John Wilson Education Society's

Wilson College (Autonomous)

Chowpatty, Mumbai-400007
RE-ACCREDITED 'A' grade by NAAC

Affiliated to the
UNIVERSITY OF MUMBAI

Syllabus for Third Year Bachelor of Science

Program: Bachelor of Science (B.Sc.)

Program Code: WUSPHY (Physics)

Academic year 2024–2025

PROGRAM: T.Y.B.Sc.			SEMESTER:V		
Course: Thermodynamics II and Statistical Mechanics			Course Code: WUSPHY501		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

1. To understand relationships between various thermodynamic quantities.
2. To study different kinds of systems by applying thermodynamics principles.
3. To learn statistical ideas which relate the microscopic properties of a system to the macroscopic behavior of the system.
4. To use different statistical ideas to understand different systems.

Course Outcomes:

CO1: Build relationships between various thermodynamic quantities.
CO2: Employ thermodynamics in the study of diverse systems.
CO3: Describe a thermodynamic system using statistical ideas.
CO4: Use different type of statistics to analyse classical and quantum systems.

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Thermodynamic Relations**	15
	1.1	Combining first and second law,Physical implications of the second law. (SS- 6.1-6.12)	
	1.2	Free energy, Thermodynamic Potentials, Maxwell' s Relations, Third Law of Thermodynamics.(SS-7.1-7.7)	
	1.3	Principles applicable to different systems, Conditions for equilibrium.(GBG – 9.1-9.6)	
II		**Applications of Thermodynamics**	15
	2.1	Study of Physical Phenomena and Systems.(SS- 8.1-8.8, DK- 12.1-12,6)	
	2.2	Study of Chemical Phenomena and Systems.(DK – 8.1-8.3, 9.1-9.3)	

	2.3	Applications to other areas in science.(SS – 8.9, DK - 13.1-13.4)	
III		**Introduction to Statistical Mechanics**	**15**
	3.1	Relation between microscopic and macroscopic description of a system, Phase Space, Ensembles. SS-11.1 -11.3, GBG – 12.1 – 12.5,12.7, DK- 17.1)	
	3.2	Basics of Probability, Distributions.(GBG- 12.6, 12.9, SS – 11.4 – 11.13, DK- 7.2 -7.3)	
	3.3	Statistical basis of thermodynamics.(SS- 11.14-11.15, GBG – 12.8,13.1,13,2, DK- 17.5,17.6)	
IV		**Classical And Quantum Statistics**	**15**
	4.1	Maxwell Boltzmann Statistics.(SS – 12.1 – 12.7, GBG – 13.3 – 13.7)	
	4.2	Bose Einstein Statistics.(GBG – 15.1 -15.3)	
	4.3	Fermi Dirac Statistics.(GBG – 14.1,14.2,14.5)	

References:

1. GBG: Garg S.C. , Bansal RM, Ghosh CK; Thermal Physics: with Kinetic Theory, Thermodynamics and Statistical Mechanics , 2nd Edition, McGraw Hill Education (2017)
2. SS: Sears F.W., Salinger G.L.; Thermodynamics Kinetic Theory and Statistical Thermodynamics, 3rd edition, Narosa Publishing House (1998)
3. DK: Kondepudi D; Introduction to modern thermodynamics, 2nd edition, Wiley (2015)

Additional Reference:

1. Schroeder D.V.; An introduction to Thermal Physics - Addison-Wesley (2021)
2. Zeemansky M.W., Dittman R.H.; Heat and Thermodynamics, McGraw Hill (2017)
3. Griener W, Niece L, Stocker H; Thermodynamics and Statistical Mechanics, Springer (1995)

PROGRAM: T.Y.B.Sc.			SEMESTER:V		
Course: Solid State Physics and Material Science			Course Code: WUSPHY502		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

- To learn basic ideas of crystallography and solid state physics.
- To learn the basics of superconductivity.
- To apply the knowledge of solid state physics in materials such as metals and polymers and to explain how the properties can be improved.
- To learn the synthesis process of various polymers.

Course Outcomes: After completion of the course, the learner will be able to
CO1: explain the solid state and its applications.
CO2: explain how and why crystalline state is studied.
CO3: characterize the crystallographic state.
CO4: explain the effects of defects on the properties of crystals.
CO5: distinguish between properties of metals, semiconductors and insulators.
CO6: correlate the mechanical properties of metals, ceramics and polymers and processes connected with them.

