R. E. Society's

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

Third Year (Semester V & VI)
Bachelor of Science Programme
(CBCS)

For Academic Year 2024-25

Program Outcomes of BSc with Subject Physics

Name of Program	BSc
Level	UG
Number of Semesters	06
Year of Implementation	2024-25
Program Specific Outcomes (PSO)	After successful completion of this program, learners will: PSO1. Understand fundamental physics concepts and will be able to apply physics principles to real world problems. PSO2. Be able to think critically and develop the ability to apply theoretical and mathematical principles to solve complex problems in various areas of physics. PSO3. 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. PSO4. 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. PSO5. 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. PSO6. Develop the ability to work individually as well as in collaboration. PSO7. 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%.

Every course of BSc in the subject Physics and Applied Component in the subject Physics will be evaluated on 100 marks scale. These courses have maximum 40 marks for Continuous Internal Evaluation and maximum 60 marks for Semester End Evaluation.

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:

There will be no conversion of marks for TYBSc.

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	

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Scheme of Courses Offered in the Subject 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	Electronics	**2.5**	USPH602	Solid State Physics	**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 in the Subject Physics 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 be able to:

CO1. Comprehend the basic concepts of thermodynamics & its applications in physical situations.

CO2. Learn some mathematical techniques required to understand the physical phenomena at the undergraduate level.

CO3. Get exposure to important ideas of statistical mechanics.

CO4. Be able to solve simple problems in probability, understand the concept of independent events and work with standard continuous distributions.

CO5. Understand the functions of complex variables.

CO6. Be able to solve non-homogeneous differential equations and partial differential equations using simple methods.

CO7. Understand the concept of statistical mechanics through the concept of microstates, the concept of configurations, Boltzmann distribution and statistical origins of entropy.

CO8. Understand the difference between classical and quantum statistics.

CO9. 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	**Electronics**
Course Code	USPH502
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 be able to:

CO1. Understand the basics of semiconductor devices and their applications.

CO2. Understand the basic concepts of operational amplifier: its prototype and applications as instrumentation amplifier, active filters, comparators and waveform generation.

CO3. Understand the basic concepts of timing pulse generation and regulated power supplies.

CO4. Understand the basic electronic circuits for universal logic building blocks and basic concepts of digital communication.

CO5. 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 Reference: AM	15

		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) Reference: AM/ KVR/MB	15

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 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 be able to:

CO1. Understand the application of quantum mechanics in atomic physics.
CO2. Understand the importance of electron spin, symmetric and antisymmetric wave functions and vector atom model.
CO3. Understand the effect of magnetic field on atoms.
CO4. Learn Molecular physics and its applications.
CO5. Get an insight into theoretical basics of spectroscopy.
CO6. 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 be able to:

CO1. Understand the laws of electrodynamics and be able to perform calculations using them.

CO2. Understand Maxwell's electrodynamics and its relation to relativity.

CO3. Understand how optical laws can be derived from electromagnetic principles.

CO4. 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 (3rd 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 (3rd 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 be able to:

CO1. Understand & practice the skills while performing experiments.
CO2. Understand the use of apparatus and their use without fear & hesitation.
CO3. Correlate the physics theory concepts to practical application.
CO4. Understand the concept of errors and their estimation.
CO5. 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):

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	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 be able to:

CO1. Understand & practice the skills while performing experiments.
CO2. Understand the use of apparatus and their use without fear & hesitation.
CO3. Correlate the physics theory concepts to practical application.
CO4. Understand the concept of errors and their estimation.
CO5. 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 be able to:

CO1. Understand the difference between a transducer and a sensor.
CO2. Understand the construction, working and uses of different types of transducers.
CO3. Understand the concept of signal conditioning, devices used and their operations.
CO4. Get acquainted with the measuring instruments used in laboratory.
CO5. 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 be able to:

CO1. Understand & practice the skills while performing experiments.
CO2. Understand the use of apparatus and their use without fear & hesitation.
CO3. Correlate the physics theory concepts to practical application.
CO4. Understand the concept of errors and their estimation.
CO5. 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 in the Subject Physics 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 be able to:

CO1. Understand the kinds of motions that can occur under a central potential and their applications to planetary orbits.

