner in Continuous Evaluation* + *Marks obtained by a learner in Semester End Evaluation*

In order to earn credits of this course, a learner is required to secure a minimum of 40% marks in Continuous Evaluation and 40% marks in Semester End Evaluation.

Conversion of Marks:

There will be no conversion of marks for TYBSc.

Credit and Grade Scheme:

<table>
<tr><th>% of Aggregate Marks Obtained</th><th>Course Grade Point</th><th>Course Grade</th><th>Performance Indicator</th><th>Credits Earned</th></tr>
<tr><td>90.0 to 100</td><td>10</td><td>O</td><td>Outstanding</td><td rowspan="7">As mentioned in Course Syllabus</td></tr>
<tr><td>80 to 89.99</td><td>9</td><td>A+</td><td>Excellent</td></tr>
<tr><td>70 to 79.99</td><td>8</td><td>A</td><td>Very Good</td></tr>
<tr><td>60 to 69.99</td><td>7</td><td>B+</td><td>Good</td></tr>
<tr><td>55 to 59.99</td><td>6</td><td>B</td><td>Above Average</td></tr>
<tr><td>50.0 to 54.99</td><td>5</td><td>C</td><td>Average</td></tr>
<tr><td>40 to 49.99</td><td>4</td><td>P</td><td>Pass</td></tr>
<tr><td>Less Than 40</td><td>0</td><td>F</td><td>Fail</td><td rowspan="2">0</td></tr>
<tr><td>Absent</td><td>0</td><td>Ab</td><td>Absent</td></tr>
</table>

Note:

For any course,

Aggregate Marks = *Marks Obtained by a learner in Continuous Evaluation* + *Marks obtained by a learner in Semester End Evaluation*

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Scheme of Courses Offered by Department of Physics for TYBSc

Semester V			Semester VI		
Course Code	**Nomenclature**	**Credits**	**Course Code**	**Nomenclature**	**Credits**
USPH501	Mathematical, Thermal and Statistical Physics	**2.5**	USPH601	Classical Mechanics	**2.5**
USPH502	Solid State Physics	**2.5**	USPH602	Electronics	**2.5**
USPH503	Atomic and Molecular Physics	**2.5**	USPH603	Nuclear Physics	**2.5**
USPH504	Electrodynamics	**2.5**	USPH604	Special Theory of Relativity	**2.5**
USPH505	Physics Lab – V	**3**	USPH605	Physics Lab – VII	**3**
USPH506	Physics Lab - VI	**3**	USPH606	Physics Lab - VIII	**3**
USACEI501	Applied Component (Electronic Instrumentation) I: Analog Circuits, Instruments and Consumer Appliances	**2**	USACEI601	Applied Component (Electronics Instrumentation) II: Digital Electronics, Microprocessor, Microcontroller and OOP	**2**
USACEI502	Practical of Course 'Applied Component (Electronic Instrumentation) I: Analog Circuits, Instruments and Consumer Appliances'	**2**	USACEI602	Practical of Course 'Applied Component (Electronics Instrumentation) II: Digital Electronics, Microprocessor, Microcontroller and OOP'	**2**

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Syllabi of Courses Offered for Semester V

Name of the Course	**Mathematical, Thermal and Statistical Physics**
Course Code	USPH501
Class	TYBSc
Semester	V
Number of Credits	2.5
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Topics on probability included in the curriculum develop learners' ability to analyze uncertainty, model random events and make informed decisions based on probabilistic reasoning. These skills are valuable for careers in statistics, data analysis, finance, engineering and various fields where uncertainty plays a significant role. Topics on complex functions included in the curriculum develop learner's skills in understanding and analyzing functions of complex variables. These skills are valuable for career in mathematics, engineering, physics and any field where understanding and manipulating complex behavior is essential. Topics on differential equations included in curriculum develop learner's ability to analyze and solve differential equations. These skills are valuable for career in mathematics, engineering, physics and other fields where understanding and predicting change over time is crucial. The curriculum also equips learners with fundamental concepts of statistical thermodynamics to develop the ability of learner to analyze and predict the behavior of systems of particles. These skills are needed for careers in physics, chemistry, materials science, engineering and other fields where understanding the probabilistic behavior of a system is essential.

Nomenclature: Mathematical, Thermal and Statistical Physics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the courses 'USPH101: Classical Physics' and 'USPH301: Mechanics and Thermodynamics' and 'USPH303: Mathematical Methods in Physics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Comprehend the basic concepts of thermodynamics & its applications in physical situations.
2. Learn some mathematical techniques required to understand the physical phenomena at the undergraduate level.
3. Get exposure to important ideas of statistical mechanics.
4. Be able to solve simple problems in probability, understand the concept of independent events and work with standard continuous distributions.
5. Understand the functions of complex variables.
6. Be able to solve non-homogeneous differential equations and partial differential equations using simple methods.
7. Understand the concept of statistical mechanics through the concept of microstates, the concept of configurations, Boltzmann distribution and statistical origins of entropy.
8. Understand the difference between classical and quantum statistics.
9. Demonstrate tentative problem solving skills in all above areas.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Probability	Review of basic concepts, introduction, sample space, events, independent events, conditional probability, probability theorems, methods of counting (derivation of formulae not expected), random variables, continuous distributions (omit joint distributions), binomial distribution, the normal distribution, the Poisson distribution Reference: MB – 15.1-15.9 Expected to cover solved problems from each section and solve at least the following	15

		problems: section 2: 1-5, 11-15, section 3: 1, 3, 4, 5, section 4: 1, 3, 5,13, 21, section 5: 1, 10, 13, section 6: 1 to 9, section 8: 1 and 3, section 9: 2, 3, 4, 9	
II	Complex functions and differential equations	**1.** Functions of complex variables: The exponential and trigonometric functions, hyperbolic functions, logarithms, complex roots and powers, inverse trigonometric and hyperbolic functions, some applications Reference: MB: 2.11 to 2.16 Expected to cover all solved problems. In addition, solve the following problems: section 2: 16 – 2, 3, 8, 9, 10 **2.** Second order non-homogeneous equations with constant coefficients, partial differential equations, some important partial differential equations in physics, method of separation of variables Reference : CH :5.2.4, 5.3.1 to 5.3.4 Expected to cover all solved problems. In addition, solve the following problems: 5.17 a to e, 5.23, 5.26, 5.29 to 5.35	15
III	Statistical Thermodynamics	Microstates and configurations, derivation of Boltzmann distribution, dominance of Boltzmann distribution, physical meaning of the Boltzmann distribution law, definition of , the canonical ensemble, relating Q to q for an ideal gas, translational partition function, equipartition theorem, energy, entropy Reference: ER	15
IV	Classical and Quantum Statistics	**1.** The probability of a distribution, The most probable distribution, Maxwell- Boltzmann statistics, Molecular speeds Reference: AB **2.** Bose-Einstein statistics, Black-body	15

		radiation, The Rayleigh-Jeans formula, The Planck radiation formula, Fermi-Dirac statistics, Comparison of results Reference: AB	

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. MB: Mathematical Methods in the Physical sciences: Mary L. Boas Wiley India, 3rd ed.
2. ER: Thermodynamics, Statistical Thermodynamics and Kinetics: T. Engel and P. Reid (Pearson)
3. AB: Perspectives of Modern Physics: Arthur Beiser, (Mc Graw Hill International)
4. CH: Introduction to Mathematical Methods: Charlie Harper (PHI Learning)

Additional reference:

1. Mathematical Physics: A K Ghatak, Chua – 1995 Macmillian India Ltd.
2. Mathematical Method of Physics: Riley, Hobson and Bence, Cambridge (Indian edition)
3. Mathematical Physics: H. K. Das, S. Chand & Co.
4. Mathematical Methods of Physics: Jon Mathews & R. L. Walker, W A Benjamin inc.
5. A Treatise on heat: Saha and Srivastava (Indian press, Allahabad)
6. Statistical Physics: F. Reif (Berkeley Physics Course, McGraw Hill)
7. Introductory Statistical Mechanics: R. Bowley and M. Sanchez (Oxford Science Publications)
8. An Introduction to Thermal Physics: D. V. Schroeder (Pearson).
9. PROBABILITY: Schaum's Outlines Series by S. Lipschutz and M. L. Lipson (Mc Graw Hill International)

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06
4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06
5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Solid State Physics**
Course Code	USPH502
Class	TYBSc
Semester	V
Number of Credits	2.5
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The course is so designed that it develops learner's ability to analyze, understand and predict structure, properties and behavior of crystalline materials at the atomic and subatomic level. The curriculum includes topics like, electrical properties of metals which develops learner's ability to understand and analyze the behavior of metallic materials for electrical and electronic applications. The curriculum also includes topics like, band theory of solids and conduction in semiconductors which develops learner's ability to understand and analyze the electronic properties of solid materials, particularly semiconductors. The curriculum also equips learners with the ability to understand, analyze and apply the principles of diode operation and superconductivity. All these skills are valuable for learners which make foundation to pursue careers in the field of material science, condensed matter physics, electrical engineering, electronics, semiconductor device engineering and related fields.

Nomenclature: Solid State Physics

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the basics of crystallography, electrical properties of metals, band theory of solids, demarcation among the types of materials, semiconductor physics and superconductivity.
2. Understand the application of Fermi - Dirac distribution function, density of states, conduction in semiconductors and BCS theory of superconductivity.
3. Demonstrate quantitative problem solving skills in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Crystal Physics	The crystalline state, Basic definitions of crystal lattice, basis vectors, unit cell, primitive and non-primitive cells, The fourteen Bravais lattices and the seven crystal systems, Elements of symmetry, nomenclature of crystal directions and crystal planes, Miller Indices, spacing between the planes of the same Miller indices, examples of simple crystal structures, The reciprocal lattice and X-ray diffraction Reference: AO	15
II	Electrical Properties of Metals	**1.** Classical free electron theory of metals, Drawbacks of classical theory, Relaxation time, Collision time and mean free path Reference: SOP **2.** Quantum theory of free electrons, Fermi Dirac statistics and electronic distribution in solids, Density of energy states and Fermi energy, The Fermi distribution function, Heat capacity of the Electron gas, Mean energy of electron gas at 0 K, Electrical conductivity from	15

		quantum mechanical considerations, Failure of Sommerfeld's free electron Theory, Thermionic emission Reference: SOP	
III	Band Theory of Solids and Conduction in Semiconductors	**1.** Band theory of solids, The Kronig- Penney model (Omit eq. 6.184 to 6.188), Allowed energy spectrum for electron in a solid, E(K) curve, Brillouin zones, Number of wave functions in a band, Motion of electrons in a one-dimensional periodic potential, Effective mass of an electron in a solid, Effective number of free electrons in a band, Distinction between metals, insulators and intrinsic semiconductors Reference: SOP **2.** Electrons and Holes in an Intrinsic Semiconductor, Conductivity of a Semiconductor, Carrier concentrations in an intrinsic semiconductor, Donor and Acceptor impurities, Charge densities in a semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation, Hall Effect Reference: MHS	15
IV	Diode Theory and Superconductivity	**1. Semiconductor-diode Characteristics:** Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction, The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics, Diode resistance Reference: MHS **2. Superconductivity:** Experimental Survey, Occurrence of Superconductivity, destruction of superconductivity by magnetic field, The Meissner effect, London equation, BCS	15

		theory of superconductivity, Type I and Type II Superconductors, Vortex state Reference: CK	

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. AO: Elementary Solid State Physics-Principles and Applications: M. Ali Omar, Pearson Education, 2012
2. SOP: Solid State Physics: S. O. Pillai, New Age International, 6th Ed.
3. MHS: Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (3rd Ed.) Tata McGraw Hill
4. CK: Introduction to Solid State Physics - Charles Kittel, 7th Ed. John Wiley & Sons.

Additional reference:

1. Solid State Physics: A. J. Dekker, Prentice Hall.
2. Electronic Properties of Materials: Rolf Hummel, 3rd Ed. Springer
3. Semiconductor Devices: Physics and Technology, 2nd Ed. John Wiley & Sons
4. Solid State Physics: Ashcroft & Mermin, Harcourt College Publisher
5. Modern Physics and Solid State Physics: Problems and solutions New Age International

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06
4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06
5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	Atomic and Molecular Physics
Course Code	USPH503
Class	TYBSc
Semester	V
Number of Credits	2.5
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The course is so designed that it includes the study of hydrogen atom and electron spin aims which develops learner's ability to understand and analyze the behavior of atomic systems at the quantum level, including the hydrogen atom and the fundamental concept of electron spin. The curriculum includes topics like, spin-orbit coupling and the effect of magnetic fields on atoms which develops learner's ability to understand and analyze the interactions between electron spin, orbital angular momentum, and external magnetic fields in atomic and molecular systems. The curriculum includes topics like, molecular spectra which develops learner's ability to understand, analyze and interpret the interactions between molecules and electromagnetic radiation, as well as the information obtained from different types of molecular spectra. The curriculum also focuses on topics like, infrared spectrometry and microwave spectrometry which develops learner's ability to understand these spectroscopic techniques, enabling them to study molecular properties and interactions in various applications. The study of Raman Effect aims to develop learner's ability to understand molecular vibrational modes, interactions and properties in Raman spectra. The study of electron and nuclear resonance develops learner's ability to understand principle of operation of ESR and NMR spectrometers, enabling them to study molecular and atomic properties, interactions and dynamics. This foundation will encourage learners for advanced study and pursue careers in the field of atomic physics, quantum mechanics, chemistry, materials science, spectroscopy, spectrometry, analytical laboratories, medical imaging and related fields.

Nomenclature: Atomic and Molecular Physics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the courses 'USPH102: Modern Physics' and 'USPH403: Quantum Mechanics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the application of quantum mechanics in atomic physics.
2. Understand the importance of electron spin, symmetric and antisymmetric wave functions and vector atom model.
3. Understand the effect of magnetic field on atoms.
4. Learn Molecular physics and its applications.
5. Get an insight into theoretical basics of spectroscopy.
6. Demonstrate quantitative problem solving skills in all topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Hydrogen Atom, Electron Spin	**1. Hydrogen atom:** Schrödinger's equation for Hydrogen atom and its solution by variable separation method, Quantum Numbers: Total quantum number, Orbital quantum number, Magnetic quantum number, Angular momentum, Electron probability density (Radial part) Reference: B **2. Electron spin:** The Stern-Gerlach experiment, Pauli's Exclusion Principle, Symmetric and Anti-symmetric wave functions Reference: B	15
II	Spin-Orbit Coupling, Effect of Magnetic Field on Atoms	**1.** Spin orbit coupling, Total angular momentum, Vector atom model, L-S and j-j coupling, Origin of spectral lines, Selection rules Reference: B **2.** Effect of Magnetic field on atoms, the normal Zeeman effect and its explanation	15

		(Classical and Quantum), The Lande g-factor, Anomalous Zeeman effect Reference: B	
III	Molecular Spectra, Spectrometer	**1.** Molecular spectra (Diatomic Molecules): Rotational energy levels, Rotational spectra, Vibrational energy levels, Vibrational-Rotational spectra, Electronic Spectra of Diatomic molecules: The Born-Oppenheimer approximation, Intensity of vibrational-electronic spectra: The Franck-Condon principle Reference: B **2.** Infrared spectrometer & Microwave spectrometer Reference: B	15
IV	Raman Effect, Electron and Nuclear Resonance	**1. Raman effect:** Quantum Theory of Raman effect, Pure Rotational Raman spectra: Linear molecules, Symmetric top molecules, Asymmetric top molecules, Vibrational Raman spectra: Raman activity of vibrations, Experimental set-up of Raman Effect Reference: BM **2. Electron spin resonance:** Introduction, Principle of ESR, ESR spectrometer Reference: GA **3. Nuclear magnetic resonance:** Introduction, principle and NMR instrumentation Reference: GA	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. B: Perspectives of Modern Physics: Arthur Beiser, McGraw Hill
2. BM: Fundamentals of Molecular Spectroscopy: C. N. Banwell & E. M. McCash (TMH).(4th Ed.)
3. GA: Molecular structure and spectroscopy: G Aruldhas (2nd Ed) PHI learning Pvt Ltd.

Additional reference:

1. Atomic Physics (Modern Physics): S. N. Ghoshal. S. Chand Publication (for problems on atomic Physics)

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06
4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06

5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Electrodynamics**
Course Code	USPH504
Class	TYBSc
Semester	V
Number of Credits	2.5
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum is so designed that it includes topics like, electrostatics which develops learner's ability to understand, analyze and solve problems related to electric fields, potentials and charge distributions in the context of electromagnetic theory. The curriculum includes topics like, electrostatics in matter and magnetostatics which develops learner's ability to understand, analyze and solve problems related to electric and magnetic fields, charges, currents and their interactions with materials. The curriculum includes topics like, magnetostatics in matter and electrodynamics which develops learner's ability to understand, analyze and solve problems related to magnetic properties, materials and electromagnetic interactions. A curriculum also focuses on study of electromagnetic waves within the context of electrodynamics which develop learner's ability to understand, analyze and predict the behavior of electromagnetic waves and their interactions with matter and boundaries. This foundation will encourage learners for advanced study and pursue careers in the field of electrostatics, magnetostatics, electrodynamics, telecommunications, optics, material science and related fields.