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Crystallography**	15
	1.1	Chapter – 1: Basics of crystallography 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, 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. (Ali Omar : Chapter 1)	
	1.2	Chapter – 2: Studies of Crystals by X-Ray Diffraction The Bragg Equation, The Debye-Scherrer Method, The Reciprocal Lattice, Laue Groups, The Determination of a Crystal Structure, Exercises on crystal structure.	

		(Walter Borchardt-Ott, Chapter 13)	
	1.3	Chapter – 3: Crystal Defects Point Defects, Substitution Defects, Solid Solutions, Schottky and Frenkel-Defects, Line Defects, Edge Dislocations, Screw Dislocations, Plane Defects, Small Angle Grain Boundaries, Stacking Faults, Twin Boundaries. (Walter Borchardt-Ott: Chapter 14)	
II		Band Theory of Solids and Superconductivity	15
	2.1	Chapter – 1: Band theory of solids The Bloch theorem, The Kronig – Penney Model, The motion of electrons in one dimension according to the band theory, the distinction between metals, insulators and intrinsic semiconductors, the concept of a 'hole', motion of electrons in three dimensional lattice, application to a simple cubic lattice, Brillouin zones; density of states, overlapping of energy bands, the density of states and soft x -ray emission spectra. Optical properties: Absorption spectrum. Photoconductivity. Photovoltaic effect. Luminescence. Junction properties Metal-metal junctions. Metal-semiconductor junctions, p-n junctions, Transistors. (Solid state physics: A. J. Dekker, Chapter 10, Introduction to solids: Leonid V. Azaroff, chapter 12)	
	2.2	Chapter – 2: Superconductivity Experimental Survey, Occurrence of Superconductivity, destruction of superconductivity by magnetic field, The Meissner effect, BCS theory of superconductivity, Type I and Type II Superconductors, applications of superconductivity. (Introduction to solid state physics: C. Kittle, Chapter 12)	
III		Properties and characteristics of Metals	15
	3.1	Mechanical Properties of Metals Concepts of Stress and Strain, Stress-Strain Behavior, Anelasticity, Elastic Properties of Materials. Plastic Deformation: Tensile Properties, True Stress and Strain, Elastic Recovery after Plastic Deformation, Compressive, Shear, and Torsional Deformation, Hardness. Property Variability and Design Safety Factors:: Variability of Material Properties	
	3.2	Dislocations and Strengthening Mechanisms Dislocations and Plastic Deformations Basic Concepts, Characteristics of Dislocations, Slip	

		Systems, Slip in Single Crystals, Plastic Deformation of Polycrystalline Materials, Deformation by Twinning, Mechanisms of Strengthening in Metals: Strengthening by Grain Size Reduction, Solid-Solution Strengthening, Strain Hardening, Recovery, Recrystallization, Grain Growth. (Materials Science and Engineering- An Introduction, William D. Callister, Jr., Chapter 6 and 7)	
IV		Applications of ceramic and polymeric materials	15
	4.1	Structures and Properties of Ceramics and applications of ceramics Ceramic Structures: Crystal Structures, Silicate Ceramics, Carbon Imperfections in Ceramics, Diffusion in Ionic Materials, Ceramic Phase Diagrams, Brittle Fracture of Ceramics, Stress–Strain Behavior, Mechanisms of Plastic Deformation, Miscellaneous Mechanical Considerations Types and applications of ceramics: Glass–Ceramics, Clay Products, Refractories, Abrasives, Cements, Advanced Ceramics. Fabrication and Processing of Ceramics: Fabrication and Processing of Glasses and Glass–Ceramics, Fabrication and Processing of Clay Products, Powder Pressing, Tape Casting. (Materials Science and Engineering- An Introduction, William D. Callister, Jr., Chapter 12)	
	4.2	Characteristics, Applications, and Processing of Polymers Mechanical Behaviour of Polymers: Stress–Strain Behavior, Macroscopic Deformation, Viscoelastic Deformation, Fracture of Polymers, Miscellaneous Mechanical Characteristics. Mechanisms of Deformation and for Strengthening of Polymers: Deformation of Semi crystalline Polymers, Factors That Influence the Mechanical Properties of Semi crystalline Polymers, Deformation of Elastomers. Polymer Types: Plastics, Elastomers, Fibers, Miscellaneous Applications, Advanced Polymeric Materials Polymer Synthesis and Processing: Polymerization, Polymer Additives, Forming Techniques for Plastics, Fabrication of Elastomers, Fabrication of Fibers and Films. (Materials Science and Engineering- An Introduction, William D. Callister, Jr., Chapter 15)	