CO2. Understand the effect of moving coordinate system, rectilinear as well as rotating.

CO3. 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.

CO4. Understand simple concepts from fluid mechanics.

CO5. Understand the dynamics of rigid bodies.

CO6. 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.

CO7. 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	**Solid State Physics**
Course Code	USPH602
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 be able to:

CO1. Understand the basics of crystallography, electrical properties of metals, band theory of solids, demarcation among the types of materials, semiconductor physics and superconductivity.

CO2. Understand the application of Fermi - Dirac distribution function, density of states, conduction in semiconductors and BCS theory of superconductivity.

CO3. 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	15

		electron gas at 0 K, Electrical conductivity from 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,	15

		destruction of superconductivity by magnetic field, The Meissner effect, London equation, BCS 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	**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 be able to:

CO1. 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.

CO2. 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.

CO3. 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 (6th Ed.) (TMH)
2. SBP: Nuclear Physics, S.B. Patel (Wiley Eastern Ltd.)
3. IK: Nuclear Physics, Irving Kaplan (2nd Ed.) (Addison Wesley)
4. SNG: Nuclear Physics, S. N. Ghoshal (S. Chand & Co.)
5. DCT: Nuclear Physics, D. C. Tayal (Himalayan Publishing House) 5th ed

Additional reference:

1. Modern Physics: Kenneth Krane (2nd 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 be able to:

CO1. Understand the significance of Michelson Morley experiment and failure of the existing theories to explain the null result.

CO2. 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.

CO3. Understand the transformation equations for: Space and time, velocity, frequency, mass, momentum, force, energy, charge and current density, electric and magnetic fields.

CO4. 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.

CO5. 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 be able to:

CO1. Understand & practice the skills while performing experiments.
CO2. Understand the use of apparatus and their use without fear & hesitation.
CO3. Correlate the physics theory concepts to practical application.
CO4. Understand the concept of errors and their estimation.
CO5. 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 – VIII

Eligibility: --

Course Outcomes:

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

CO1. Understand & practice the skills while performing experiments.
CO2. Understand the use of apparatus and their use without fear & hesitation.
CO3. Correlate the physics theory concepts to practical application.
CO4. Understand the concept of errors and their estimation.
CO5. 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 be able to:

CO1. Analyze/design and implement combinational logic circuits.
CO2. Develop assembly language programing skills and understand real time applications of microprocessor.
CO3. Illustrate how to interface the I/O peripheral (PPI) with 8085 microprocessor.
CO4. Understand architecture, salient features, instruction set.
CO5. Write assembly language programs for basic and interfacing experiments with 8051 microcontroller.
CO6. 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.

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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 be able to:

CO1. Understand & practice the skills while performing experiments.

CO2. Understand the use of apparatus and their use without fear & hesitation.

CO3. Correlate the physics theory concepts to practical application.

CO4. Understand the concept of errors and their estimation.

CO5. Learn scientific method of recording of the data, its analysis and result/conclusion of an experiment.

CO6. Understand basic principles and concepts of digital electronics and become familiar with various digital components commonly used in computer.

CO7. Implement digital circuits and develop skills in troubleshooting, identifying and fixing issues in digital circuits.

CO8. Understand architecture, operation and basic assembly language programming of 8085 microprocessor, 8031/8051 microcontroller.

CO9. Write and perform basic assembly language programming with 8085 microprocessor, 8031/8051 microcontroller.

CO10. 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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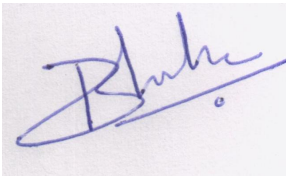

Chairperson
BoS Physics