Nomenclature: Electrodynamics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the courses 'USPH303: Mathematical Methods in Physics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the laws of electrodynamics and be able to perform calculations using them.
2. Understand Maxwell's electrodynamics and its relation to relativity.
3. Understand how optical laws can be derived from electromagnetic principles.
4. Develop quantitative problem solving skills.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Electrostatics	**1.** Review of Coulomb & Gauss law, The divergence of E, Applications of Gauss' law, The curl of E, Introduction to potential, Comments on potential, The potential of a localized charge distribution, Poisson's equation and Laplace's equation, Solution and properties of 1D Laplace equation, Properties of 2D and 3D Laplace equation (without proof) Reference: DG **2.** Boundary conditions and Uniqueness theorems, Conductors and Second Uniqueness theorem, The classic image problem- point charge and grounded infinite conducting plane and conducting sphere Reference: DG	15
II	Electrostatics in Matter and Magnetostatics	**1.** Dielectrics, Induced Dipoles, Alignment of polar molecules, Polarization, Bound charges and their physical interpretation, Gauss' law in presence of dielectrics, A deceptive parallel, Susceptibility, Permittivity, Dielectric constant and relation between them, Energy in dielectric systems	15

		Reference: DG **2.** Review of Biot-Savart's law and Ampere's law, Straight-line currents, The Divergence and Curl of B, Applications of Ampere's Law in the case of a long straight wire and a long solenoid, Comparison of Magnetostatics and Electrostatics, Magnetic Vector Potential Reference: DG	
III	Magnetostatics in Matter and Electrodynamics	**1.** Magnetization, Bound currents and their physical interpretation, Ampere's law in magnetized materials, A deceptive parallel, Magnetic susceptibility and permeability Reference: DG **2.** Energy in magnetic fields, Electrodynamics before Maxwell, Maxwell's correction to Ampere's law, Maxwell's equations, Magnetic charge, Maxwell's equations in matter, Boundary conditions Reference: DG	15
IV	Electromagnetic Waves	**1.** The continuity equation, Poynting's theorem Reference: DG **2.** The wave equation for E and B, Monochromatic Plane waves, Energy and momentum in electromagnetic waves, Propagation in linear media, Reflection and transmission of EM waves at normal incidence, Reflection and transmission of EM waves at oblique incidence Reference: DG	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. DG: Introduction to Electrodynamics, David J. Griffiths (3^{rd} Ed) Prentice Hall of India

Additional reference:

1. Introduction to Electrodynamics: A. Z. Capria and P. V. Panat, Narosa Publishing House
2. Engineering Electrodynamics: William Hayt Jr. & John H. Buck (TMH)
3. Foundations of Electromagnetic Theory: Reitz, Milford and Christy
4. Solutions to Introduction to Electrodynamics: David J. Griffiths (3^{rd} Ed) Prentice Hall of India

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06
4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06

5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Physics Lab - V**
Course Code	USPH505
Class	TYBSc
Semester	V
Number of Credits	3
Nature	Practical
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Physics Lab - V

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. Learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. A learner must enroll for physics practical courses USPH505 and USPH506 simultaneously and there will be a common journal for courses USPH505 and USPH506.
4. In order to appear for Semester End Practical Examination of both these courses, minimum 8 experiments from the group of 'General Physics' from course USPH505, all 3 'Skill Experiments' from course USPH505, minimum 8 experiments from the group of 'Electricity and Electronics' from course USPH506 and all 3 'Skill Experiments' from course USPH506 should be completed compulsorily and learners are required to report all these experiments in the common journal of these Physics practical courses.
5. After completing all required number of experiments for these courses and recording them in journal, a learner will have to get their journal certified and produce the certified journal at the time of Semester End Practical Examination of these courses.
6. A learner will be allowed to appear for the Semester End Practical Examination of these courses, only if a learner submits a common certified journal of these courses or a certificate from the head of the Physics department that the learner has completed these practical courses as per minimum requirements.
7. For Semester End Practical Examination of these courses, the learner will be examined for 1 experiment from each course. For Semester End Practical Examination of course USPH505, the experiment will be from 'General Physics' group and for Semester End Practical Examination of course USPH506, the experiment will be from 'Electricity and Electronics' group and each experiment will be of three hours duration.

8. Evaluation in viva voce will be separate for each of these courses and it will be based on experiments done from the respective courses.
9. While evaluating learner's performance for Semester End Practical Examination of each course, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (50 min.)
A	Skill Experiments	1. Estimation of errors from actual experimental data 2. Spectrometer: Optical Leveling and Schuster's Method 3. Laser beam profile	**10**
B	General Physics	1. Determination of 'g' by Kater's pendulum 2. Elastic constants of a rubber tube 3. Determination of dielectric constant 4. Logarithmic decrement 5. Searle's Goniometer 6. Determination of Rydberg's constant 7. Edser's 'A' pattern 8. Determination of e/m by Thomson's method 9. R. I. by total internal reflection 10. Velocity of sound in air using CRO	**80**

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B.Sc Practical Physics – Harnam Singh S. Chand & Co. Ld. 2001
3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics – C. L. Arora (1st Edition) -2001 S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition) Cambridge University
6. University Practical Physics – D C Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint

Evaluation Pattern for course USPH505:

A. Continuous Evaluation (40 Marks):

<table>
<tr><th>Method</th><th>Marks</th></tr>
<tr><td>Performance and engagement during practical sessions:
Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical
Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments
Submission of journal within a week after every practical session
Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.</td><td>30</td></tr>
<tr><td>Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)</td><td>05</td></tr>
<tr><td>Viva</td><td>05</td></tr>
</table>

B. Semester End Evaluation (Exam Pattern) (60 Marks – 3 hours):

Question No.	Group	Title	Method	Marks
1	B	General Physics	Experiment performance as per practical slip	60

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Name of the Course	**Physics Lab - VI**
Course Code	USPH506
Class	TYBSc
Semester	V
Number of Credits	3
Nature	Practical
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Physics Lab - VI

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. Learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. A learner must enroll for physics practical courses USPH505 and USPH506 simultaneously and there will be a common journal for courses USPH505 and USPH506.
4. In order to appear for Semester End Practical Examination of both these courses, minimum 8 experiments from the group of 'General Physics' from course USPH505, all 3 'Skill Experiments' from course USPH505, minimum 8 experiments from the group of 'Electricity and Electronics' from course USPH506 and all 3 'Skill Experiments' from course USPH506 should be completed compulsorily and learners are required to report all these experiments in the common journal of these Physics practical courses.
5. After completing all required number of experiments for these courses and recording them in journal, a learner will have to get their journal certified and produce the certified journal at the time of Semester End Practical Examination of these courses.
6. A learner will be allowed to appear for the Semester End Practical Examination of these courses, only if a learner submits a common certified journal of these courses or a certificate from the head of the Physics department that the learner has completed these practical courses as per minimum requirements.
7. For Semester End Practical Examination of these courses, the learner will be examined for 1 experiment from each course. For Semester End Practical Examination of course USPH505, the experiment will be from 'General Physics' group and for Semester End Practical Examination of course USPH506, the experiment will be from 'Electricity and Electronics' group and each experiment will be of three hours duration.
8. Evaluation in viva voce will be separate for each of these courses and it will be

based on experiments done from the respective course.

9. While evaluating learner's performance for Semester End Practical Examination of each course, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (50 min.)
A	Skill Experiments	1. C1/C2 by BG 2. Internal resistance of voltage and current source 3. Dual trace CRO: Phase shift measurement	**10**
B	Electricity and Electronics	1. Mutual inductance by BG 2. L/C by Maxwell's bridge 3. Band gap energy of Ge diode 4. Design and study of transistorized astable multivibrator (BB) 5. Design and study of Wien bridge oscillator 6. Design and study of first order active low pass filter Circuit (BB) 7. Design and study of first order active high pass filter circuit (BB) 8. Application of IC 555 timer as a ramp generator (BB) 9. LM 317 as constant current source 10. Counters Mod 2, 5, 10 (2 x 5, 5 x 2) (BB) Note: BB: Using Breadboard	**80**

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, PC Rakshit & B Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B.Sc Practical Physics – Harnam Singh S. Chand & Co. Ld. 2001
3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics – C. L. Arora (1st Edition) -2001 S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition) Cambridge University

6. University Practical Physics – D C Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint

Evaluation Pattern for course USPH506:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (60 Marks – 3 hours):

Question No.	Group	Title	Method	Marks
1	B	Electricity and Electronics	Experiment performance as per practical slip	60

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Name of the Course	**Electronic Instrumentation (A. C.) I: Analog Circuits, Instruments and Consumer Appliances**
Course Code	USACEI501
Class	TYBSc
Semester	V
Number of Credits	2
Nature	Theory
Type	Applied
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum is so designed that learner will understand the construction and operating principle of transducers, sensors and optoelectronic devices. This will equip learners with the knowledge and skills necessary to work in the field of instrumentation. The curriculum equips learners with understanding of fundamental concepts of signal conditioning and applications of these techniques to enhance the quality of analog and digital signals. The curriculum empowers learners with comprehensive understanding of design and operation of SMPS and its application in converting and regulating electrical power for electronic systems. Curriculum develops learner's understanding about principle and characteristics of measuring instruments, such as, oscilloscope and multimeter. The curriculum also develops learner's understanding about operating principle of microphones and loud speakers. All this content will provide the foundation to learner to work with signals, power supplies and measuring instruments in various industries, contributing to the design, optimization and maintenance of electronic systems and applications. The curriculum equips learners with the fundamental concepts of data acquisition and mechanism of conversion of data/signal from analog to digital and from digital to analog. The curriculum includes study of PCB components, layers, materials and its manufacturing processes, which will help learner for the development of reliable and efficient electronic circuits. Learners will also gain the comprehensive understanding of microwave oven technology and learners will be well-prepared to utilize the full range of features offered by microwave ovens. The curriculum also provides basics of various methods used in the field of medical diagnostics, such as, ECG, EEG, EMG, CT Scan, MRI and Ultrasonography which will provide the foundation to learner to work in the field of medical diagnostics.

	Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learner's theoretical understanding to real world applications.

Nomenclature: Applied Component (Electronic Instrumentation) I: Analog Circuits, Instruments and Consumer Appliances

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Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the difference between a transducer and a sensor.
2. Understand the construction, working and uses of different types of transducers.
3. Understand the concept of signal conditioning, devices used and their operations.
4. Get acquainted with the measuring instruments used in laboratory.
5. Get the insight of the modern medical instruments in principle, which are used in day to day life.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Transducers, Sensors and Optoelectronic Devices	**1. Transducers:** Definition, Classification, Selection of transducer Reference: R3 **2. Electrical transducers:** Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT, Peizo-electric Transducer Reference: R2, R3, R6, R9 **3. Chemical sensors**: PH sensor, Gas sensor (Fundamental aspects), Humidity sensor (Resistive) Reference: R6, R7 **4. Electronic Weighing Systems:** Operating principle, Block diagram, features Reference: R12, R13 **5. Optoelectronic Devices:** LDR, LED (Construction, Working & Applications), Multicolour LED, Seven Segment Display, Liquid	15

		Crystal Display (LCD), Photodiode (construction, Characteristics & applications), Phototransistor Reference: R1, R2, R3	
II	Signal Conditioning, SMPS and Measuring Instruments	**1.** Half wave precision rectifier, Active Peak detector, Active Positive Clamper, Active Positive and Negative Clippers Reference: R19, R20 **2. Microphones:** characteristics, types (list only), carbon microphone and dynamic type microphone (principle, construction and working) **Loud speakers:** Characteristics, Dynamic (Moving coil type) speaker, Multi-way speaker system (woofer and tweeter) Reference: R4 **3. Switching Regulators:** Basic and Monolithic Switching regulators (buck, boost and buck – boost) (Only basic Configurations) Reference: R19 **4. Cathode Ray Oscilloscope:** Single trace CRO (Block diagram), Front Panel Controls (Intensity, Focus, Astigmatism, X & Y position, Level knob, Time base (Time/Division) and attenuation (Volts/Division) knobs X-Y mode), Dual Trace CRO (Block diagram), Probes: 1:1 & 10:1, Digital storage oscilloscope Reference: R3, R10 **5. DMM:** 3 ½ Digit display, resolution and sensitivity, general specifications Reference: R3	15
III	Data Acquisition and Conversion	**1. Data acquisition system:** Objectives of DAS, Signal conditioning of inputs, Single channel Data Acquisition system, Multichannel Data Acquisition system. Reference: R11 **2. D to A Converters:** Resistive divider	15

		network, Binary ladder network Reference: R7, R8 **3. A to D Converters:** Successive approximation type, Voltage to Time (Single slope, Dual slope) Reference: R7, R8	
IV	Modern Techniques and Appliances	**1. Printed Circuit Board:** Idea of PCB, advantages, copper clad, Etching processes, Principle of Photolithography (For PCB) Reference: R4, R14, R15 **2. Microwave Oven:** Operating principle, block diagram, features Reference: R12, R13 **3. Medical instruments:** Bio-Potential, Types of electrodes, ECG, EEG, EMG, CT Scan and MRI (principle, block diagram and features), Ultrasonography: working principle Reference: R16, R17, R18	15

Learning Resources recommended:

1. R1: A Textbook of Applied Electronics – R S Sedha, S Chand & Company, New Delhi
2. R2: Basic Electronics Solid state - B. L. Thereja, S Chand & Company, New Delhi
3. R3: Electronic Instrumentation – H. S. Kalsi, Tata McGraw Hill Publishing Company Limited, New Delhi
4. R4: Electronic components and materials: Principles, Manufacture and Maintenance- S. M. Dhir, Tata McGraw-Hill Publishing Company Limited, New Delhi
5. R5: Measurement and Instrumentation Principles: Alan S. Morris, Butterworth-Heinemann
6. R6: Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi
7. R7: Digital principles and applications: A. P. Malvino and D. P. Leach, Tata McGraw-Hill
8. R8: Data Converters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi
9. R9: Modern Electronic Instruments and Measurement techniques- Albert D.

Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi
10. R10: A course in electrical and electronic Measurements and Instrumentation: A. K. Sawhney, Dhanpat Rai and Sons.
11. R11: Instrumentation Devices & Systems, 2nd Edition Tata McGraw Hill, C. S. Rangan, G. R. Sarma, V. S. Mani
12. R12: Consumer Electronics R. P. Bali, Pearson Education (2008)
13. R13: S.P Bali, "Consumer Electronics", Pearson Education Asia Pvt., Ltd., 2008 Edition
14. R14: Printed Circuits Handbook pdf, Clyde F. Coombs. Jr., McGraw Hill Handbooks, 6th ed.
15. R15: PCB design basics, Mahmoud Wahby, EDN Networks, Nov 2013
16. R16: Introduction to Bio-medical Electronics: Joseph-Du-bary, McGraw Hill Co. Ltd.
17. R17: Medical instrumentation Application and design- J. C. Wobster
18. R18: Biomedical instruments and measurements – L. Cromwell, F. J. Weibell, Printice hall of India of India Pvt. Ltd, New Delhi
19. R19: Electronic Principles, Malvino
20. R20: Operational Amplifier and Linear integrated Circuits – Ramakant Gaikawad

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06

4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06
5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Practical of Course 'Applied Component (Electronic Instrumentation) I: Analog Circuits, Instruments and Consumer Appliances'**
Course Code	USACEI502
Class	TYBSc
Semester	V
Number of Credits	2
Nature	Practical
Type	Applied
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. The curriculum is so designed that learners will be well-prepared to apply their theoretical knowledge to practical situations, effectively utilize electronic instruments and confidently work with ac circuits and consumer appliances in a laboratory setting.

Nomenclature: Practical of Course 'Electronic Instrumentation (A. C.) I: Analog Circuits, Instruments and Consumer Appliances'

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. Learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this applied component course in Physics, minimum 8 experiments (minimum 2 from A group, minimum 2 from B group, minimum 2 from C group and minimum 2 from D group) from this course should be completed compulsorily and learners are required to report all these experiments in the journal of this course.
4. After completing all required number of experiments for this course and recording them in journal, a learner will have to get their journal certified and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A learner will be allowed to appear for the Semester End Practical Examination of this course, only if a learner submits a certified journal of this course or a certificate from the head of the department that the learner has completed this practical course as per the minimum requirements.
6. For Semester End Practical Examination of this course, the learner will be examined in only one experiment either from Group A or from Group B or from Group C or from Group D, from this course and the experiment will be of three hours duration.
7. Evaluation in viva voce will be based on all experiments done from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course, weightage will be given to circuit diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (50 min.)
A	Transducers	1. Thermistor as sensor in temperature to voltage converter using OPAMP 2. Characteristics of Photo diode and photo transistors 3. Study of LVDT characteristics 4. Study of seven segment display	**15**
B	Data Acquisition Circuits	1. OPAMP D/A Converter: Binary weighted resistors 2. OPAMP D/A Converter: Ladder network 3. Basic Instrumentation Amplifier using 3 OPAMPs coupled to resistance bridge 4. Peak detector using OPAMP 741	**15**
C	Waveform Shaping Circuits	1. Active Notch Filter (frequency response & phase relation) 2. Square and Triangular wave generator using OPAMPs with concept of duty cycle 3. Half wave precision rectifier using precision OPAMPs 4. Positive and Negative Clippers using OPAMP	**15**
D	Current, Voltage Sources and Consumer Appliances	1. Study of variable dual power supply using LM 317 & LM 337 (± 3V to ± 15V) 2. Constant Current source using OPAMP and PNP transistor (o/p current less than 50 mA) 3. Simple microphone amplifier using a transistor 4. Low voltage audio amplifier using IC LM386	**15**

Learning Resources recommended:

1. Modern Electronic Instrumentation & Measurement Techniques by Albert D. Helfrick & William D. Cooper PHI) Edition
2. OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll (6th edition PHI)
3. OPAMPs and linear integrated circuits by R.A. Gayakwad (4th edition, PHI)
4. Electronic Principles by A. P. Malvino, (PHI), 6th edition
5. Electronic Instrumentation by H. S. Kalsi, (TMH) 2nd Edition
6. Digital Principle and Applications" by Malvino and Leach, (TMH), 5th edition
7. Modern Digital Electronics, R .P. Jain, (TMH), 3rd edition

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks and finally the total marks obtained by a learner will be converted to marks out of 25.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (60 Marks – 3 hours):

Question No.	Group	Title	Method	Marks
1	A / B / C / D	Transducers / Data Acquisition Circuits / Waveform Shaping Circuits / Current, Voltage Sources and Consumer Appliances	Experiment Performance as per practical slip	60

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Syllabi of Courses Offered for Semester VI

Name of the Course	**Classical Mechanics**
Course Code	USPH601
Class	TYBSc
Semester	VI
Number of Credits	2.5
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum is so designed that, learners will understand and analyze the behavior of objects under the influence of central force. Learners will also be equipped to analyze complex motion scenarios under central force and understand the dynamics of systems in moving and rotating coordinate frames, which will enhance their ability to address advanced problems in physics and related fields. The curriculum focuses on Lagrangian Formulation which is powerful mathematical formalism for analyzing and solving complex problems in classical mechanics and learners will develop the ability to apply Lagrange's equations to a diverse set of mechanical systems, including rigid bodies, oscillators, coupled systems and systems with constraints. The curriculum equips learners to analyze, interpret and solve problems on complex fluid dynamics and rotational motion, which will provide foundation to learners to work in various engineering and scientific contexts. The curriculum also equips learners to analyze and interpret nonlinear dynamics, predict chaotic behavior and understand the underlying principles governing complex systems, enabling them to contribute to various scientific, engineering and interdisciplinary applications.