References:

1. Elementary Solid State Physics-Principles and Applications: M. Ali Omar, Pearson Education, 2012: (AO)
2. Crystallography- An Introduction: Walter Borchardt-Ott, Springer-Verlag Berlin Heidelberg 2011, (WB) Chapter 13 and 14
3. Solid state physics: A. J. Dekker Prentice – Hall Inc., (AJD)(Chapter 10),

4. Introduction to solids: Leonid V. Azaroff, McGraw – Hill Inc,(LA) (Chapter 12)
5. Introduction to solid state physics: C. Kittle, John - Wiley Inc. (CK) (Chapter 12)
6. Materials Science and Engineering- An Introduction, William D. Callister, Jr., (WDC) John Wiley & Sons, Inc. (Chapters 6, 7, 12 and 15)
7. Condensed matter physics By M. P. Marder, Wiley.

PROGRAM: T.Y.B.Sc.			SEMESTER:V		
Course: Atomic and Nuclear Physics			Course Code: WUSPHY503		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

1) Studying mathematical model of atom and nucleus
2) Study of spectra for various elements
3) Understanding properties of nuclei by various methods
4) Analysing nuclear energy generation techniques

Course Outcomes: After completing the course, learner will be able to

CO1: solve the differential equation for Hydrogen atom
CO2: infer various quantization conditions from the solutions of Hydrogen atom
CO3: analyze atomic spectra for various electronic configurations and in magnetic fields
CO4: enlist properties of nuclei
CO5: compare various nuclear models
CO6: analyze various radioactive emissions
CO7: assess nuclear energy generation methods

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Quantum theory of Hydrogen atom**	**15**
	1.1	Schrodinger Equation for Hydrogen Atom, Separation of Variables, Quantum Numbers	
	1.2	Principal quantum number, Orbital quantum number, Magnetic quantum number, Electron probability density	
	1.3	Radiative Transitions, Selection Rules, Zeeman Effect	
II		**Many-electron atoms**	**15**
	2.1	Electron spin, Exclusion principle, symmetric and anti-symmetric wave functions	
	2.2	Periodic Table, Atomic structures, Explaining periodic table	
	2.3	Spin orbit coupling, Total angular momenta, X ray spectra	
III		**Nuclear Structure**	**15**
	3.1	Nuclear Composition, Nuclear properties, Stable Nuclei, Binding Energy	
	3.2	Liquid drop model, shell model	
	3.3	Meson theory of nuclear forces	
IV		**Nuclear Transformations**	**15**
	4.1	Alpha Decay, Theory of alpha decay, beta decay,	
	4.2	Gamma decay, Cross section, Nuclear reactions	
	4.3	Nuclear fission, Nuclear Reactors, Nuclear fusion in stars, Fusion reactors	

References: Beiser, A; Concepts of Modern Physics, Sixth Edition, Chapter 6 (u1), 7(u2), 11(u3) and 12(u4)
Additional Reference: Ohanian; Modern Physics, Prentice Hall Inc.

PROGRAM: T.Y.B.Sc.			SEMESTER:V		
Course: Electromagnetism II			Course Code: WUSPHY504		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

1. To explain classical electrodynamics based on Maxwell's equations.
2. To learn the propagation of electromagnetic waves in vacuum.
3. To learn the propagation of electromagnetic waves in various medium.

Course Outcomes: After completion of the course, learners will be able to
CO1: develop quantitative problem solving skills.
CO2: derive laws of optics from electrodynamics
CO3: apply electrostatics and magnetostatics in vacuum.
CO4: apply electrostatics and magnetostatics in ponderable media.

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Electrostatics in Vacuum.**	**15**
	1.1	Electric Field, potential, work and energy (2.1, 2.3, 2.4) [revision - 3 lectures]	
	1.2	Divergence and curl of electrostatic fields (2.2)	
	1.3	Conductors (2.5)	
	1.4	Laplace equation in one, two and three dimensions. (3.1.1, 3.1.2, 3.1.3, 3.1.4)	
	1.5	Boundary conditions and the uniqueness theorems. Conductors and the Second Uniqueness Theorem (3.1.5, 3.1.6)	
	1.6	Method of Images (3.2)	
II		**Electrostatic fields in matter and magnetostatics in vacuum.**	**15**
	2.1	Polarization (4.1)	