Nomenclature: Classical Mechanics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the courses 'USPH101: Classical Physics' and 'USPH301: Mechanics and Thermodynamics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the kinds of motions that can occur under a central potential and their applications to planetary orbits.
2. Understand the effect of moving coordinate system, rectilinear as well as rotating.
3. Learn the concepts needed for the important formalism of Lagrange's equations and derive the equations using D'Alembert's principle and able to solve simple examples using this formalism.
4. Understand simple concepts from fluid mechanics.
5. Understand the dynamics of rigid bodies.
6. Understand the drastic effect of adding nonlinear corrections to usual problems of mechanics and nonlinear mechanics which will help to understand the irregularity we observe around us in nature.
7. Be able to solve simple mathematical problems in all above areas.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Central Force	**1.** Motion under a central force, the central force inversely proportional to the square of the distance, Elliptic orbits, The Kepler problem Reference: KRS **2.** Moving origin of coordinates, Rotating coordinate systems, Laws of motion on the rotating earth, The Foucault pendulum, Larmor's theorem Reference: KRS	15
II	Lagrange's Equations	**1.** D'Alembert's principle, Constraints, Examples of holonomic constraints, examples of	15

		nonholonomic constraints, degrees of freedom and generalized coordinates, virtual displacement, virtual work, D'Alembert's principle, illustrative problems Reference: PVP **2.** Lagrange's equations (using D'Alembert's principle), properties of Lagrange's equations, illustrative problems, canonical momentum, cyclic or ignorable coordinates Reference: PVP	
III	Fluid Motion and Rigid Body Rotation	**1.** Kinematics of moving fluids, Equation of motion for an ideal fluid, Conservation laws for fluid motion, Steady flow Reference: KRS **2.** Rigid dynamics: introduction, degrees of freedom, rotation about an axis: orthogonal matrix, Euler's theorem, Eulerian angles, inertia tensor, angular momentum of rigid body, Euler's equation of motion of rigid body, free motion of rigid body, motion of symmetric top (without notation) Reference: KRS	15
IV	Non Linear Mechanics	**1.** Nonlinear mechanics: Qualitative approach to chaos, The anharmonic oscillator, Numerical solution of Duffing's equation Reference: BO **2.** Transition to chaos: Bifurcations and strange attractors, Aspects of chaotic behavior (Logistic map) Reference: BO	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. PVP: Classical Mechanics, P. V. Panat (Narosa)
2. KRS: Mechanics : Keith R. Symon, (Addision Wesely) 3rd Ed.
3. BO: Classical Mechanics- a Modern Perspective: V. D. Barger and M. G. Olsson. (Mc Graw Hill International 1995 Ed.)

Additional reference:

1. Classical Mechanics: Herbert Goldstein (Narosa 2nd Ed.)
2. An Introduction to Mechanics: Daniel Kleppner & Robert Kolenkow Tata McGraw Hill (Indian Ed. 2007)
3. Chaotic Dynamics- an introduction: Baker and Gollub (Cambridge Univ. Press)
4. Classical Mechanics: J. C. Upadhyaya (Himalaya Publishing House)

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06

4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06
5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Electronics**
Course Code	USPH602
Class	TYBSc
Semester	VI
Number of Credits	2.5
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum describes different semiconductor devices, like, JFET, MOSFET, SCR and UJT. The curriculum equips learners to analyze and design circuits using these semiconductor devices, contributing to various fields of electronics and technology. The curriculum equips learners to analyze and design differential amplifiers using transistors and a variety of OPAMP based circuits, for a wide range of electronic applications and to design, analyze and optimize power supply circuits to meet specific voltage and current requirements. The curriculum also equips learners to analyze and design multivibrators and timer circuits for a variety of electronic applications, ranging from timing and pulse generation to digital logic and control systems. The curriculum also develops comprehensive understanding of various digital communication methods, their principles, modulation techniques, signal processing and practical applications. This will provide the foundation to learners to work with digital communication techniques, design efficient communication systems and contribute to various industries such as telecommunications, networking and wireless technologies. Additionally, some of the topics in this theory course will be covered in following physics lab courses which will reinforce learners' theoretical understanding to real world applications.

Nomenclature: Electronics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the courses 'USPH202: Electricity and Electronics' and 'USPH302: Electronics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the basics of semiconductor devices and their applications.
2. Understand the basic concepts of operational amplifier: its prototype and applications as instrumentation amplifier, active filters, comparators and waveform generation.
3. Understand the basic concepts of timing pulse generation and regulated power supplies.
4. Understand the basic electronic circuits for universal logic building blocks and basic concepts of digital communication.
5. Develop quantitative problem solving skills in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Semiconductor Devices	**1. Field effect transistors: JFET:** Basic ideas, Drain curve, The transconductance curve, Biasing in the ohmic region and the active region, Transconductance, JFET common source amplifier, JFET analog switch, multiplexer, voltage controlled resistor, Current sourcing Reference: MB **2. MOSFET:** Depletion and enhancement mode, MOSFET operation and characteristics, digital switching Reference: MB **3. SCR:** Construction, static characteristics, Analysis of the operation of SCR, Gate Triggering Characteristics, Variable half wave rectifier and Variable full wave rectifier, Current ratings of SCR	15

		Reference: AM **4. UJT:** Construction, Operation, characteristics and application as a relaxation oscillator Reference: AM	
II	Differential Amplifier and OPAMP Applications	**1. Differential Amplifier using transistor:** The Differential Amplifier, DC and AC analysis of a differential amplifier, Input characteristic-effect of input bias, offset current and input offset voltage on output, common mode gain, CMRR Reference: MB **2. OPAMP Applications:** Log amplifier, Instrumentation amplifiers, Voltage controlled current sources (grounded load), First order Active filters, Astable using OPAMP, square wave and triangular wave generator using OPAMP, Wein-bridge oscillator using OPAMP, Comparators with Hysteresis, Window Comparator Reference: MB	15
III	Multivibrators, Timer, Power Supply	**1. Transistor Multivibrators:** Astable, Monostable and Bistable Multivibrators, Schmitt trigger Reference: AM/ KVR/MB **2. 555 Timer:** Review Block diagram, Monostable and Astable operation Voltage Controlled Oscillator, Pulse Width modulator, Pulse Position Modulator, Triggered linear ramp generator Reference: AM/ KVR/MB **3. Regulated DC power supply:** Supply characteristics, series voltage regulator, Short circuit protection (current limit and fold back) Monolithic linear IC voltage Regulators. (LM 78XX, LM 79XX, LM 317, LM337)	15

		Reference: AM/ KVR/MB	
IV	Logic families, Digital Communication Techniques	**1. Logic families:** Standard TTL NAND, TTL NOR, Open collector gates, Three state TTL devices, MOS inverters, CMOS NAND and NOR gates, CMOS characteristics Reference: ML **2. Digital Communication Techniques:** Digital Transmission of Data, Benefits of Digital Communication, Disadvantages of Digital Communication, Parallel and Serial Transmission, Pulse Modulation, Comparing Pulse-Modulation Methods (PAM, PWM, PPM), Pulse-Code Modulation Reference: LF	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. MB: Electronic Principles, Malvino & Bates -7th Ed TMH Publication
2. AM: Electronic Devices and Circuits, Allen Mottershead -PHI Publication
3. KVR: Functional Electronics, K.V. Ramanan-TMH Publication
4. ML: Digital Principles and Applications, Malvino and Leach (4th Ed)(TMH)
5. LF: Communication Electronics: Principles and applications, Louis E Frenzel 4th edition TMH Publications

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Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered /4 unit tests of 10 marks each and best two out of	20

four will be considered)	
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06
4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06
5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Nuclear Physics**
Course Code	USPH603
Class	TYBSc
Semester	VI
No of Credits	2.5
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum is so designed that, learners will develop a basic understanding of alpha, beta and gamma decay processes, including their principles, characteristics and decay equations. Learners will also develop a basic understanding of various nuclear models, including liquid drop model and shell model. The curriculum focuses on understanding and analyzing nuclear energy processes, their applications and challenges. The curriculum also focuses on design, operation and advancement of particle accelerators. The curriculum also develops conceptual understanding about nuclear forces, deuteron problem and the meson theory as fundamental aspects of nuclear physics. This will help learners to evaluate properties of deuteron and to analyze potential energy curves. All this content will encourage learners to work in the field of research and applications related to elementary particles, contribute to advancements in nuclear and particle physics and potentially pursue further studies or careers in nuclear and particle physics research, medical applications, industrial applications and related fields.

Nomenclature: Nuclear Physics

Eligibility: To be eligible for enrolment in this course, a learner must have appeared for the courses 'USPH102: Modern Physics'.

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the fundamental principles and concepts governing classical nuclear and particle physics and will get a knowledge of their applications - interactions of ionizing radiation with matter, the key techniques for particle accelerators, the physical processes involved in nuclear power generation.
2. Understand the concept of elementary particles, the fundamental constituents of matter and lay foundation for the understanding of unsolved questions about dark matter, antimatter and other research oriented topics.
3. Demonstrate quantitative problem solving skills in all the topics covered.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Alpha & Beta Decay	**1. Alpha decay:** Velocity, energy and Absorption of alpha particles: Range, Ionization and stopping power, Nuclear energy levels. Range of alpha particles, alpha particle spectrum, Fine structure, long range alpha particles, Alpha decay paradox: Barrier penetration (Gamow's theory of alpha decay and Geiger- Nuttal law) Reference: IK, SBP, SNG **2. Beta decay:** Introduction, Velocity and energy of beta particles, Energy levels and decay schemes, Continuous beta ray spectrum- Difficulties encountered to understand it, Pauli's neutrino hypothesis, Detection of neutrino, Energetics of beta decay Reference: IK, SBP, SNG	15

II	Gamma Decay & Nuclear Models	**1. Gamma decay:** Introduction, selection rules, Internal conversion, nuclear isomerism, Mossbauer effect Reference: SBP, AB **2. Nuclear Models:** Liquid drop model, Weizsacker's semi-empirical mass formula, Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Shell model (Qualitative), Magic numbers in the nucleus Reference: SBP, AB	15
III	Nuclear Energy & Particle Accelerators	**1. Nuclear energy:** Introduction, Asymmetric fission - Mass yield, Emission of delayed neutrons, Nuclear release in fission, Nature of fission fragments, Energy released in the fission of U235, Fission of lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor (Four Factor Formula), Nuclear power and breeder reactors, Natural fusion Possibility of controlled fusion Reference: SBP, AB **2. Particle Accelerators:** Van de Graaff Generator, Cyclotron, Synchrotron, Betatron and Idea of Large Hadron Collider Reference: SBP, AB	15
IV	Nuclear force & Elementary particles	**1. Nuclear force:** Introduction, Deuteron problem, Meson theory of Nuclear Force- A qualitative discussion Reference: SBP, DCT, AB **2. Elementary particles:** Introduction, Classification of elementary particles, Particle interactions, Conservation laws (linear &angular momentum, energy, charge, baryon number & lepton number), particles and antiparticles	15

		(Electrons and positrons, Protons and anti-protons, Neutrons and anti- neutrons, Neutrinos and anti-neutrinos), Photons, Mesons, Quark model (Qualitative) Reference: SBP, DCT, AB	

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. AB: Concepts of Modern Physics: Arthur Beiser, Shobhit Mahajan, S Rai Choudhury (6^{th} Ed.) (TMH)
2. SBP: Nuclear Physics, S.B. Patel (Wiley Eastern Ltd.)
3. IK: Nuclear Physics, Irving Kaplan (2^{nd} Ed.) (Addison Wesley)
4. SNG: Nuclear Physics, S. N. Ghoshal (S. Chand & Co.)
5. DCT: Nuclear Physics, D. C. Tayal (Himalayan Publishing House) 5^{th} ed

Additional reference:

1. Modern Physics: Kenneth Krane (2^{nd} Ed.), John Wiley & Sons.
2. Atomic & Nuclear Physics: N Subrahmanyam, Brij Lal. (Revised by Jivan Seshan.) S. Chand
3. Atomic & Nuclear Physics: A B Gupta & Dipak Ghosh Books & Allied (P) Ltd.
4. Introduction to Elementary Particles: David Griffith, Second Revised Edition, Wiley-VCH

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06
4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06
5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Special Theory of Relativity**
Course Code	USPH604
Class	TYBSc
Semester	VI
Number of Credits	2.5
Nature	Theory
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum includes basic principles and concepts of special relativity like Lorentz transformations, time dilation and length contraction. It also covers study of mathematical equations to calculate relativistic effects, such as time dilation, length contraction and relativistic momentum. The curriculum helps learners to visualize and interpret relativistic effects using space-time diagrams, enhancing the ability to understand the geometry of space-time. Learners will also be able to apply critical thinking to evaluate the implications of special relativity on concepts like simultaneity, mass-energy equivalence and relativistic dynamics. All this knowledge will encourage learners to pursue higher study in the field of research, specifically in the field of theoretical physics.

Nomenclature: Special Theory of Relativity

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand the significance of Michelson Morley experiment and failure of the existing theories to explain the null result.
2. Understand the importance of postulates of special relativity, Lorentz transformation equations and how it changed the way we look at space and time, absolutism and relativity, Common sense versus Einstein concept of Space and time.
3. Understand the transformation equations for: Space and time, velocity, frequency, mass, momentum, force, energy, charge and current density, electric and magnetic fields.
4. Be able to solve problems based on length contraction, time dilation, velocity addition, Doppler effect, mass energy relation and resolve paradoxes in relativity like twin paradox, etc.
5. Develop quantitative problem solving skills.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Introduction to Special Theory of Relativity, Relativistic Kinematics – I	**1. Introduction to Special theory of Relativity:** Inertial and Non-inertial frames of reference, Galilean transformations, Newtonian relativity, Electromagnetism and Newtonian relativity. Attempts to locate absolute frame: Michelson- Morley experiment (omit derivation part), Attempts to preserve the concept of a preferred ether frame: Lorentz Fitzgerald contraction and Ether drag hypothesis (conceptual), Stellar aberration, Attempt to modify electrodynamics Reference: RR **2. Relativistic Kinematics - I:** Postulates of the special theory of relativity, Simultaneity, Derivation of Lorentz transformation equations. Some consequences of the Lorentz	15

		transformation equations: length contraction, time dilation and meson experiment, The observer in relativity Reference: RR	
II	Relativistic Kinematics – II, The Geometric Representation of Space-Time	**1. Relativistic Kinematics - II:** The relativistic addition of velocities, acceleration transformation equations, Aberration and Doppler effect in relativity, The common sense of special relativity Reference: RR **2. The Geometric Representation of Space-Time:** Space-Time Diagrams, Simultaneity, Length contraction and Time dilation, The time order and space separation of events, The twin paradox Supplementary topics A1, A2, A3, B1, B2, B3 Reference: RR	15
III	Relativistic Dynamics	Mechanics and Relativity, The need to redefine momentum, Relativistic momentum, Alternative views of mass in relativity, The relativistic force law and the dynamics of a single particle, The equivalence of mass and energy, The transformation properties of momentum, energy and mass Reference: RR	15
IV	Relativity and Electromagnetism	**1.** Introduction, The interdependence of Electric and Magnetic fields, The Transformation for E and B, The field of a uniformly moving point charge, Force and fields near a current-carrying wire, Force between moving charges, The invariance of Maxwell's equations Reference: RR **2.** The principle of equivalence and general relativity, Gravitational red shift Supplementary topic C1, C2, C3, C4 Reference: RR	15

Note: A good number of numerical examples on all units (as far as possible) are expected to be covered during the prescribed lectures.

Learning Resources recommended:

Main References:

1. RR: Introduction to Special Relativity: Robert Resnick (Wiley Student Edition)

Additional reference:

1. Special theory of Relativity: A. P. French
2. Very Special Relativity – An illustrated guide: by Sander Bais - Amsterdam University Press
3. Chapter 1: Concepts of Modern Physics by Arthur Beiser
4. Chapter 2: Modern Physics by Kenneth Krane

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06
4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06

5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.
3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

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Name of the Course	**Physics Lab – VII**
Course Code	USPH605
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Practical
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Physics Lab – VII

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. To learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. A learner must enroll for physics practical courses USPH605 and USPH606 simultaneously and there will be a common journal for courses USPH605 and USPH606.
4. In order to appear for Semester End Practical Examination of both these courses, minimum 8 experiments from the group of 'General Physics' from course USPH605, 3 'Demonstration Experiments' from course USPH605, minimum 8 experiments from the group of 'Electricity and Electronics' from course USPH606 and 3 'Demonstration Experiments' from course USPH606 should be completed compulsorily and learners are required to report all these experiments in the common journal of these Physics practical courses.
5. After completing all required number of experiments for these courses and recording them in journal, a learner will have to get their journal certified and produce the certified journal at the time of Semester End Practical Examination of these courses.
6. A learner will be allowed to appear for the Semester End Practical Examination of these courses, only if a learner submits a common certified journal of these courses or a certificate from the head of the Physics department that the learner has completed these practical courses as per minimum requirements.
7. For Semester End Practical Examination of these courses, the learner will be examined for 1 experiment from each course. For Semester End Practical Examination of course USPH605, the experiment will be from 'General Physics' group and for Semester End Practical Examination of course USPH606, the experiment will be from 'Electricity and Electronics' group and each experiment will be of three hours duration.

8. Evaluation in viva voce will be separate for each of these courses and it will be based on demonstrations and experiments done from the respective course.
9. While evaluating learner's performance for Semester End Practical Examination of each course, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (50 min.)
A	General Physics	1. Surface tension of mercury by Quincke's method 2. Thermal conductivity by Lee's method 3. Study of JFET characteristics 4. JFET as a common source amplifier 5. JFET as switch (series and shunt) 6. UJT characteristics and relaxation oscillator 7. R. P. of Prism 8. Double refraction 9. Determination of h/e by photocell 10. Lloyd's single mirror: determination of wavelength	**80**
B	Demonstration Experiments	1. Open CRO, Power Supply and Signal Generator: block diagram study 2. Michelson's interferometer 3. Constant deviation spectrometer (CDS) 4. Zeeman Effect	**10**

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, P. C. Rakshit & B. Saha (6th Edition) Book and Allied Pvt. Ltd.
2. B. Sc. Practical Physics – Harnam Singh S. Chand & Co. Ld. 2001
3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics – C. L. Arora (1st Edition) -2001 S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition) Cambridge University
6. University Practical Physics – D C Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint

Evaluation Pattern for course USPH605:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (60 Marks – 3 hours):

Question No.	Group	Title	Method	Marks
1	A	General Physics	Experiment performance as per practical slip	60

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Name of the Course	**Physics Lab – VIII**
Course Code	USPH606
Class	TYBSc
Semester	VI
No of Credits	3
Nature	Practical
Type	Core
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that it offers hands-on approach to learn the subject. The curriculum also demonstrates how physics principles apply to real world scenarios. Learners will develop the skill to handle - measuring instruments, basic physics laboratory equipments, etc. Learners will also learn to perform basic physics experiments, learn to improve the accuracy of measurements, learn to analyze experimental observations / data, learn to draw meaningful conclusions of experiments and to interpret results.

Nomenclature: Physics Lab – VII

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. To learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. A learner must enroll for physics practical courses USPH605 and USPH606 simultaneously and there will be a common journal for courses USPH605 and USPH606.
4. In order to appear for Semester End Practical Examination of both these courses, minimum 8 experiments from the group of 'General Physics' from course USPH605, all 3 'Demonstration Experiments' from course USPH605, minimum 8 experiments from the group of 'Electricity and Electronics' from course USPH606 and all 3 'Demonstration Experiments' from course USPH606 should be completed compulsorily and learners are required to report all these experiments in the common journal of these Physics practical courses.
5. After completing all required number of experiments for these courses and recording them in journal, a learner will have to get their journal certified and produce the certified journal at the time of Semester End Practical Examination of these courses.
6. A learner will be allowed to appear for the Semester End Practical Examination of these courses, only if a learner submits a common certified journal of these courses or a certificate from the head of the Physics department that the learner has completed these practical courses as per minimum requirements.
7. For Semester End Practical Examination of these courses, the learner will be examined for 1 experiment from each course. For Semester End Practical Examination of course USPH605, the experiment will be from 'General Physics' group and for Semester End Practical Examination of course

USPH606, the experiment will be from 'Electricity and Electronics' group and each experiment will be of three hours duration.

8. Evaluation in viva voce will be separate for each of these courses and it will be based on demonstrations and experiments done from the respective course.
9. While evaluating learner's performance for Semester End Practical Examination of each course, weightage will be given to circuit / ray diagram, observations, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No .of lectures (50 min.)
A	Electricity and Electronics	1. Determination of M/C by using BG 2. Design and study of transistorized monostable multivibrator (BB) 3. Design and study of transistorized bistable multivibrator (BB) 4. Application of Op-Amp as a window comparator 5. Application of Op-Amp as a Log amplifier 6. Application of IC 555 as a voltage to frequency converter (BB) 7. LM-317 as variable voltage source 8. Shift register (BB) 9. Hall effect 10. Application of IC 555 as a voltage to time converter (BB) Note: BB: Using Breadboard	**80**
B	Demonstration Experiments	1. Digital storage oscilloscope (DSO) 2. Determination of OPAMP parameters (offset voltage, slew rate, input impedance, output impedance, A_{CM}) 3. Transformer (theory, construction and working), types of transformers and energy losses associated with them 4. Data sheets: Diodes, Transistor, OPAMP & Optoelectronic devices	**10**

Learning Resources recommended:

1. Advanced course in Practical Physics D. Chattopadhya, P. C. Rakshit & B. Saha. (6th Edition) Book and Allied Pvt. Ltd.
2. B.Sc Practical Physics – Harnam Singh S. Chand & Co. Ld. 2001
3. A test book of advanced practical PHYSICS _ SAMIR Kumar Ghosh, New Central Book Agency (3rd edition)
4. B.Sc. Practical Physics – C. L. Arora (1st Edition) -2001 S. Chand and Co. Ltd.
5. Practical Physics – C. L. Squires (3rd Edition) Cambridge University
6. University Practical Physics – D C Tayal. Himalaya Publication
7. Advanced Practical Physics – Worsnop & Flint

Evaluation Pattern for course USPH606:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (60 Marks – 3 hours):

Question No.	Group	Title	Method	Marks
1	A	Electricity and Electronics	Experiment performance as per practical slip	60

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Name of the Course	**Applied Component (Electronics Instrumentation) II: Digital Electronics, Microprocessor, Microcontroller and OOP**
Course Code	USACEI601
Class	TYBSc
Semester	VI
Number of Credits	2
Nature	Theory
Type	Applied
Revision of syllabus specific to employability/ entrepreneurship/ skill development	Restructuring of syllabus has been done to ensure a smooth and logical flow of content throughout the curriculum. It also facilitates the logical progression of subjects which allows students to build their understanding of subject progressively and systematically and to grasp contents more effectively. The curriculum is so designed that learners will understand various types of binary code, simplify Boolean expressions and effectively apply K-maps for logic simplification. Learners will be equipped with necessary knowledge to design, analyze and optimize combinational logic circuits using decoder, encoder, multiplexer, demultiplexer, D-latch and tri-state logic buffers for a variety of applications in the field of digital electronics. Learner will also be equipped with necessary knowledge in advanced 8085 microprocessor programming techniques, memory/IO interfacing and interfacing with the 8255 Programmable Peripheral Interface (PPI), enabling them to develop and optimize microprocessor based systems and applications. Learners will understand the foundations of microcontroller, architecture of microcontroller 8051 and will develop the skills to write basic assembly language programming with microcontroller 8051. Learners will also understand the fundamental principles of object-oriented programming, master C++ syntax and will be able to apply their knowledge to develop basic applications using C++. Additionally, most of the topics in this theory course will be covered in following lab course which will reinforce learners' theoretical understanding to real world applications.

Nomenclature: Applied Component (Electronics Instrumentation) II: Digital Electronics, Microprocessor, Microcontroller and OOP

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Be able to analyze/design and implement combinational logic circuits.
2. Develop assembly language programing skills and understand real time applications of microprocessor.
3. Illustrate how to interface the I/O peripheral (PPI) with 8085 microprocessor.
4. Understand architecture, salient features, instruction set.
5. Be able to write assembly language programs for basic and interfacing experiments with 8051 microcontroller.
6. Develop the programming skills in programming language C++.

Curriculum:

Unit	Title	Learning Points	No. of Lectures (50 min.)
I	Digital Electronics	**1.** Combinational Logic Design: Introduction, Code Converters (based on – binary, BCD, Gray and Excess – 3 codes), Boolean identities, K – map (2, 3 and 4 variable) Reference: NGP **2.** Tri-State logic, buffers, D latch, Design and implementations of: Decoders, Encoders, Multiplexers, De-multiplexers, Use of MUX and DEMUX in Combinational Logic design Reference: NGP, RG, RPJ	15
II	Advanced 8085 Programming and 8255 (PPI)	**1.** Introduction to advanced instructions and applications Reference: RG **2.** Stack and Subroutines: Stack, Subroutine Reference: RG **3.** The 8255 Programmable Peripheral Interface: Block Diagram of the 8255, Mode 0 –	15

		Simple Input / Output mode, BSR (Bit Set/Reset Mode) Reference: RG	
III	Introduction to Microcontrollers	**1.** Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Block diagram of 8051 Microcontroller, Embedded Versus External Memory Devices, 8-bit & 16-bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Commercial Microcontrollers Reference: AVD, MMM **2. 8051 Microcontrollers:** Introduction, MCS-Architecture, Registers in MCS-51, 8051 Pin Description, 8051 Connections, 8051 Parallel I/O Ports, Memory Organization Reference: AVD **3. 8051 Instruction Set and Programming:** MCS-51 Addressing Modes and Instructions: 8051 Addressing modes, MCS-51 Instruction Set, 8051 Instructions and Simple Programs, Using Stack Pointer Reference: AVD	15
IV	Basic Concepts of Object Oriented Programming and C++	**1. Basics of Object-Oriented Programming & Beginning with C++:** Basic concepts of Object-Oriented Programming, Benefits of OOP, Object- Oriented Languages, Applications of OOP, What is C++?, Applications of C++, A simple C++ program, More C++ Statements, Example with Class, Structure of C++ Program, Creating the Source File, Compiling and Linking Reference: EB **2. Tokens and Expressions in C++:** Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Symbolic Constants,	15

		Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Operators in C++, Scope Resolution Operator, Member Dereferencing Operators, Memory Management Operators, Manipulators, Type Cast Operator, Expressions and Their Types, Special Assignment Expressions, Implicit Conversions, Operator Overloading, Operator Precedence Reference: EB **3. Control Structures and Functions:** Control Structures, Functions: The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, Constant Arguments, Function Overloading, Math Library Functions Reference: EB	

Learning Resources recommended:

Main References:

1. RG: Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition
2. NGP: Digital Electronics and Logic design by N. G. Palan
3. RPJ: R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition
4. MMM: The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidiand R. D. Mckinlay, Second Edition, Pearson
5. AVD: Microcontrollers (Theory and Applications) by Ajay V Deshmukh, The Tata McGraw Hill Companies
6. EB: Object Oriented Programming with C++ by E Balagurusamy, Third/Fourth Edition, Tata McGraw-Hill Publishing Company Limited

Additional reference:

1. Microprocessor and Applications by Vibhute and Borole, Techmax Publications
2. Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH
3. Programming with C++ by D. Ravichandran, Tata McGraw Hill Publishing Company Limited
4. Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company
5. Digital Electronics - by A. P. Godse & D. A. Godse Technical publications, Pune,

Revised third edition, 2008
6. Intel's 8031/8051 Data sheet
7. The 8051 Microcontroller & Embedded Systems, Dr. Rajiv Kapadia (Jaico Pub. House)
8. 2.8051 Micro-controller by K. J. Ayala, Penram International
9. Programming & customizing the 8051 microcontroller By Myke Predko, TMH

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Unit Test (MCQ / Descriptive – Based on Theory and/or Problems - Online/Offline – 1 unit test of 20 marks / 2 unit tests of 10 marks each / 3 unit tests of 10 marks each and best two out of three will be considered / 4 unit tests of 10 marks each and best two out of four will be considered)	20
Assignments / Seminars	10
Attendance and active participation in classroom	10

B. Semester End Evaluation (Paper Pattern) (60 Marks – 2 hours):

Question No.	Question Type	Unit	Marks
1	A) Long questions with 100% internal option B) Short questions with 100% internal option	I	06 06
2	A) Long questions with 100% internal option B) Short questions with 100% internal option	II	06 06
3	A) Long questions with 100% internal option B) Short questions with 100% internal option	III	06 06
4	A) Long questions with 100% internal option B) Short questions with 100% internal option	IV	06 06
5	Objective type of questions without internal option	I II III IV	03 03 03 03

Guidelines for paper pattern for Semester End Evaluation:

1. As far as possible, one fifth weightage of the total marks should be given to numerical examples in above paper pattern.
2. All questions will be compulsory and may be divided into sub-questions.

3. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving / numericals based questions, etc.
4. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

****

Name of the Course	**Practical of Course 'Applied Component (Electronics Instrumentation) II: Digital Electronics, Microprocessor, Microcontroller and OOP'**
Course Code	USACEI602
Class	TYBSc
Semester	VI
No of Credits	2
Nature	Practical
Type	Applied
Revision of syllabus specific to employability/ entrepreneurship/ skill development	The curriculum is so designed that learners will be well-prepared to work with specific ICs and components commonly used in digital electronics, understand their operation and applications, and apply their knowledge to designing, building and troubleshooting digital circuits. Learners will be proficient in advanced 8085 microprocessor programming techniques, memory/IO interfacing and interfacing with the 8255 Programmable Peripheral Interface (PPI), enabling them to develop and optimize microprocessor-based systems and applications. Learners will develop the skill to write and execute basic assembly language programming with microcontroller 8051. Learners will also develop the skill to write and execute basic C++ program. The curriculum is so designed that learners will apply their theoretical knowledge to practical situations. All this content and skills developed by this course will provide foundation to learners to work in the field of digital electronics, embedded systems, IT, automation and related fields.

Nomenclature: Practical of Course 'Applied Component (Electronics Instrumentation) II: Digital Electronics, Microprocessor, Microcontroller and OOP'

Eligibility: --

Course Outcomes:

On successful completion of this course, a learner will:

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. Learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.
6. Understand basic principles and concepts of digital electronics and become familiar with various digital components commonly used in computer.
7. Implement digital circuits and develop skills in troubleshooting, identifying and fixing issues in digital circuits.
8. Understand architecture, operation and basic assembly language programming of 8085 microprocessor, 8031/8051 microcontroller.
9. Write and perform basic assembly language programming with 8085 microprocessor, 8031/8051 microcontroller.
10. Gain proficiency in writing assembly language programs for microprocessor 8085, 8031/8051 microcontroller to control and communicate with interfaced devices, reinforcing the theoretical concepts learned in this course and gain hands-on experience through practical exercises.

Instructions for learners:

1. All measurements and readings should be written with proper units.
2. Skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
3. In order to appear for Semester End Practical Examination of this applied component course in Physics, minimum 8 experiments (minimum two from A group, minimum 2 from B group, minimum 2 from C group and minimum 2 from D group) from this course should be completed compulsorily and learners are required to report all these experiments in the journal of this practical course.
4. After completing all required number of experiments for this course and recording them in journal, a learner will have to get their journal certified and produce the certified journal at the time of Semester End Practical Examination of this course.
5. A learner will be allowed to appear for the Semester End Practical Examination of this course, only if a learner submits a certified journal of this course or a

certificate from the head of the department that the learner has completed this practical course as per the minimum requirements.

6. For Semester End Practical Examination of this course, the learner will be examined in only one experiment either from Group A or from Group B or from Group C or from Group D, from this course and the experiment will be of three hours duration.
7. Evaluation in viva voce will be based on all experiments done from this course.
8. While evaluating learner's performance at Semester End Practical Examination of this course, weightage will be given to circuit diagram, observations, tabular representation, experimental skills and procedure, graph, flowchart, assembly language program, C++ program, calculation and result, whichever applicable.

Curriculum:

Group	Title	Learning Points	No. of lectures (50 min.)
A	Digital Electronics	1. Study of 3:8 Decoder (74LS138), 8:3 Priority Encoder (74LS148) and their applications 2. Study of Latch (74LS373) and its application 3. Study of 8:1 Multiplexer (74LS151), 1:4 De-multiplexer (74LS155) and their applications 4. Study of unidirectional buffer (74LS244) and bidirectional buffer (74LS245)	**15**
B	8085 Advanced Programming and 8255 Interfacing	**8085 Advanced Programming:** Prerequisites: The students should be familiar with Keyboard and Display utilities such as READ KEYBOARD, TO DISPLAY ON ADDRESS FIELD, and TO DISPLAY ON DATA FIELD, mentioned in the 8085 μp kit's manual. 1. 16-bit Data manipulation (Addition, subtraction). Display result on Address field. 2. Write ALP for Addition/ Subtraction/Multiplication of two, 8-bit hex, numbers. (Note: Use Read Keyboard Utility for inputting the hex numbers and display the result on the Address field.) **8255 Interfacing:** 1. Design a system (both Software and Hardware) to control ON/OFF operation of	**15**

		4 electrical loads (appliances). 2. Design a system (both Software and Hardware) using 8 LED display to demonstrate: A. Binary - up, down and ring counters B. Flashing display	
C	Experiments for 8031 / 8051 / 89C51	1. 8031/51 assembly language programming: A. Simple data manipulation programs (8/16-bit addition, subtraction, multiplication, division) B. 8/16 bit data transfer, cubes of numbers, to rotate a 32- bit number C. 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: A. To display bit pattern on LED's B. To count the number of "ON" switches and display on LED's C. To trip a relay depending on the logic condition of switches D. Event counter (using LDR and light source)	**15**
D	C++ Programming	1. Program based on Control Statements A. Program based on if-else statement B. Program based on nested if statement 2. Program based on for loop, while loop and do-while loop 3. Program based on Input, Output Statements (Programs to read any two numbers through keyboard and to perform simple arithmetic operations and to display the result) 4. Program using switch statements and if-else ladder	**15**

Learning Resources recommended:

1. Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition
2. Digital Electronics and Logic design by N. G. Palan
3. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition
4. The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidiand R. D. Mckinlay, Second Edition, Pearson
5. Microcontrollers (Theory and Applications) by Ajay V Deshmukh, The Tata McGraw Hill Companies
6. Object Oriented Programming with C++ by E Balagurusamy, Third/Fourth Edition, Tata McGraw-Hill Publishing Company Limited
7. Microprocessor and Applications by Vibhute and Borole, Techmax Publications
8. Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH
9. Programming with C++ by D. Ravichandran, Tata McGraw Hill Publishing Company Limited
10. Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company
11. Digital Electronics - by A. P. Godse & D. A. Godse Technical publications, Pune, Revised third edition, 2008
12. Intel's 8031/8051 Data sheet
13. The 8051 Microcontroller & Embedded Systems, Dr. Rajiv Kapadia (Jaico Pub. House)
14. 8051 Micro-controller by K. J. Ayala, Penram International
15. Programming & customizing the 8051 microcontroller By Myke Predko, TMH
16. 8085 Kit User Manual
17. 8031/8051 User Manual

Evaluation Pattern:

A. Continuous Evaluation (40 Marks):

Method	Marks
Performance and engagement during practical sessions: • Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical • Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments • Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed for 10 marks during regular practical session and finally the total marks obtained by a learner will be converted to marks out of 30.	30

Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (Exam Pattern) (60 Marks – 3 hours):

Question No.	Group	Title	Method	Marks
1	A / B / C / D	Digital Electronics / 8085 Advanced Programming and 8255 Interfacing / Experiments for 8031 or 8051 or 89C51 / C++ Programming	Experiment performance as per practical slip	60

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R. E. Society's

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

Department of Physics
PG Programme 2023-24
Courses & Syllabus

Under Choice Based Credit System (CBCS)

R. E. SOCIETY'S,

R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND R. V. JOGALEKAR COLLEGE OF COMMERCE (AUTONOMOUS), RATNAGIRI

SYLLABI OF COURSES OFFERED BY DEPARTMENT OF PHYSICS OF THE COLLEGE IN THE SUBJECT PHYSICS FOR THE FIRST YEAR (SEMESTER I & II) OF PROGRAM M.Sc. AS PER NEP 2020

UNDER

CHOICE BASED CREDIT SYSTEM (CBCS)

WITH THE EFFECT FROM ACADEMIC YEAR 2023-24

Program Outcomes of M.Sc. Physics

Name of Programme	**Master of Science**
Level	PG
No of Semesters	04
Year of Implementation	**2023-24**
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 development in various dolmens 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, 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 assessed by Continuous Assessment 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: -

A) Continuous Assessment: (40% marks)

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

B) Semester End Examination: (60% marks)

The Examination shall be of 2 hours duration.