	2.2	The Field of a Polarized Object (4.2)	
	2.3	The Electric Displacement (4.3)	
	2.4	Linear Dielectrics (4.4)	
	2.5	The Biot-Savart Law (5.2) [revision-2 lectures]	
	2.6	The Divergence and Curl of B (5.3)	
	2.7	Magnetic Vector Potential (5.4.1, 5.4.2)	
III		**Magnetostatics in Matter and Electrodynamics**	**15**
	3.1	Magnetization (6.1)	
	3.2	The Field of a Magnetized Object (6.2)	
	3.3	The Auxiliary Field H (6.3.1, 6.3.2)	
	3.4	Linear and Nonlinear Media (6.4.1)	
	3.5	Energy in magnetic fields (7.2.4)	
	3.6	Maxwell's Equations (7.3)	
IV		**Continuity Equation, Poynting's Theorem and Electromagnetic waves.**	**15**
	4.1	The Continuity Equation (8.1.1)	
	4.2	Poynting's Theorem (8.1.2)	
	4.3	Electromagnetic Waves in Vacuum (9.2)	
	4.4	Electromagnetic Waves in Matter (9,3)	
	4.5	Guided Waves (9.5)	

NOTE: All references cited in the syllabus are representative. Any other book / source can be used. Sections quoted are from reference 1.

References:

1. INTRODUCTION TO ELECTRODYNAMICS (Fourth Edition) – David J. Griffiths.

Additional Reference:

2. Classical Electrodynamics, 3ed – John David Jackson.
3. Electricity and Magnetism, 3ed – Purcell and Morin.

PROGRAM: T.Y.B.Sc.			SEMESTER:V		
Course: Physics Applied Component - Electronic Instrumentation 1			Course Code: WUSPHY505		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

1) To introduce sensors and transducers, Signal conditioning, data acquisition systems and measuring instruments used in the laboratory.
2) To know, in principle, the modern techniques in the field of medical science.
3) To learn PCB designing and working of consumer electronic devices.

Course Outcomes: After completion of the course, learner will be able to

CO1: explain construction, working and uses of different types of sensors and transducers.
CO2: use with the measuring instruments used in the laboratory.
CO3: explain the working of modern medical instrument's principles, which are used in day to day life.

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Hours
I		**Transducers, Sensors and Optoelectronic Devices**	12
	1.1	Transducers: Definition, Classification, Selection of transducers.	2
	1.2	Electrical transducers: Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT, Peizo-electric Transducer. Electronic Weighing Systems: Operating principle, Block diagram, features.	4
	1.3	Chemical sensors: PH sensor, Gas sensor (Fundamental aspects), Humidity sensor (Resistive)	3
	1.4	Optoelectronic Devices: LDR, LED (Construction, Working & Applications), Multicolour LED, Seven Segment Display, Liquid Crystal Display (LCD), Photodiode (construction, Characteristics & applications), Phototransistor	3

II		**Signal Conditioning, SMPS and Measuring Instruments**	**12**
	2.1	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)	3
	2.2	Half wave precision rectifier, Active Peak detector, Active Positive Clamper, Active Positive and Negative Clippers.	3
	2.3	Switching Regulators: Basic and Monolithic Switching regulators (buck, boost and buck – boost) (Only basic Configurations)	2
	2.4	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 DMM: 3 ½ Digit, resolution and sensitivity, general specification.	4
III		**Data Acquisition and Conversion**	**12**
	3.1	Data acquisition system: Objectives of DAS, Signal conditioning of inputs, Single channel Data Acquisition system, Multichannel Data Acquisition system. [Data Transmission systems IEEE-488 GPIB*]	
	3.2	D to A Converters: Resistive divider network, Binary ladder network	
	3.3	A to D Converters: Successive approximation type, Voltage to Time (Single slope, Dual slope).	
IV		**Modern Techniques and Appliances**	**12**
	4.1	Printed Circuit Board: Idea of PCB, advantages, copper clad, Etching processes, Principle of Photolithography (For PCB).	3
	4.2	Microwave Oven: Operating principle, block diagram, features.	1
	4.3	Medical instruments: Bio-Potential, Types of electrodes, ECG, EEG, EMG, CT Scan and MRI (principle, block diagram and features), Ultrasonography: working principle	8

References:

1) Electronic Instrumentation – H S Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2) Digital principles and applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill.