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 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 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.-I

Master of Science (M.Sc.) Programme

Under Choice Based Credit System (CBCS)

Course Structure

M.Sc. Physics-I

(To be implemented from Academic Year 2023-24)

<table>
<tr><th>No. of Courses</th><th>Semester I</th><th colspan="2">Credits</th><th>No. of Courses</th><th>Semester II</th><th colspan="2">Credits</th></tr>
<tr><td></td><td colspan="3">Major Mandatory</td><td></td><td colspan="3">Major Mandatory</td></tr>
<tr><td>PSPH 101</td><td>Mathematical Methods</td><td colspan="2">02</td><td>PSPH 201</td><td>Electrodynamics</td><td colspan="2">02</td></tr>
<tr><td>PSPH 102</td><td>Classical Mechanics</td><td colspan="2">04</td><td>PSPH 202</td><td>Advanced Electronics</td><td colspan="2">04</td></tr>
<tr><td>PSPH 103</td><td>Quantum Mechanics-I</td><td colspan="2">04</td><td>PSPH 203</td><td>Quantum Mechanics-II</td><td colspan="2">04</td></tr>
<tr><td>PSPH 104</td><td>Physics LAB-I</td><td colspan="2">04</td><td>PSPH 204</td><td>Physics LAB-I</td><td colspan="2">04</td></tr>
<tr><td></td><td>Major Electives</td><td colspan="2"></td><td></td><td>Major Electives</td><td colspan="2"></td></tr>
<tr><td>PSPH 105</td><td>Crystal Physics</td><td>02</td><td rowspan="2">04</td><td>PSPH 205</td><td>Physics of Semiconductor diodes and Transistors</td><td>02</td><td rowspan="2">04</td></tr>
<tr><td>PSPH 106</td><td>Physics LAB-II</td><td>02</td><td>PSPH 206</td><td>Physics LAB-II</td><td>02</td></tr>
<tr><td></td><td>OR</td><td colspan="2"></td><td></td><td>OR</td><td colspan="2"></td></tr>
<tr><td>PSPH 107</td><td>Magnetism</td><td>02</td><td rowspan="2">04</td><td>PSPH 207</td><td>Semiconductor Physics and Devices</td><td>02</td><td rowspan="2">04</td></tr>
<tr><td>PSPHP 108</td><td>Physics LAB-III</td><td>02</td><td>PSPH 208</td><td>Physics LAB-III</td><td>02</td></tr>
<tr><td>PSPH 109</td><td>Research Methodology</td><td colspan="2">04</td><td>PSPH 209</td><td>On Job Training/ Field Project</td><td colspan="2">04</td></tr>
<tr><td colspan="2">Total Credits</td><td colspan="2">22</td><td colspan="2">Total Credits</td><td colspan="2">22</td></tr>
</table>

SEMESTER-I

No. of Courses	Semester I	Credits
	Major: Mandatory	
PSPH 101	Mathematical Methods	2
PSPH 102	Classical Mechanics	4
PSPH 103	Quantum Mechanics-I	4
PSPH 104	Physics LAB-I	4
	Major: Elective (Any One from below)	
PSPH 105	Crystal Physics	4
PSPH 106	Physics LAB-II	
PSPH 107	Magnetism	4
PSPH 108	Physics LAB-III	
PSPH 109	Research Methodology	4
Total Credits		22

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Mathematical Methods
Course Code	PSPH101
Class	M.Sc.
Semester	I
No of Credits	2
Nature	Theory
Type	Major
Employability/ Entrepreneurship/ Skill Development	The mathematical technique is utilized in the core subject to teach mathematical skills such as problem solving. Learners learn Mathematical Physics and solve a variety of Physics-related tasks. They can also handle open-ended problems and mathematical modelling using computational skills. It is beneficial in physics education and research as well.

Course Outcomes:

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

1. Understand the significance of differentiability of complex functions and be familiar with Cauchy-Riemann equations.
2. Evaluate integrals along a path in the complex plane and understand the statement of Cauchy's theorem.
3. Compute the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculate residues.
4. Use the Cauchy Residue Theorem to evaluate integrals and sum series.
5. Find the Laplace transform and inverse Laplace Transform of a function.
6. Find the convolution of two functions and the transform of a convolution.
7. Use the Laplace transform in solving differential equations.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Complex Analysis	Complex variables, Limits, Continuity, Derivatives, Cauchy-Reimann Equation, Analytic functions, Harmonic functions, Elementary functions: Exponential and trigonometric, Taylor and Laurent series, Residues, Residues theorem, Principal part of the functions, Residues at poles, zeroes and poles of order m, contour integral, Evaluation of improper real integral, improper integral involving sines and cosines, Definite Integrals involving sine and cosine functions. Reference: AW	10
II	Differential Equations	General treatment of second order linear differential equations with non-constant coefficients, Power series solutions, Frobenius method, Legendre, Hermite and Laguerre polynomials, Bessel equations, Nonhomogeneous equation – Green's function, Sturm-Liouville theory. Reference: - MLB	10
III	Integral Transforms	Introduction to Fourier analysis, Integral transforms: three dimensional Fourier transforms and its applications to PDEs (Green function of Poisson's PDE), convolution theorem, Parseval's relation, Laplace transforms, Laplace transform of derivatives, Inverse Laplace transform and Convolution theorem, use of Laplace's transform in solving differential equations. Reference: -MLB	10

Learning Resources recommended:

A. Main references**:**

1. MLB: - M.L. Boas, Mathematical methods in the Physical Sciences, Wiley India 2006

2. AW: - G. Arfken and H. J. Weber: Mathematical Methods for Physicists, Academic Press 2005

B. Additional references:

1. A.K. Ghatak, I.C. Goyal and S.J. Chua, Mathematical Physics, McMillan
2. A.C. Bajpai, L.R. Mustoe and D. Walker, Advanced Engineering Mathematics, John Wiley.
3. J. Mathews and R.L. Walker, Mathematical Methods of physics
4. P. Dennery and A. Krzywicki, Mathematics for physicists
5. T. Das and S.K. Sharma, Mathematical methods in Classical and Quantum Mechanics
6. R. V. Churchill and J.W. Brown, Complex variables and applications, V Ed. Mc Graw. Hill

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.	07 08
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 08
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 08
4	I II III	Objective type of questions without internal option	05 05 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Classical Mechanics
Course Code	PSPH102
Class	M.Sc.-I
Semester	I
No of Credits	4
Nature	Theory
Type	Major
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn principles of variational calculus and methods to solve complex classical systems. Learners learn reduction of the Two body Central force problem to one dimensional problem and finding orbits for different potentials. Learners also learn Hamilton's formalism of mechanics.

Course Outcomes:

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

1. Represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics.
2. Use the d'Alembert principle to derive the Lagrange equations.
3. Understand the concept of small oscillation and will be able to formulate it.
4. Find Lagrangian and Hamiltonian for a mechanical system, set up and solve the equations of motion for them including two-body systems, coupled linear and non-linear oscillators, system with time dependent constraints, etc.
5. Understand the concept of canonical transformations to write equations of motion.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Lagrangian Formulation	Review of Newton's laws, Mechanics of a particle, Mechanics of a system of particles, Frames of references, rotating frames, Centrifugal and Coriolis force, Constraints, D'Alembert's principle and Lagrange's equations, Velocity-dependent potentials and the dissipation function, Simple applications of the Lagrangian formulation. Hamilton's, principle, Calculus of variations, Derivation of Lagrange's equations from Hamilton's principle, Lagrange Multipliers and constraint exterimization problems, Extension of Hamilton's principle to nonholonomic systems, Advantages of a variational principle formulation. Reference: RJ, GPS	15
II	Central force and classical scattering	Conservation theorems and symmetry properties, Energy Function and the conservation of energy. The Two-Body Central Force Problem: Reduction to the equivalent one body problem, the equations of motion and first integrals, the equivalent one-dimensional problem and classification of orbits, the virial theorem, the differential equation for the orbit and integrable power-law potentials, The Kepler problem: Inverse square law of force, the motion in time in the Kepler problem, Scattering in a central force field, Transformation of the scattering problem to laboratory coordinates. Reference: - GPS	15
III	Small Oscillations	Small Oscillations: Formulation of the problem, the eigenvalue equation and the principal axis transformation, Frequencies of free vibration and normal coordinates, Forced and damped oscillations, Resonance and beats. Legendre transformations and the Hamilton equations of motion, Cyclic coordinates and conservation theorems, Derivation of Hamilton's equations from a variational principle.	15

		Reference: -GPS, RJ	
IV	Canonical Transformation and Poisson Bracket	Canonical Transformations, Examples of canonical transformations, The symplectic approach to canonical transformations, Poisson brackets and other canonical invariants, Equations of motion, infinitesimal canonical transformations and conservation theorems in the Poisson bracket formulation, The angular momentum Poisson bracket relations. Reference: -RJ	15

Learning Resources recommended:

A. Main Reference:
   1. GPS: - Classical Mechanics, H. Goldstein, Poole and Safko, 3rd Edition, Narosa Publication (2001)
   2. RJ: -Classical Mechanics, N. C. Rana and P. S. Jog. Tata McGraw Hill Publication.

B. Additional References:
   1. Classical Mechanics, S. N. Biswas, Allied Publishers (Calcutta).
   2. Classical Mechanics, V. B. Bhatia, Narosa Publishing (1997).
   3. Mechanics, Landau and Lifshitz, Butterworth, Heinemann.
   4. The Action Principle in Physics, R. V. Kamat, New Age Intnl. (1995).
   5. Classical Mechanics, Vol I and II, E. A. Deslougue, John Wiley (1982).
   6. Theory and Problems of Lagrangian Dynamics, Schaum Series, McGraw (1967).
   7. Classical Mechanics of Particles and Rigid Bodies, K. C. Gupta, Wiley Eastern (2001)

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Courses of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Quantum Mechanics-I
Course Code	PSPH103
Class	M.Sc.-I
Semester	I
No of Credits	4
Nature	Theory
Type	Major
Employability/ entrepreneurship/ skill development (if any) 100 words	Learners learn higher concepts of Quantum mechanics along with its mathematical formalism and learn to solve advanced problems in order to enhance analytical thinking skills.

Course Outcomes:

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

1. Understand the central concepts and principles in quantum mechanics.
2. Solve the Schrödinger equation for simple systems in one and three dimensions.
3. Work with vector spaces.
4. Understand How to calculate wave function, energy Eigen value using matrix formulation.
5. Understand use of Fourier transformation in quantum mechanics.
6. Understand the concepts of angular momentum and spin, as well as the rules for quantization and addition of these.
7. Understand the concept of spin-orbit coupling, what is meant by identical particles and quantum statistics.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Review and formalism of Quantum Mechanics	**Review of Quantum Mechanics:** Postulates of quantum mechanics, observables and operators, measurements, state function and expectation values, the time-dependent Schrodinger equation, time development of state functions, solution to the initial value problem. The Superposition principle, commutator relations, their connection to the uncertainty principle, complete set of commuting observables. Time development of expectation values, conservation theorems and parity. **Formalism:** Linear Vector Spaces and operators, Dirac notation, Hilbert space, Hermitian operatorsand their properties, Matrix mechanics: Basis and representations, unitary transformations, the energy representation. Schrodinger, Heisenberg and interaction picture. Reference: - RL	15
II	Wave packet and Schrodinger equation solutions	**Wave packet:** Gaussian wave packet, Fourier transform. **One dimensional problem:** General properties of one-dimensional Schrodinger equation, Particle in a box, Harmonic oscillator by raising and lowering operators and Frobenius method, unbound states, one dimensional barrier problems, finite potential well. Reference: - NZ, GL	15
III	Schrodinger equation solutions- 3D problems	**Schrodinger equation solutions- 3D problems**: Orbital angular momentum operators in cartesian and spherical polar coordinates, commutation and uncertainty relations, spherical harmonics, two particle problem- coordinates relative to center of mass, radial equation for a spherically symmetric centralpotential, hydrogen atom, eigenvalues and radial eigenfunctions, degeneracy, probability distribution.	15

		Reference: - GL	
IV	Angular Momentum	**Angular Momentum:** - Ladder operators, eigenvalues and eigen functions of L^2 and L_z using spherical harmonics, angular momentum and rotations, total angular momentum J, LS coupling; eigenvalues of J^2 and Jz, addition of angular momentum, coupled and uncoupled representation of eigenfunctions, Clebsch Gordan coefficient for $j_1 = j_2 = ½$ and $j_1 =1$ and $j_2 = ½$. Angular momentum matrices, Pauli spin matrices, spin eigenfunctions, free particle wave function including spin, addition of two spins. Reference: - RL, GL, NZ	15

Learning Resources Recommended:

A. Main references:
   1. RL: - Richard Liboff, Introductory Quantum Mechanics, 4th edition, Pearson.
   2. DG: - D J Griffiths, Introduction to Quantum Mechanics 4th edition
   3. GL: - A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.
   4. NZ: - N Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley.

B. Additional References
   1. W Greiner, Quantum Mechanics: An introduction, Springer, 2004
   2. R Shankar, Principles of Quantum Mechanics, Springer, 1994
   3. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977).
   4. J. J. Sakurai Modern Quantum Mechanics, Addison-Wesley (1994).

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Physics Lab-I
Course Code	PSPH104
Class	M.Sc.-I
Semester	I
No of Credits	4
Nature	Practical
Type	Major
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn various experimental and measurement skills including skills of independent investigation of Physics-related problems. Learners also develop the fundamental understanding of the instruments used. Learner will able to design electronic systems and to troubleshoot them independently.

Course Outcomes:

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

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. To design and trouble shoot electronics circuits.

Curriculum:

Unit	Title	Learning Points	No of Lectures
Group A	General Physics experiments	1. Michelson Interferometer. 2. Analysis of sodium spectrum. 3. Carrier lifetime by pulsed reverse method. 4. Study of He-Ne laser- Measurement of divergence and wavelength. 5. Determination of particle size of lycopodium particles by laser diffraction method. 6. Susceptibility measurement by Quincke's method /Guoy's balance method. 7. h/e by vacuum photocell	60
Group B	Electronics experiments	1. Diac - Triac phase control circuit. 2. Temperature on-off controller using IC LM35 3. Study of 8-bit DAC. 4. 16-bit digital multiplexer. 5. Delayed linear sweep generator using IC 555 6. Regulated dual power supply using IC LM 317 & IC LM337 voltage regulator ICs. 7. Regulated power supply using IC LM317 voltage regulator	60

Note:

1. Minimum number of experiments to be performed and reported in the journal = 08 with minimum 4 experiments from each Group. i.e., Group A: 04 and Group B: 04.
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.
4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Learning Resources recommended:

1. Advanced Practical Physics -Worsnop and Flint
2. Atomic spectra- H.E. White
3. Experiments in modern physics –Mellissinos
4. Semiconductor electronics by Gibson
5. A course of experiments with Laser – Sirohi
6. Elementary experiments with Laser- G. White
7. Solid state devices- W.D. Cooper
8. Electronic text lab manual - P.B. Zbar
9. Digital principles and applications by Malvino and leach
10. Digital circuit practice by R.P. Jain
11. Electronic principles -A. P. Malvino
12. Operational amplifiers and linear Integrated circuits - Coughlin & Driscoll
13. Op-amps and linear integrated circuit technology- R. Gayakwad
14. Digital Electronics - Roger Tokheim

Evaluation Pattern:

A. Continuous Assessment: (40 Marks)

Method	Marks
Journal	20
Lab performance	10
Seminar	10

B. Semester End Examination: (60 Marks)

Question No.	Group	Title	Method	Marks
1	A or B	General Physics and Electronics	Any one long experiment performance from Group A or B as per the practical slip	40
2	A or B	General Physics and Electronics	Any one short experiment performance from Group A or B as per the practical slip	20

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Crystal Physics
Course Code	PSPH105
Class	M.Sc-I
Semester	I
No of Credits	2
Nature	Theory
Type	Elective
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn about X-Ray diffraction techniques and acquire skills to calculate Millar indices and study reciprocal lattices of various crystal systems which can be used in research field.

Course Outcomes:

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

1. Understand inter atomic forces and bonds.
2. Account for how crystalline materials are studied using diffraction, including concepts like the Ewald sphere, form factor, structure factor and scattering amplitude.
3. Understand the concept of reciprocal space and be able to use it as a tool.
4. Understand the significance of Brilloune zones.
5. Understand what phonons are and perform estimates of their dispersive and thermal properties.
6. Understand thermal and electrical properties in the free-electron model.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Diffraction of Waves by Crystals and Reciprocal Lattice	**Diffraction of Waves by Crystals and Reciprocal Lattice**: - Bragg law, Scattered Wave Amplitude – Fourier analysis, Reciprocal Lattice Vectors, Diffraction Conditions, Brillouin Zones, Reciprocal Lattice to SC, BCC and FCC lattice. Interference of Waves, Atomic Form Factor, Elastic Scattering by crystal, Ewald Construction, Structure Factor, Temperature Dependence of the Reflection Lines, experimental Techniques (Laue Method, Rotating Crystal Method, Powder Method) Scattering from Surfaces, Elastic Scattering by amorphous solids. Reference: CK, MAW	15
II	Lattice vibration and thermal properties	**Lattice vibration and thermal properties**: - Vibrations of Monoatomic Lattice, normal mode frequencies dispersion relation, Lattice with two atoms per unit cell, normal mode frequencies, dispersion relation., Quantization of lattice vibrations, phonon momentum, Inelastic scattering of neutrons by phonons, Surface vibrations, Inelastic Neutron scattering. Anharmonic Crystal Interaction. Thermal conductivity – Lattice Thermal Resistivity, Umklapp Process, Imperfections. Reference: - CK, MAW	15

Learning Resources recommended:

A. Main References: -
   1. CK: - Charles Kittel "Introduction to Solid State Physics", 7th edition John Wiley & sons.
   2. MAW: - M.A.Wahab "Solid State Physics –Structure and properties of Materials" Narosa Publications 1999.

B. Additional Main References: -
   1. JRC: - J.Richard Christman "Fundamentals of Solid State Physics" John Wiley & sons

2. MAO: - M. Ali Omar "Elementary Solid-State Physics" Addison Wesley (LPE)
3. IL: - H.Ibach and H.Luth 3rd edition "Solid State Physics – An Introduction to Principles of Materials Science" Springer International Edition (2004)

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. A. Short questions with 100% Internal option.	10 10
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 10
3	I II	Objective type of questions without internal option	10 10

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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Physics Lab- II
Course Code	PSPH106
Class	M.Sc.-I
Semester	I
No of Credits	2
Nature	Practical
Type	Elective
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn various experimental and measurement skills including skills of independent investigation of Physics-related problems. Learners also develop the fundamental understanding of the instruments used. Learner will able to design electronic systems and to troubleshoot them independently.

Course Outcomes:

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

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. To design and trouble shoot electronics circuits.

Curriculum:

Unit	Title	Learning Points	No of Lectures
Group A	General Physics	1. Resistivity by four probe method. 2. DC Hall effect. 3. Absorption spectrum of specific liquid	30
Group B	Electronics	1. Active filter circuits (second order) 2. Study of 4-digit multiplex display system 3. Constant current supply using IC 741 and LM317	30

Learning Resources Recommended:

1. Manual of experimental physics - E.V. Smith
2. Semiconductor Measurements – Runyan
3. Semiconductors and solid-state physics – Mackelvy
4. Handbook of semiconductors – Hunter
5. Op-amps and linear integrated circuit technology – R A Gayakwad
6. Operational amplifiers and linear integrated circuits- Coughlin & Driscoll
7. Digital Electronics by Roger Tokheim (5th Ed, page 371)
8. Advance practical physics -Worsnop and Flint.

Note:

1. Minimum number of experiments to be performed and reported in the journal = 04 with minimum 2 experiments from each Group. i.e., Group A: 02 and Group B: 02.
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.
4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Evaluation Pattern:

A. Continuous 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	A or B	General Physics and Electronics	Any one long experiment performance from Group A or B as per the practical slip	40
2	A or B	General Physics and Electronics	Any one short experiment performance from Group A or B as per the practical slip	20

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Magnetism
Course Code	PSPH107
Class	M.Sc.-I
Semester	I
No of Credits	2
Nature	Theory
Type	Elective
Relevance with Employability/ Entrepreneurship/ Skill development	Learners gain theoretical understanding of the atomic origin of magnetism and able to solve problem based on magnetism and enhance problem solving skills.

Course Outcomes:

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

1. Understand diamagnetic and paramagnetic behavior of materials and its quantum mechanical formulation.
2. Understand magnetic ordering in ferrimagnetic, ferromagnetic and antiferromagnetic materials.
3. Understand Hund's Rule in magnetism.
4. Use Langevin diamagnetic equation.
5. Solve numericals based on magnetism.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Diamagnetism and Paramagnetism	Langevin diamagnetic equation, diamagnetic response, Quantum mechanical formulation, core diamagnetism. Quantum Theory of Paramagnetism, Rare Earth Ions, Hund's Rule, Iron Group ions, Crystal Field Splitting and Quenching of orbital angular momentum Adiabatic Demagnetization of a paramagnetic Salt, Paramagnetic susceptibility of conduction electrons. Reference: -CK, JRC, MAW, MAO	15
II	Magnetic Ordering	Ferromagnetic order- Exchange Integral, Saturation magnetization, Magnons, neutron magnetic scattering Ferrimagnetic order, spiels, Yttrium Iron Garnets, Anti Ferromagnetic order. Ferromagnetic Domains – Anisotropy energy, origin of domains, transition region between domains, Bloch wall, Coercive force and hysteresis. Reference: -CK, JRC, MAW, MAO	15

Learning Resources recommended:

A. Main References: **-**
   1. CK: - Charles Kittel "Introduction to Solid State Physics", 7th edition John Wiley & sons.
   2. JRC: - J.Richard Christman "Fundamentals of Solid State Physics" John Wiley & sons
   3. MAW: - M.A.Wahab "Solid State Physics –Structure and properties of Materials" Narosa Publications 1999.
   4. MAO: - M. Ali Omar "Elementary Solid-State Physics" Addison Wesley (LPE)

B. Additional References: **-**
   1. IL: - H.Ibach and H.Luth 3rd edition "Solid State Physics – An Introduction to Principles of Materials Science" Springer International Edition (2004)

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 10
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 10
3	I II	Objective type of questions without internal option	10 10

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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Physics Lab- III
Course Code	PSPH108
Class	M.Sc.-I
Semester	I
No of Credits	2
Nature	Practical
Type	Elective
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn various experimental and measurement skills including skills of independent investigation of Physics-related problems. Learners also develop the fundamental understanding of the instruments used. Learner will able to design electronic systems and to troubleshoot them independently.

Course Outcomes:

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

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. To designed and trouble shoot electronics circuits.

Curriculum:

Unit	Title	Learning Points	No of Lectures
Group A	General Physics	1. Coupled Oscillations 2. Temperature dependence of avalanche and Zener breakdown diodes. 3. Magneto resistance of Bi specimen	30
Group B	Electronics	1. Waveform Generator using ICs. 2. Study of elementary digital voltameter 3. Instrumentation amplifier and its application	30

Learning Resources Recommended:

1. Advanced Practical Physics – Worsnop and Flint
2. Experiments in modern physics -Mellissinos
3. Solid state devices - W.D. Cooper
4. Electronic text lab manual - PB Zbar
5. Electronic devices & circuits - Millman and Halkias
6. Integrated Circuits - K. R. Botkar
7. Op-amps and linear integrated circuit technology by Gayakwad
8. Operational amplifiers and linear integrated circuits- Coughlin & Driscoll
9. Operational amplifiers: experimental manual C.B. Clayton
10. Digital Electronics by Roger Tokheim

Note:

1. Minimum number of experiments to be performed and reported in the journal = 04 with minimum 2 experiments from each Group. i.e., Group A: 02 and Group B: 02.
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.

4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Evaluation Pattern:

A. Continuous 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	A or B	General Physics and Electronics	Any one long experiment performance from Group A or B as per the practical slip	40
2	A or B	General Physics and Electronics	Any one short experiment performance from Group A or B as per the practical slip	20

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester I with Effect from the Academic Year 2023-2024

Name of the Course	Research Methodology
Course Code	PSPH109
Class	M.Sc.-I
Semester	I
No of Credits	4
Nature	Theory
Type	Compulsory
Relevance with Employability/ Entrepreneurship/ Skill development	Learner will gain the knowledge of Research Methodology in Physics. Further, the learner will be benefited in the form of increase in research aptitude, analytical and decision-making skills. Acquisition of the knowledge in the field of research will increase the chances of employability and will offer better prospects in industry.

Course Outcomes:

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

1. Understand fundamentals of research methods.
2. Learn design and measurement concept of research.
3. Know data collection and analysis tool.
4. Get knowledge of scientific report writing.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Fundamentals of Research Methods	**Fundamentals of Research Methods**: Definition of research, Role and objectives of research, importance of research, Applications and types of research, Creativity and innovation, Critical thinking, Research process and steps in it, Collecting and reviewing the literature, Conceptualization and Formulation of: research problem, identifying variables, constructing hypothesis and Synopsis. Interpretation of results and discussion. Reference: - CRK, RK, MS	15
II	Research Design and Measurement Concepts and Literature Searching	**Research Design and Measurement Concepts**: Selecting and defining a research problem, Need for research design, Features of a good research design, Different research designs, Scales of measurements, Nominal, Ordinal, Internal and ratio scales, Errors in measurements, Validity and Reliability in measurement, Scale Construction Techniques. **Digital**: Web sources, E-journals, Journal access, Citation Index, Impact factor, H-index, E-consortium, UGC info net, eBooks, Internet discussion groups and communities, Blogs, preprint servers, Search engines, Scirus, Google Scholar, Scopus. Reference: - CRK, RK	15
III	Documentation, scientific writing and Academic Integrity	**Documentation and scientific writing**: Results and Conclusions, Preparation of manuscript for Publication of Research paper, Presenting a paper in scientific seminar, Thesis writing. Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography. for illustration, style, publications of scientific work, **Research and Academic Integrity**: Intellectual property rights (IPRs). Plagiarism, Copyright issues, Ethics in research, and case studies. Reference: SP, CRK	15
IV	Data analysis	**Statistical analysis and fitting of data**: Introduction to Statistics – Probability Theories - Conditional Probability, Poisson Distribution,	15

		Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi-Square Test, Association of Attributes - t-Test –Anova- Standard deviation - Co-efficient of variations. Co-relation and Regression Analysis. Reference: RK, CRK	

Learning Resources recommended:

A. Main References:

1. CRK:- Kothari C.R., "Research Methodology, Methods and Techniques" (Second revised edition, New Age International Publication, 2004).
2. SP:- Saravanavel P., "Research Methodology" (Kitab Mahal, Sixteenth edition, 2007).
3. RK: -Ranjit Kumar, "Research Methodology, a step-by-step guide for beginners" (Pearson education Australia, Second edition 2005).
4. MS:- Mark Saunders, Philip Lewis, Adrain Thornhiu, "Research Methods for Business Students"(Pearson Education ltd, Seventh edition, 2016)DG: - How to write and publish by Robert A. Day and Barbara Gastel, (Cambridge University Press).

B. Additional Reference: -

1. Thesis & Assignment Writing–J Anderson, B.H.Dursten & M.Poole, Wiley Eastern, 1977
2. A Hand Book of Methodology of Research – P. Rajammal and P. Devadoss, R. M. M. Vidya Press,1976.
3. The Craft of Scientific Writing by Michael Alley, (Springer).
4. Research Methodology by R. Panneerselvam, PHI, New Delhi 2005
5. Research Methodology- A step by step Guide for Beginners, (2nd ed.) Kumar Ranjit, 2005, Pearson Education.
6. How to write and publish by Robert A. Day and Barbara Gastel, (Cambridge University Press).
7. S. Gupta, (2005). Research Methodology and Statistical techniques, Deep and Deep Publications (P) Ltd. New Delhi, India.
8. R. Kothari, (2008). Research Methodology, New Age International, New Delhi, India.
9. Standard /Reputed Journal authors' instructions.
10. Web resources: www.sciencedirect.com for journal references,
11. www.aip.org and www.aps.org for reference styles.
12. Web resources: www.nature.com, www.sciencemag.org,
13. www.springer.com, www.pnas.org, www.tandf.co.uk,
14. www.opticsinfobase.org for research updates.

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

SEMESTER-II

No. of Courses	Semester II	Credits
	Major: Mandatory	
PSPH 201	Electrodynamics	2
PSPH 202	Advanced Electronics	4
PSPH 203	Quantum Mechanics-II	4
PSPH 204	Physics LAB-I	4
	Major: Elective	
PSPH 205	Physics of Semiconductor diodes and Transistors	04
PSPH 206	Physics LAB-II	
	OR	
PSPH 207	Semiconductor Physics and Devices	04
PSPH 208	Physics LAB-III	
PSPH 209	On Job Training/ Field Project	04
	Total Credits	22

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	Electrodynamics
Course Code	PSPH201
Class	M.Sc.-I
Semester	II
No of Credits	2
Nature	Theory
Type	Major
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn advanced concepts of electrodynamics. They learn about the EM waves from the perspective originating from Maxwell's equations and their propagation through different media and through waveguides.

Course Outcomes:

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

1 Use four vector and tensor for electrodynamics.
2 Formulate covariant formulation for electrodynamics.
3 Identify the nature of electromagnetic wave and its propagation through different media, interfaces and cavities.
4 Use Maxwell equations in analyzing the electromagnetic field due to time varying charge and current distribution.
5 Explain charged particle dynamics and radiations from localized time varying electromagnetic sources.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Electrodynamics in Four vector notation	Four vectors and tensors, Lorentz transformation in 4-vector notation, Transformations of electric and magnetic field; Electromagnetic field Tensor in Four dimensions and Maxwell's Equations, Dual Field Tensor, Covariance of Maxwell's equations. Reference: - WG	10
II	Electromagnetic wave and wave guide	Electromagnetic waves in vacuum, Polarization of plane waves. Electromagnetic waves in matter, Wave guides, boundary conditions, classification of fields in wave guides, phase velocity and group velocity, resonant cavities. Reference: - WG	10
III	Radiation Theory	**Motion of Charged Particles in Electromagnetic Field:** Uniform E and B fields, non-uniform fields, diffusion across magnetic fields, time varying E and B fields, **Radiation by moving charges**: Lienard-Wiechert potentials and fields for a point charge, charges moving with uniform velocity, accelerated charges, radiation from accelerated charges moving (i) with low velocities and (ii) with relativistic velocities, bremsstrahlung, synchrotron radiation; Cherenkov radiation. Rayleigh's scattering and the colour of sky. Reference: - HM	10

Learning Resources recommended:

A. Main Reference:
   1. WG: - W. Greiner, Classical Electrodynamics (Springer- Verlag, 2000) (WG).
   2. HM: - M.A. Heald and J.B. Marion, Classical Electromagnetic Radiation, 3rd edition (Saunders, 1983) (HM)

B. Additional references:
   1. J.D. Jackson, Classical Electrodynamics, 4Th edition, (John Wiley & sons) 2005 (JDJ)
   2. W.K.H. Panofsky and M. Phillips, Classical Electricity and Magnetism,2nd edition, (Addison - Wesley) 1962.

3. D.J. Griffiths, Introduction to Electrodynamics,2nd Ed., Prentice Hall, India,1989.
4. J.R. Reitz, E.J. Milford and R.W. Christy, Foundation of Electromagnetic Theory, 4th ed., Addison -Wesley, 1993

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.	07 08
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 08
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	07 08
4	I II III	Objective type of questions without internal option	05 05 05

Guidelines for pattern for Semester End Evaluation:

4. All questions shall be compulsory with internal option. Questions may be subdivided into sub questions.
5. Long and short questions will include descriptive type of questions, derivation-based questions, problem solving /numericals based questions, etc.
6. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	Advanced Electronics
Course Code	PSPH202
Class	M.Sc.-I
Semester	II
No of Credits	4
Nature	Theory
Type	Major
Relevance with Employability/ Entrepreneurship/ Skill development	Learners acquire the 8085 and 8051 controller programming skills, the analogue circuit designing and implementation skills. They will apply their knowledge to design of electronic systems.

Course Outcomes:

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

1 Understand Counters and Time Delays, Stack and Sub-routines for 8085 microprocessors.
2 Understand History of Microcontrollers and Microprocessors, Embedded versus External Memory Devices, 8–bit and 16–bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures.
3 Understand Instruction set of 8051 microcontrollers.
4 Write programs for 8085 microprocessor and 8051 microcontrollers.
5 Understand the concept of Linear Power supply, Switch Mode Power supply, Uninterrupted Power Supply, Step up and Step-down Switching Voltage Regulators.
6 Understand the principle and operation of various types of inverters.
7 Understand the concept and operation of various types of signal conditioners.
8 Understand the concept and operation of various types of data transmission systems.
9 Understand the structure, mechanism, mathematical analysis needed, types and applications of optical fiber.
10 Understand Microprocessors/ Microcontrollers based Instrumentation Systems.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Microprocessors and Microcontrollers	**Microprocessors:** Counters and Time Delays, Stack and Sub-routines. **Introduction to Microcontrollers**: Introduction, Microcontrollers and Microprocessors, History of Microcontrollers and Microprocessors, Embedded versus External Memory Devices, 8–bit and 16–bit Microcontrollers, CISC and RISC Processors, Harvard and Von Neumann Architectures, Commercial Microcontroller Devices. **8051 Microcontrollers**: Introduction, MCS–51 Architecture, Registers in MCS-51, 8051 Pin Description, Connections,8051 Parallel I/O Ports and Memory Organization. **8051 Instruction set and Programming**: MCS-51 Addressing Modes and Instruction set. 8051 Instructions and Simple programs using Stack Pointer. Reference: - RSG, AVD	15
II	Analog and Data Acquisition Systems	**Power Supplies**: Linear Power supply, Switch Mode Power supply, Uninterrupted Power Supply, Step up and Step-down Switching Voltage Regulators. **Inverters:** Principle of voltage driven inversion, Principle of current driven inversion, sine wave inverter, square wave inverter. **Signal Conditioning:** Operational Amplifier, Instrumentation Amplifier using IC, Precision Rectifier, Voltage to Current Converter, Current to Voltage Converter, Op-Amp Based Butterworth Higher Order Active Filters and Multiple Feedback Filters, Voltage Controlled Oscillator, Analog Multiplexer, Sample and Hold circuits, Analog to Digital Converters, Digital to Analog Converters. Reference: - AJ, RAG, CD	15
III	Data Transmission Systems and Fiber Optics	**Data Transmission Systems**: Analog and Digital Transmissions, Pulse Amplitude Modulation, Pulse Width Modulation, Time Division Multiplexing, Pulse Modulation, Digital Modulation, Pulse Code Format, Modems. **Optical Fiber**: Introduction to optical fibers, wave propagation and total internal reflection	15

		in optical fiber, structure of optical fiber, Types of optical fiber, numerical aperture, acceptance angle, single and multimode optical fibers, optical fiber materials and fabrication, attenuation, dispersion, splicing and fiber connectors, fiber optic communication system, fiber sensor, optical sources and optical detectors for optical fiber. Reference: - BS, HSK	
IV	Instrumentation Circuits and Designs	**Instrumentation Circuits and Designs**: Microprocessors/ Microcontrollers based D C motor speed controller, Microprocessors /Microcontrollers based temperature controller, electronic weighing single pan balance using strain gauge/ load cell, Optical analog communication system using fiber link, electronic intensity meter using optical sensor, IR remote controlled ON/OFF switch. Reference: - AVD, MMM, KJA	15

Learning Resources recommended:

A. Main Reference:

1. AVD: -Microcontrollers (Theory and Applications) by Ajay V. Deshmukh, TMH.
2. RSG: - Microprocessor Architecture, Programming and Applications with the 8085 R. S. Gaonkar, 4th Edition. Penram International.
3. RAG: - Op-Amps and Linear Integrated Circuits - R. A. Gayakwad , 3rd Edition Prentice Hall India.
4. AJ: - Power Electronics and its applications, Alok Jain, 2nd Edition, Penram International India.
5. CD: -Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin and Frederic F. Driscoll, 6th Edition, Pearson Education Asia.
6. BS: -A text book of optics; Brijlal Subrhamanyam.
7. HSK: - Electronic Instrumentation, H.S. Kalsi, Tata-McGraw. Hill, 1999.
8. MMM: - The 8051 Microcontroller & Embedded Systems by M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay.
9. KJA: - The 8051 Microcontroller: K.J.Ayala: Penram International.

B. Additional Reference

1. RK: - The 8051 Microcontroller and Embedded Systems, Dr. Rajiv Kapadia, Jaico Publishing House.

2. MP: - Programming & customizing the 8051 Mocrocontroller : Myke Predko, TMH.
3. KG: - Optical Fiber Communications, Keiser G., Mcgraw Hill, Int. Learner Ed.
4. KD: - Electronic Communication Systems; 4th. Ed. Kennedy and Davis, (Tata-McGraw. Hill, 2004.

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	Quantum Mechanics – II
Course Code	PSPH 203
Class	M.Sc.-I
Semester	II
No of Credits	4
Nature	Theory
Type	Major
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn advanced concepts of quantum mechanics such as perturbation theory, approximation methods to solve complex problems based on these concepts. These problem-solving skills will also be useful in competitive exams such as NET, SET, and GATE, Pre-PhD. etc.

Course Outcomes:

On successful completion of this course learners will be able to

1. Understand and formulate time dependent and time independent perturbation theory.
2. Understand various approximation methods and apply it to various problems.
3. Understand scattering theory and its various aspects.
4. Understand the concept of identical particles through its wave functions.
5. Understand how Pauli's exclusion principle is obeyed by fermions.
6. Understand the concept of Relativistic Quantum Mechanics.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Perturbation Theory	**Time independent perturbation theory:** First order and second order corrections to the energy eigenvalues and eigenfunctions. **Degenerate perturbation Theory**: first order correction to energy. **Time dependent perturbation theory:** Harmonic perturbation, Fermi's Golden Rule, sudden and adiabatic approximations, applications. Reference: -RL	15
II	Approximation Methods	**Variation Method:** Basic principle, applications to simple potential problems, He-atom. **WKB Approximation:** WKB approximation, turning points, connection formulas, Quantization conditions, applications. Reference: - GL, DJG	15
III	Scattering Theory	**Scattering Theory**: Laboratory and Centre of mass frames, differential and total scattering cross-sections, scattering amplitude, Partial wave analysis and phase shifts, optical theorem, S-wave scattering from finite spherical attractive and repulsive potential wells, Born approximation. Reference: - DJG, NZ, RL	15
IV	Relativistic Quantum Mechanics and Identical Particles	**Identical Particles:** Symmetric and antisymmetric wave functions, Bosons and Fermions, Pauli Exclusion Principle, slater determinant. **Relativistic Quantum Mechanics:** The Klein Gordon and Dirac equations, Dirac matrices, spinors, positive and negative energy solutions physical interpretation, Nonrelativistic limit of the Dirac equation. Reference: - NZ, RL, BD	15

Learning Resources recommended:

A. Main references**:**
   1. RL: - Richard Liboff, Introductory Quantum Mechanics, 4th edition, Pearson.
   2. DJG: - D J Griffiths, Introduction to Quantum Mechanics 4th edition
   3. GL: - A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition.