3) S.P Bali, “Consumer Electronics”, Pearson Education Asia Pvt., Ltd., 2008 Edition
4) PCB design basics, Mahmoud Wahby, EDN Networks, Nov 2013.
5) Introduction to Bio-medical Electronics: Joseph-Du-bary, McGraw Hill Co. Ltd.
6) Medical instrumentation Application and design- J. C. Wobster.

Additional Reference:

1) A Textbook of Applied Electronics – R S Sedha, S Chand & Company, New Delhi.
2) Basic Electronics Solid state - B. L. Thereja, S Chand & Company, New Delhi.
3) Measurement and Instrumentation Principles: Alan S. Morris., Butterworth-Heinemann.

NOTE: All references cited in the syllabus are representative. Any other book / source can be used. Sections quoted are from reference 1.

Modality of Assessment

Theory Examination Pattern:

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	Evaluation Type	Marks
1	**Class Test**	**20**
2	**Assignment/ Case study/ field visit report/ presentation/ project**	**20**
	Total	**40**

B. **External Examination- 60%- 60 Marks per paper**

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
   a. There shall be 4 questions each of 15 marks one on each unit.
   b. All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	Options	Marks	Questions Based on
1	100%	15	Unit I
2	100%	15	Unit II
3	100%	15	Unit III
4	100%	15	Unit IV
	TOTAL	**60**	

PROGRAM: T.Y.B.Sc.			SEMESTER:V		
Course: Physics Practical Course 5			Course Code: WUSPHY5P1		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
-	6.4	-	4	40	60

Learning Objectives:

1. To learn experimental skills required to perform experiments in physics.
2. To understand the techniques involved to measure different physical quantities.
3. To compare experimentally observe the physical phenomena learnt in theory.

Course Outcomes:

CO1: Analyse data using different skills learnt.
CO2: Demonstrate principles learnt in theory.
CO3: Relate theoretical results to experimental findings.
CO4: Operate advanced instruments.

DETAILED SYLLABUS

Sr. No.	Experiments	Credits/Hours (60 Hours)
	Skills	
1	Estimation of Error	
2	Minimising Error	
3	Plotting of Graphs	
4	Curve fitting	
	Experiments	
5	Thermal conductivity	
6	Thermal Expansion	
7	Hall Effect	
8	Surface tension	
9	Searle's Goniometer	

10	Hysteresis loop by CRO	
11	Determination of dielectric constant	
12	Study of Optical Fibre.	
13	Wave properties of Sound	
14	Elastic constants of rubber	
15	Window Comparator	
16	Instrumentation Amplifier	

A Manual will be provided for the above experiments.

References:

1. Practical Physics by C. L. Squires – (3rd Edition) Cambridge University Press.
2. Advanced Practical Physics by Worsnop & Flint.
3. Integrated Electronics by Millman and Halkias - Mcgraw Hill

Modality of Assessment

Practical Examination Pattern for Practical Course 5:

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	**Evaluation Type**	**Marks**
1	Completion of procedure, readings, calculations and result in the Journal for all experiments	20
2	Relating the experiment to theory, performing required error analysis, proper plotting of graph, drawing proper circuit diagrams in the journal for respective experiments	10
3	Viva Voce on all experiments performed	10
	Total	**40**

B. **External Examination- 60%- 60 Marks per course**

Semester End Practical Examination:

1. Duration - These examinations shall be of **four hours** duration.
2. The Journal will be certified and the student allowed to sit for the examination only if 12 (inclusive of skills) experiments have been entered in the journal.
3. The student will be required to ask for and arrange the apparatus properly, connect circuits wherever required(on a breadboard), obtain readings of physical quantities in an appropriate range, plot graphs, and perform calculations as required by the question paper.
4. The student needs to demonstrate good presentation skills.
5. The student will be required to obtain necessary results and answer questions related to or provide comments as mentioned in the question paper.
6. 10% weightage will be given to an open ended question at the end of the paper.

PROGRAM: T.Y.B.Sc.			SEMESTER:V		
Course: Physics Practical Course 6			Course Code: WUSPHY5P2		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
-	6.4	-	4	40	60

Learning Objectives:

1. To be able to perform detailed experiments.
2. To learn Presentation skills.
3. To understand finer details of design and implementation of experiments in physics.

Course Outcomes: After completion of the course, learner will be able to

CO1: perform an experiment independently.
CO2: write a report of an experiment.
CO3: analyse data so that meaningful conclusions are drawn.
CO4: set up given equipment in order to make necessary measurements.

This paper will be an experimental project for 100 marks. The student will use the practical turns to set up and run an experiment independently. The student will then report and present the findings of the experiment. The student may choose from one of the topics given below.