4. NZ: - N Zettili, Quantum Mechanics: Concepts and Applications, 2nd edition, Wiley.
5. BD: - J. Bjorken and S. Drell, Relativistic Quantum Mechanics, McGraw-Hill (1965).

B. Additional References

1. W Greiner, Quantum Mechanics: An introduction, Springer, 2004
2. R Shankar, Principles of Quantum Mechanics, Springer, 1994
3. P.M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977).
4. J.J. Sakurai Modern Quantum Mechanics, Addison-Wessley (1994).

Evaluation Pattern:

C. Continuous Assessment (40 Marks):

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

D. 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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	Physics Lab-I
Course Code	PSPH204
Class	M.Sc.-I
Semester	II
No of Credits	4
Nature	Practical
Type	Major
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn various experimental and measurement skills including skills of independent investigation of Physics-related problems. Learners also develop the fundamental understanding of the instruments used. Learner's design electronic systems and troubleshoot them independently. Learners acquire the 8085-programming skill.

Course Outcomes:

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

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. Design and troubleshoot electronics circuits.

Curriculum:

<table>
<tr><th>Unit</th><th>Title</th><th>Learning Points</th><th>No of Lectures</th></tr>
<tr><td>Group A</td><td>General Physics</td><td>1. Ultrasonic Interferometry-Velocity measurements in different Fluids.
2. Measurement of Refractive Index of Liquids using Laser.
3. Measurement of dielectric constant.
4. Faraday Effect -Magneto Optics Effect:
a. To Calibrate Electromagnet
b. To determine verdet's constant
For KCL & KI Solution.
5. Double slit-Fraunhofer diffraction.
6. Carrier mobility by conductivity
7. Characteristics of a Geiger Muller counter and measurement of dead time</td><td>60</td></tr>
<tr><td>Group B</td><td>Electronics</td><td>1. Shift registers.
2. Study of 8085 microprocessor Kit and execution of simple Programmes.
3. Waveform generation using 8085.
4. Study of sample and hold circuit.
5. Switching Voltage Regulator.
6. Pulse width modulation for speed control of dc toy motor.
7. Use of monitor utility in 8085 programs
a. Hex counter
b. Flashing Message</td><td>60</td></tr>
</table>

Note:

1. Minimum number of experiments to be performed and reported in the journal = 08 with minimum 4 experiments from each Group. i.e., Group A: 04 and Group B: 04.
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.

4. At the semester-end Practical exam, the learner shall perform one long experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Learning Resources recommended:

1. Advance practical physics - Worsnop and Flint
2. Experiments in modern physics – Mellissinos
3. Manual of experimental physics –EV Smith
4. Experimental physics for students - Whittle & Yarwood
5. Medical Electronics- Khandpur
6. A course of experiments with He-Ne Laser – Sirohi, Wiley Eastern Ltd
7. Digital Principles and applications-Malvino and Leach
8. Integrated Circuits - K. R. Botkar
9. Experiment in digital principles – D. P. Leach
10. Semiconductor electronics-Gibson
11. Microprocessor Architecture, programming and applications with the 8085-R.S. Gaonkar
12. Microprocessor fundamentals -Schaum Series, Tokheim
13. Semiconductor Electronics – Gibson
14. 8085 kit user Manual

Evaluation Pattern

A. Continuous Assessment: (40 Marks)

Method	Marks
Journal	20
Lab performance	10
Seminar	10

B. Semester End Examination: (60 Marks)

Question No.	Group	Title	Method	Marks
1	A or B	General Physics and Electronics	one Long Experiment performance from Group A or B as per the practical slip	40
2	A or B	General Physics and Electronics	one Short Experiment performance from Group A or B as per the practical slip	20

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	Physics of Semiconductor diodes and Transistors
Course Code	PSPH205
Class	M.Sc.-I
Semester	II
No of Credits	2
Nature	Theory
Type	Elective
Relevance with Employability/ Entrepreneurship/ Skill development	Learners acquire knowledge about the fabrication of p-n junction by different methods and also study their characteristics. It provides a basic background for advanced courses in electronics system designs to fulfill skills required in semiconductor industries.

Course Outcomes:

On successful completion of this course learners will be able to

1. Understand fabrication methods of different types of p-n junctions.
2. Understand IV and C-V characteristics of p-n junctions.
3. Calculate the contact potential and the maximum electrical field in a p-n junction in equilibrium.
4. Understand breakdown mechanisms in p-n junctions.
5. Calculate the excess carrier concentrations at the boundaries between the space-charge region and the neutral n- and p-type regions of a p-n junction for either forward or reverse bias.
6. Distinguish between the current conduction mechanisms and calculate the minority and majority carrier currents in a forward or reverse biased p-n junction diode.
7. Understand principle of operation and construction of BJT and heterojunction bipolar transistors.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Semiconductor Devices I	p-n junction : Fabrication of p-n junction by diffusion and ion-implantation; Abrupt and linearly graded junctions; Thermal equilibrium conditions; Depletion regions; Depletion capacitance, Capacitance – voltage (C-V) characteristics, Evaluation of impurity distribution, Varactor, Ideal and Practical Current-voltage (I-V) characteristics; Tunneling and avalanche reverse junction break down mechanisms; Minority carrier storage, diffusion capacitance, transient behavior; Ideality factor and carrier concentration measurements; Carrier life time measurement by reverse recovery of junction diode; p- i-n diode; Tunnel diode, Introduction to p-n junction solar cell and semiconductor laser diode. Reference: - SMS, SB	15
II	Semiconductor Devices II	Metal – Semiconductor Contacts: Schottky barrier – Energy band relation, Capacitance- voltage (C-V) characteristics, Current-voltage (I-V) characteristics; Schottky barrier – Ideality factor, Barrier height and carrier concentration measurements; Ohmic contacts. Bipolar Junction Transistor (BJT): Static Characteristics; Frequency Response and Switching. Semiconductor heterojunctions, Heterojunction bipolar transistors, Quantum wellstructures. Reference: - SMS, SB, WRR, ABL	15

Learning Resources recommended:

A. Main References:

1. SMS: - S.M. Sze; Semiconductor Devices: Physics and Technology, 2nd edition, John Wiley, New York, 2002.
2. SB: - B.G. Streetman and S. Banerjee; Solid State Electronic Devices, 5th edition, Prentice Hall of India, NJ, 2000.
3. WRR: - W.R. Runyan; Semiconductor Measurements and Instrumentation, McGraw Hill, Tokyo, 1975.
4. ABL: - Adir Bar-Lev: Semiconductors and Electronic devices, 2nd edition, Prentice Hall, Englewood Cliffs, N.J., 1984.

B. Additional References:

1. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.
2. Donald A. Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, Tata McGraw-Hill, New Delhi, 2002.
3. M. Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.
4. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi, 1995.

Evaluation Pattern

C. Continuous Assessment (40 Marks):

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

D. 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 10
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 10
3	I II	Objective type of questions without internal option	10 10

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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	Physics Lab-II
Course Code	PSPH 206
Class	M.Sc.-I
Semester	II
No of Credits	2
Nature	Practical
Type	Elective
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn various experimental and measurement skills including skills of independent investigation of Physics-related problems. Learners also develop the fundamental understanding of the instruments used. Learner will able to design electronic systems and to troubleshoot them independently.

Course Outcomes:

On successful completion of this course learners will be able to

1. Understand & practice the skills while performing experiments.
2. Understand the use of apparatus and their use without fear & hesitation.
3. Correlate the physics theory concepts to practical application.
4. Understand the concept of errors and their estimation.
5. Design and troubleshoot electronics circuits.

Curriculum:

Unit	Title	Learning Points	No of Lectures
Group A	General Physics	1. Barrier capacitance of a junction diode 2. Energy Band gap by four probe method 3. Determine of Young's modulus of metal rod by interference method.	30
Group B	Electronics	1. Adder-subtractor circuits using ICs 2. Study of Presettable counters- 74190 and 74193 3. TTL Characteristics of Totempole Open collector and tristate devices	30

Learning Resources Recommended:

1. Electronic instrumentation & measurement: W. D. Cooper
2. Introduction to solid state physics: C. Kittel
3. Solid state physics: A. J. Dekkar
4. Electronic engineering: Millman Halkias
5. Manual of experimental physics: E.V. Smith
6. Experimental physics for students: Whittle & Yarwood
7. Semiconductor measurements: Runyan
8. Experiments in digital principles: D.P. Leach
9. Digital principles and applications: Melvino and Leach
10. Digital circuit practice: R. P. Jain
11. Electronic instrumentation: H. S. Kalsi
12. Advance Practical Physics: Worsnop and Flint

Note:

1. Minimum number of experiments to be performed and reported in the journal = 04 with minimum 02 experiments from each Group. i.e., Group A: 02 and Group B: 02.
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.

4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Evaluation Pattern:

A. Continuous 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	A or B	General Physics and Electronics	Any one Long Experiment performance from Group A or B as per the practical slip	40
2	A or B	General Physics and Electronics	Any one Short Experiment performance from Group A or B as per the practical slip	20

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	Semiconductor Physics and Devices
Course Code	PSPH207
Class	M.Sc.-I
Semester	II
No of Credits	2
Nature	Theory
Type	Elective
Relevance with Employability/ Entrepreneurship/ Skill development	The learners learn different aspects of semiconductors, their classification, crystal structures, etc. They also study the transport properties and different types of recombination. They acquire skill to study their characteristics. They also acquire skills to apply their knowledge to different devices such as BJT, MOSFET, MODFET etc.

Course Outcomes:

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

1 Calculate the intrinsic carrier concentration in semiconductors and apply the concept of compensation and space charge neutrality to calculate the electron and hole concentrations in extrinsic semiconductor samples.
2 Compute the electron and hole concentrations if the Fermi or quasi-Fermi level is given.
3 Understand the carrier generation and various recombination processes and excess carrier concentrations as a function of time for low-level injection conditions in a semiconductor.
4 Determine the drift and diffusion components of electron and hole currents.
5 Understand the applications of continuity equation.
6 Understand the concept of MESFET.
7 Understand I-V characteristics of MESFET, MODFET.

Curriculum

Unit	Title	Learning Points	No of Lectures
I	Semiconductor Physics	Classification of Semiconductors; Crystal structure with examples of Si, Ge & GaAs semiconductors; Energy band structure of Si, Ge & GaAs; Extrinsic and compensated Semiconductors; Temperature dependence of Fermi-energy and carrier concentration. Drift, diffusion and injection of carriers; Carrier generation and recombination processes- Direct recombination, Indirect recombination, Surface recombination, Auger recombination; Applications of continuity equation- Steady state injection from one side, Minority carriers at surface, Haynes Shockley experiment, High field effects. Hall Effect; Four – point probe resistivity measurement; Carrier life time measurement by light pulse technique. Reference: SMS	15
II	Field Effect Transistors	**Field Effect Transistors**: - Metal-semiconductor field effect transistor (MESFET)- Device structure, Principles of operation, Current voltage (I-V) characteristics, High frequency performance. Modulation doped field effect transistor (MODFET), Introduction to ideal MOS device, MOSFET fundamentals, Measurement of mobility, channel conductance etc. from I_{ds} vs, V_{ds} and I_{ds} vs V_g characteristics, Introduction to Integrated circuits. Reference: - SMS, SB, ABL	15

Learning Resources recommended:

A. Main References:
   1. SMS: - S.M. Sze; Semiconductor Devices: Physics and Technology, 2nd edition, John Wiley, New York, 2002.
   2. SB: - B.G. Streetman and S. Banerjee; Solid State Electronic Devices, 5th edition, Prentice Hall of India, NJ, 2000.
   3. ABL: - Adir Bar-Lev: Semiconductors and Electronic devices, 2nd edition, Prentice Hall, Englewood Cliffs, N.J., 1984.

B. Additional References:

1. Jasprit Singh; Semiconductor Devices: Basic Principles, John Wiley, New York, 2001.
2. Donald A. Neamen; Semiconductor Physics and Devices: Basic Principles, 3rd edition, Tata McGraw-Hill, New Delhi, 2002.
3. M. Shur; Physics of Semiconductor Devices, Prentice Hall of India, New Delhi, 1995.
4. Pallab Bhattacharya; Semiconductor Optoelectronic Devices, Prentice Hall of India, New Delhi, 1995.
5. WRR: - W.R. Runyan; Semiconductor Measurements and Instrumentation, McGraw Hill, Tokyo, 1975.

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 10
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	10 10
3	I II	Objective type of questions without internal option	10 10

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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	Physics Lab-III
Course Code	PSPH208
Class	M.Sc.-I
Semester	II
No of Credits	2
Nature	Practical
Type	Elective
Relevance with Employability/ Entrepreneurship/ Skill development	Learners learn various experimental and measurement skills including skills of independent investigation of Physics-related problems. Learners also develop the fundamental understanding of the instruments used. Learner will be able to design electronic systems and troubleshoot them independently. Learners acquire the 8085-programming skill.

Course Outcomes:

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

1 Understand & practice the skills while performing experiments.
2 Understand the use of apparatus and their use without fear & hesitation.
3 Correlate the physics theory concepts to practical application.
4 Understand the concept of errors and their estimation.
5 Write flowcharts and assembly language programs for 8085 microprocessors.
6 Execute programs on 8085 microprocessor kit.

Curriculum:

Unit	Title	Learning Points	No of Lectures
Group A	General Physics	1) Linear Voltage Differential Transformer 2) I-V/C-V measurement on semiconductor specimen 3) Zeeman Effect using Fabry-Perot etalon/Lummer – Gehrecke plate	30
Group A	Electronics	1) Ambient Light control power switch. 2) SID & SOD using 8085 3) Interfacing TTL with buzzers, relay, motor and solenoids	30

Learning Resources Recommended:

1. Semiconductor electronics – Gibson
2. Electronic instrumentation & measurement: W. D. Cooper
3. Introduction to solid state physics - C. Kittel
4. Solid state physics — A. J. Dekkar
5. Electronic engineering - Millman Halkias
6. Manual of experimental physics: E.V. Smith
7. Experimental physics for students: Whittle & Yarwood
8. Semiconductor measurements — Runyan
9. Experiments in digital principles-D.P. Leach
10. Digital principles and applications - Malvino and Leach
11. Microprocessor Architecture, Programming and Applications with the 8085 - R. S. Gaonkar
12. Microprocessor fundamentals- Schaum Series-Tokheim
13. 8085 Kit User manual
14. Electronic Instrumentation – H. S. Kalsi
15. Advance practical physics – Worsnop and Flint

Note:

1. Minimum number of experiments to be performed and reported in the journal = 04 with minimum 02 experiments from each Group. i.e., Group A: 02 and Group B: 02.
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.
4. At the semester-end Practical exam, the learner shall perform any one experiment from Group A or B. If the learner performs the long experiment from group A, then he will perform a short experiment from Group B, or vice versa.
5. For the semester-end Practical Exam 3 hours of duration for a long experiment and 1 hour of duration for a short experiment.

Evaluation Pattern:

A. Continuous 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	A or B	General Physics and Electronics	Any one Long Experiment performance from Group A or B per the practical slip	40
2	A or B	General Physics and Electronics	Any one Short Experiment performance from Group A or B as per the practical slip	20

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester II with Effect from the Academic Year 2023-2024

Name of the Course	On Job Training/ Field Project
Course Code	PSPH209
Class	M.Sc.
Semester	II
No of Credits	4
Nature	Practical
Type	On Job Training/ Field Project
Relevance with Employability/ Entrepreneurship/ Skill development	The primary goal of the course is to provide learners with the theoretical and experimental knowledge and skills necessary to identify the social needs, to provide solutions to them and to do work in research or in industry or in community. Learners develop technical and analytical skills that lead to the development and working on a project. They can use procedural knowledge in their professional field in future and acquire communication skills, collaborative approach and ability to apply it for betterment of society.

Guidelines and Evaluation pattern for On Job Training/ Project/Extended Experiment (100 Marks)

Introduction:

Inclusion of On Job Training/ Field Project in the course curriculum of the M.Sc. programme is one of the ambitious aspects in the programme structure. The main objective of inclusion of On Job Training/ Project is to inculcate ability to interpret particular aspect of the study in his/ her own words.

Guidelines for On Job Training

On-the-Job Training/Field Project: Learners will be required to undertake a designated project or tasks in an organization or industry relevant to their field of study. The course aims to provide learners with practical exposure and hands-on experience in a professional work environment related to their field of study.

Course Objectives:

By the end of the course, learners should be able to:

1. Gain exposure to real-world insights and apply theoretical knowledge to practical situations.
2. Enhance skills regarding problem-solving, decision-making, and communication skills.
3. Understand organizational dynamics and work culture.
4. Build industry connections and networking opportunities.

Course Duration:

Minimum 20 days / 120 hours of On Job Training with an Organization/Private firm.

- The theme of the On Job Training should be based on any study area of the Major course.
- Systematic Report of the work should be submitted.
- Work completion Certificate is Mandatory.

Report Structure:

The learners will be required to submit a comprehensive report at the end of the On-the-Job Training/Field Project. A project report has to be brief in content and must include the following aspects:

a) **Title Page:**

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

b) **Certificate of Completion:**

A certificate issued by the organization or supervisor confirming the successful completion of the training.

c) **Declaration:**

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

d) **Acknowledgments:**

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

e) **Table of Contents:**

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

f) **Executive Summary:**

A bird's eye view of learner's entire presentation has to be precisely offered under this Category.

g) **Introduction on the Company:**

A Concise representation of company/organization defining its scope, products/ services etc.

h) **Your Role in the Organization during the on-Job Training:**

The key aspects handled, the department under which learner were deployed and brief Summary report duly acknowledged by the reporting head.

i) **Challenges**:

The challenges confronted while churning out theoretical knowledge into practical world.

j) **Conclusion:**

A brief overview of learner experience and suggestions to bridge the gap between theory and practice.

Course Outcomes:

1. Apply theoretical knowledge and concepts acquired during the academic program to real-world work scenarios.
2. Develop practical skills and competencies necessary for successful professional engagement.
3. Demonstrate effective problem-solving, decision-making, and critical thinking abilities in a work environment.
4. Adapt to and navigate organizational dynamics and work culture in the chosen industry.

5. Prepare a comprehensive report documenting the training/project experience, findings, and recommendations.

Evaluation Pattern for On Job Training

A. Continuous Evaluation: (40 Marks)

Method	Marks
Certificate for performance in Training Place	30
Presentation	10

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

Sr No	Criteria	Marks
1	On Job Training Report as per report structure	40
2	Presentation/Viva	20

Guidelines for Field Project

Course Outcomes:
By the end of the course, learners should be able to:

1 Understand the ethics and research methodology.
2 Do a literature review.
3 Do research.
4 Analyze the research work data.
5 Write research thesis.
6 Design, build and test necessary experimental setup.

Course Duration: One Semester Minimum 120 hours of field project work.

Course Outline:

1. Identifying problem for project work (20 Hours).
2. Literature survey (20 Hours).

3. Designing and implementing the project through necessary experimental work (30 Hours).
4. Data collection and its analysis and interpretation. (20 Hours).
5. Report writing and presentation (30 Hours).

Evaluation Pattern for Field Project

A. Continuous Evaluation: (40 Marks)

Method	Marks
Lab performance as per course outline	30
Presentation	10

B. Semester End Evaluation (Paper 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

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 Student

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)

R. E. SOCIETY'S,
R. P. GOGATE COLLEGE OF ARTS & SCIENCE
AND
R. V. JOGALEKAR COLLEGE OF COMMERCE
(AUTONOMOUS),
RATNAGIRI

SYLLABI OF COURSES OFFERED BY DEPARTMENT OF PHYSICS OF THE COLLEGE IN THE SUBJECT PHYSICS (ELECTRONICS-1) FOR THE SECOND YEAR (SEMESTER III & IV) OF PROGRAM M.SC.

UNDER
CHOICE BASED CREDIT SYSTEM (CBCS)

WITH THE EFFECT FROM ACADEMIC YEAR 2023-24

Program Outcomes of M.Sc. Physics

Name of Programme	**Master of Science**
Level	PG
No of Semesters	04
Year of Implementation	**2023-24**
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 development in various dolmens 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, 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 assessed by Continuous Assessment 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: -

A) Continuous Assessment: (40% marks)

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

B) Semester End Examination: (60% marks)

The Examination shall be of 2hours duration.

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 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 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
PSPH301	Statistical Mechanics	04	PSPH401	Experimental Physics	04
PSPH302	Nuclear Physics	04	PSPH402	Atomic and Molecular Physics	04
PSPH303	8, 16 – bit Microprocessors, Microcontroller and PIC Microcontrollers	04	PSPH403	32-bit microprocessor, interfacing 8-bit microcontrollers & PIC microcontrollers	04
PSPH304	Programming Using C++, VC++, Embedded Systems and RTOS	04	PSPH404	VHDL, Understanding USB and Communication Interface.	04
PSPH305	Physics lab-1	04	PSPH405	Physics lab-2	04
PSPH306	Project-1	04	PSPH406	Project-2	04
Total Credits		24	Total Credits		24

SEMESTER-III

No. of Courses	Semester III	Credits
PSPH301	Statistical Mechanics	4
PSPH302	Nuclear Physics	4
PSPH303	8, 16 – bit Microprocessors, Microcontroller and PIC Microcontrollers	4
PSPH304	Programming Using C++, VC++, Embedded Systems and RTOS	4
PSPH305	Physics Lab-1	4
PSPH306	Project	4
Total Credits		24

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2023-2024

Name of the Course	Statistical Mechanics
Course Code	PSPH301
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum includes introduction to statistical mechanics based on theoretical foundation of ensemble theory. It is expected to develop strong analytical skills to interpret complex relationships between macroscopic and microscopic states and their applications to simple thermodynamic systems. It deals with advanced concepts like partition functions, probability distributions and quantum states. It also introduces Fermi Dirac and Bose Einstein Statistics which are used in frontier research field.

Nomenclature: Statistical Mechanics

Course Outcomes:

On successful completion of this course learners will:

1. Understand the concept of microstates and macrostates of a system.
2. Understand need of using statistical approach to study thermodynamic system.
3. Understand the concept of Liouville's theorem and its consequences.
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.
5. Be able to use of micro canonical, canonical and grand canonical ensembles to derive the properties of various classical and quantum thermodynamic systems.
6. Understand the basic of formulation of Quantum Statistics.

Curriculum:

Unit	Title	Learning Points	No of Lectures
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	15
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	15
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	15
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	15

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

Learning Resources recommended:

Main Reference:

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

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. JKB: - Non-equilibrium Statistical Mechanics, J.K. Bhattacharjee.
6. RF: - Statistical Mechanics, Richard Feynman.
7. LL: - Statistical Mechanics, Landau and Lifshitz.
8. HBC: - Thermodynamics, H.B. Callen.

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2023-2024

Name of the Course	Nuclear Physics
Course Code	PSPH302
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum includes various radioactive decay processes and their selection rules. It imparts basic knowledge of elementary particle physics and applications of these concepts to analyze a nuclear reaction. Working with complex physics problems develops critical thinking and problem-solving skills.

Nomenclature: Nuclear Physics

Course Outcomes:

On successful completion of this course, learners will understand:

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

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	Nucleus and Deuteron theory	**Properties of Nucleus: -** 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 R_0 (mirror nuclei and mesonic atom method) **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. Reference: - KK, SNG, SBP	15
II	Theory of alpha, beta and gamma decay	**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. Reference: - SBP, KK	15
III	Nuclear Models and Nuclear reactions	**Nuclear Models:** Shell Model (extreme single particle): Introduction, Assumptions, Evidences, Spin-orbit interactions, Predictions including Schmidt lines, limitations, Collective model - Introduction to Nilsson Model. **Nuclear Reactions:** Kinematics, scattering and reaction cross sections, Compound nuclear reaction, direct nuclear reaction. Q-value equation, energy release in fusion and fission reaction. Reference: SBP, KK	15
IV	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),	15

		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. Reference: - DG	

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

Learning Resources recommended:

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.

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)

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2023-2024

Name of the Course	8, 16 – bit Microprocessors, Microcontroller and PIC Microcontrollers
Course Code	PSPH303
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum is designed to focus on study of microprocessors and microcontrollers and their applications in embedded systems, electronics manufacturing and computer hardware. It is designed to develop programming skills with microprocessors 8085, 8086 and microcontrollers 8051 and PIC.

Nomenclature: 8, 16 – bit Microprocessors, Microcontroller and PIC Microcontrollers

Course Outcomes:

On successful completion of this course learners will:

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

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	8085 Microprocessor and programmable peripheral devices	**1. 8085 Interrupts**: The 8085 Interrupt, 8085 Vectored Interrupts, Restart as Software Instructions, Additional I/O Concepts and Processes. **2. 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 **3. 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	15
II	8086 microprocessor	**1. 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. **2. 8086 Instruction set and assembler directives:** Machine Language Instructions Formats, addressing modes of 8086, Instruction set of 8086. **3. 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. **4. 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	15
III	8051 Microcontroller	**8051 microcontrollers: Timer/Counters, Interrupts, Serial communication**: Programming 8051 Timers, Counter Programming, Basics of Serial Communication, 8051 Connection to RS232,	15

		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	15

Learning Resources recommended:

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 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.

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.

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2023-2024

Name of the Course	Programming Using C++, VC++, Embedded Systems and RTOS
Course Code	PSPH304
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum designed to provide skills of writing, compiling and executing codes in C++ and VC++ for carrying out numerical analysis and for handling physical problems. The curriculum includes study of embedded systems like chocolate vending machine, washing machine, etc. The curriculum not only enhances learner employability but also equips learners with skills and knowledge needed for entrepreneurial pursuits in software development, embedded systems and technical fields.

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

Course Outcomes:

On successful completion of this course learners will:

1. Be able to write C++ program using decision making, Looping, Function, Arrays, Pointers, classes, Inheritance, polymorphism, virtual functions.
2. Be able to write basic VC++ programs.
3. Understand the basics, classification, purpose and applications of embedded systems.
4. Understand basic concept of multitasking, types of scheduling under Real Time Operating System.

Curriculum:

Unit	Title	Learning Points	No of Lectures
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. Reference: - TG	15
II	Introduction to classes and VC++	**Introduction to classes**: - Classes, Inheritance, polymorphism, virtual functions. **VC++**: - Introduction to VC++ Reference: - TG, YK	15
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, RK	15
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	15

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. YK: - Introduction to Visual C++ by Yashwant Kanetkar.
  3. SKV: - Introduction to embedded system 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.

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.

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester III with Effect from the Academic Year 2023-2024

Name of the Course	Physics Lab -I
Course Code	PSPH305
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Practical
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum provides practical exposure in programming skills for microprocessors 8085, 8086, PIC microcontroller and 8051 controller along with compiling and executing the codes. It also provides hands-on experience in working with different microprocessor and microcontroller systems. The curriculum includes basics about higher level language C++ through simple programming. It also includes concepts of object-oriented programming. It also provides training in debugging and troubleshooting of embedded systems.

Nomenclature: Physics Lab-I

Course Outcomes:

On successful completion of this course, learners will:

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

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

3 Be able to write, debug and execute C++ and Visual C++ programmes.

Curriculum:

Unit	Title	Learning Points	No of Lectures
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.	60
Group B	PIC microcontroller, C++ and VC++ based experiments	**B1: (16F84 or 16FXXX) PIC Micro-controller-based experiments (Using assembly language only): (Any two experiments from 1, 2, 3 & 4)** 1. a) Interfacing LED's: flashing LED's, to display bit pattern, 8-bit counter. 1. b) Interfacing Push Buttons: to increment and decrement the count value at the output by recognizing of push buttons, etc 2. Interfacing Relay: to drive an ac bulb through a relay; the relay should be tripped on recognizing of a push button.	60

		3. Interfacing buzzer: the buzzer should be activated for two different frequencies, depending on recognizing of corresponding push buttons. **B2: C++ and Visual C++ 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). 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). b) C++ experiment (Programs on class, traffic lights). 3. C++ experiment (Programs on inheritance, over loading). 4. Visual C++ experiments: - a) Get window on screen. b) Get several windows on screen. c) Display window on screen and interact with it. d) Display a message in the center of the window. e) Display a message at any place on a window when clicked with left mouse button. f) Create simple window using MFC. g) Create a window of desired size using MFC. h) To Attach a menu to a window using MFC.	

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.

Evaluation Pattern

A. Continuous 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 VC++ 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 2023-2024

Name of the Course	Project-I
Course Code	PSPH306
Class	M.Sc.-II
Semester	III
No of Credits	4
Nature	Project
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The primary goal of the course is to give an exposure to the learner to identify the social needs, to provide solutions based on acquired knowledge and to work on the solution.Technical and analytical training acquired from this course lead to the development of communication skills, collaborative approach and ability to apply it in various professional fields.

Nomenclature: Project-I

Course Outcomes:

On successful completion of this course, learners will:

1. Understand the ethics and research methodology.
2. Do a literature review.
3. Do research.
4. Analyze the research work data.
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

Evaluation Pattern

A. Continuous 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 each in Semester III and Semester IV with four credits (100 marks) each.
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 of 100 marks with 40% by continuous evaluation and 60% by 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

Sr No	Title	Page No.
01		
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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)

SEMESTER-IV

No. of Courses	Semester IV	Credits
PSPH401	Experimental Physics	4
PSPH402	Atomic and Molecular Physics	4
PSPH403	32-bit microprocessor, interfacing 8-bit microcontrollers & PIC microcontrollers	4
PSPH404	VHDL, Understanding USB and Communication Interface.	4
PSPH405	Physics lab-2	4
PSPH406	Project-2	4
Total Credits		24

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2023-2024

Name of the Course	Experimental Physics
Course Code	PSPH401
Class	M.Sc.-II
Semester	IV
No of Credits	4
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum focuses on population and sample, probability distributions, normal distribution, t-distribution, binomial distribution, and Poisson distribution, which equips individuals with strong data analysis and statistical skills that will be useful in careers such as data-driven industries, research, and decision-making processes. The curriculum leads to the study of various spectroscopic and microscopy techniques, such as XRD, XRF, SEM, TEM, and AFM, which are useful in materials characterization, nanotechnology, and materials science research. Theoretical knowledge with data analysis, vacuum systems, nuclear detectors, and spectroscopy develops research and analytical skills, which are essential for academic and industrial research positions.

Nomenclature: Experimental Physics

Course Outcomes:

On successful completion of this course learners will:

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

Curriculum:

Unit	Title	Learning Points	No of Lectures
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	15
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	15
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	15
IV	Characterization techniques for material analysis	**Spectroscopy:** XRD, XRF, XPS, EDAX, Raman, UV Visible spectroscopy, FTIR spectroscopy. **Microscopy:** SEM, TEM, AFM Reference: - KPR	15

Learning Resources recommended:

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.

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.

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2023-2024

Name of the Course	Atomic and Molecular Physics
Course Code	PSPH402
Class	M.Sc.-II
Semester	IV
No of Credits	4
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum leads to the study of various types of electron systems and their Schrodinger equations. It develops problem-solving skills related to atomic and molecular systems, such as the Zeeman effect, Paschen-Back effect, and Stark effect, which are essential for understanding the behaviour of these systems under external perturbations. It also develops analytical thinking skills to analyze and interpret complex physical phenomena, such as the fine structure of hydrogenic atoms, Lamb shift, hyperfine structure, and isotope shift, and derive relationships between different parameters. The curriculum focuses on the absorption and emission of electromagnetic radiation by an atom and various aspects of the spectra of atoms as well as molecules, which is beneficial in research.

Nomenclature: Atomic and Molecular Physics

Course Outcomes:

On successful completion of this course learners will:

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

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	One electron and two electron atoms	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	15
II	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	15

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	15
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	15

Learning Resources recommended:

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.

Additional Reference:

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.
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)

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2023-2024

Name of the Course	32-bit microprocessor, interfacing 8-bit microcontrollers & PIC microcontrollers
Course Code	PSPH403
Class	M.Sc.-II
Semester	IV
No of Credits	4
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum focuses on the interfacing of microcontrollers / PIC with various devices like LEDs, push buttons, relays, 7-segment displays, LCDs, ADCs, and DACs. It also develops programming skills for designing electronics systems, which are useful in industries like automotive, healthcare, and consumer electronics. The curriculum leads to study the architecture and assembly language programming of ARM7. Learners with expertise in these areas have better employability prospects.

Nomenclature: 32-bit microprocessor, interfacing 8-bit microcontrollers & PIC microcontrollers.

Course Outcomes:

On successful completion of this course learners will:

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

Curriculum:

Unit	Title	Learning Points	No of Lectures
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	15
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	15
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	15
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	15

Learning Resources recommended:

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.

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.

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2023-2024

Name of the Course	VHDL, Understanding USB and Communication Interface.
Course Code	PSPH404
Class	M.Sc-II
Semester	IV
No of Credits	4
Nature	Theory
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum covers VHDL and digital design ideas, which prepare learners to describe and implement sophisticated hardware systems using hardware description languages. This skill set is in great demand in industries involving FPGA design and digital system development. The curriculum includes the study of communication protocols such as USB, I2C, SPI, Bluetooth, and Wi-Fi, which are used to develop skills in programming, interfacing, and implementing these protocols, which can lead to opportunities in telecommunications, and networking.

Nomenclature: VHDL, Understanding USB and Communication Interface.

Course Outcomes:

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

1. Understand the IEEE Standard 1076 Hardware Description Language (VHDL).
2. Understand the concept of architecture, data types of VHDL.
3. Understand entity, operators, Signal and generate statements, sequential statements, loops and decision-making statements, package and component statements in VHDL.
4. Understand hardware details of USB.
5. Understand USB communication through Transfer Basics, Elements of a Transfer, USB 2.0 Transactions, Ensuring Successful Transfers, Super Speed Transactions.
6. Understand USB protocols for data transfer.
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	No of Lectures
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	15
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	15

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	15
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	15

Learning Resources recommended:

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

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.	06 06
2	II	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
3	III	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
4	IV	A. Long questions with 100% Internal option. B. Short questions with 100% Internal option.	06 06
5	I II III IV	Objective type of questions without internal option	03 03 03 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.
3. Objective type of questions will include MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc.

Revised Syllabus of Course of Master of Science (M.Sc.) Programme at Semester IV with Effect from the Academic Year 2023-2024

Name of the Course	Physics Lab-2
Course Code (refer to learner handbook)	PSPH405
Class	M.Sc. -II
Semester	IV
No of Credits	4
Nature	Practical
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The curriculum provides hands-on experience with external components and communication peripherals interfacing with microcontrollers. It helps learners to build and improve their practical abilities in circuit design, programming, testing, and debugging. The curriculum teaches learners how to interface various peripherals, such as DACs, ADCs, and stepper motors, with microcontrollers and VHDL, preparing them to construct advanced applications in robotics, automation, and control systems. The curriculum motivates the students to design integrated circuits using VHDL. The practical experiments specified in the curriculum, like the arm base manipulation programmes, the arm base interfacing programming, etc., help learners pursuing jobs in embedded systems, electronics, and microcontroller-based applications improve their employability and skill development.

Nomenclature: Physics Lab-2

Course Outcomes:

On successful completion of this course learners will:

1 Be able to draw and write flowcharts, assembly language programs for 8051 microcontrollers.

2 Be able to Interface stepper motor, ADC with 8051.

3 Be able to draw and write flowcharts, assembly language programs for PIC 16F84A.

4 Be able to Interface seven segment display, optocoupler with 16F84A.

5 Be able to draw and write flowcharts, assembly language programs for ARM7 processor.

5 Execute programs on ARM7 kit.

6 Draw and write flowcharts, assembly language programs (basic and interfacing) in VHDL.

7 Implement logic on an FPGA and a CPLD kit.

Curriculum:

Unit	Title	Learning Points	No of Lectures
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.	60
Group B	VHDL and ARM 7	**B1: Basic VHDL experiments: (Any two experiments from 1, 2, & 3.)**	60

		1. a) Write VHDL programs to realize: logic gates, half adder and full adder. 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.	

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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.

Evaluation Pattern

A. Continuous 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 2023-2024

Name of the Course	Project-2
Course Code	PSPH406
Class	M.Sc.-II
Semester	IV
No of Credits	4
Nature	Project
Type	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The primary goal of the course is to give an exposure to the learner to identify the social needs, to provide solutions based on acquired knowledge and to work on the solution. Technical and analytical training acquired from this course lead to the development of communication skills, collaborative approach and ability to apply it in various professional fields.

Nomenclature: Project

Course Outcomes:

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

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

Curriculum:

Unit	Title	Learning Points	No of Lectures
-	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).	120

Learning Resources recommended:

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

Evaluation Pattern

A. Continuous Evaluation: (40 Marks)

Method	Marks
Lab performance	30
Presentation	10

B. Semester End Evaluation (Paper 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 each in Semester III and Semester IV with four credits (100 marks) each.
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 of 100 marks with 40% by internal and 60% by external evaluation.
10. The project report should be 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.
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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)