Topics

Unit	Course/ Unit Title
1	Computer Simulation of a System in Statistical Mechanics.
2	Building an accurate Thermometer.
3	Synthesis/Characterisation of a crystalline solid.
4	Synthesis/Characterisation of a substance in nano-particle form.
5	Study of Spectra of various elements.
6	Computer simulation of a Quantum System
7	Study of Dielectric Constant of a Material.
8	Study of susceptibility of a material.
9	Analysing physical data from an experiment.

Modality of Assessment

Practical Examination Pattern for Practical Course 5:

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	Evaluation Type	Marks
1	**Maintaining a regular Log of laboratory work in the Journal.**	**20**
2	**Report of the experiment**	**20**
	Total	**40**

B. **External Examination- 60%- 60 Marks per course**

Semester End Theory Examination:

1. The student will be allowed to be present during the examination only if the log maintained in the Journal covers 75% of the total practical turns available for the project.
2. The examiner will examine the student based on various parameters as shown in the table below.
3. The presentation will be for 15 minutes.
4. The student will partly demonstrate the experimental setup/simulation.
5. A rubric will be prepared by the teacher incharge at the start of the term after the student has chosen the topic, the final evaluation will be as per this rubric.

PROGRAM: T.Y.B.Sc.			SEMESTER:V		
Course: Physics Applied Component Practical 1			Course Code: WUSPHY5P3		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
-	3.2	-	2	40	60

Learning Objectives:

1. To learn experimental skills required to perform experiments in electronic instrumentation.
2. To understand the techniques involved in making various electrical circuits.
3. To study characteristics of various transducers and sensors.

Course Outcomes: After completing the course, learner will be able to
CO1: construct electronic circuits on breadboards.
CO2: design instrumentation circuits using different sensors.
CO3: design power supply and regulation circuits

DETAILED SYLLABUS

Note: **1)** Perform a minimum of Three Experiments from each group.
2) All experiments should be performed on a breadboard.

	GROUP - A
1.	Thermistor Characteristics –Thermal and electrical. (H & C)
2.	Thermistor as sensor in temperature to voltage converter using OP AMP.
3.	Study of LVDT characteristics.
4.	Study of Load Cell / Strain Gauge.
5.	Study of seven segment display.
6.	Characteristics of Photodiodes and phototransistors.
	GROUP - B
1.	Basic Instrumentation Amplifier using 3 Op-Amps coupled to resistance bridge. (C & D Ch. 8)
2.	Temperature to frequency Conversion using 555 timer. (C & D Ch.13)
3.	OP AMP D/A Converter: Binary weighted resistors.

4.	OP AMP D/A Converter: Ladder network. (M & L Ch. 12)
5.	Sample and hold circuit using op-amp 741. (G Ch. 8)
6.	Peak detector using op-amp 741. (G Ch. 8)
GROUP – C	
1.	Half wave precision rectifier using precision op-amps (OPA177)
2.	Positive and Negative Clippers using op-amp.
3.	Positive and Negative Clampers using single power supply op-amp (124/324).
4.	Second Order active Low Pass filter (frequency response & phase relation)
5.	Second Order active High Pass filter (frequency response & phase relation)
6.	Active Notch Filter (frequency response & phase relation)
7.	Square and Triangular wave generator using OPAMPs with concept of duty cycle
GROUP - D	
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
5.	Construction of Audio power amplifiers using IC TBA 810.
6.	Making PCB for simple circuits (like rectifiers, regulators, oscillators, multivibrators, op-amp applications, single stage amplifier etc.), building and testing of the circuit.
7.	Visit to Hospital/Diagnostic Center/ Bio-medical Research Laboratory and submission of its report.

Modality of Assessment

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	**Evaluation Type**	**Marks**
1	Completion of procedure, readings, calculations and result in the Journal for all experiments	20
2	Relating the experiment to theory, performing required error analysis, proper plotting of graph, drawing proper circuit diagrams in the journal for respective experiments	10

3	Viva Voce on all experiments performed	10
	Total	**40**

B. **External Examination- 60%- 60 Marks per course**
Semester End Practical Examination:

1. Duration - These examinations shall be of **four hours** duration.
2. The Student's journal will be certified and allowed to sit for the examination only if a **minimum of 19** experiments have been satisfactorily performed and entered in the journal.
3. The student will be required to ask for and arrange the apparatus properly, connect circuits wherever required(on a breadboard), obtain readings of physical quantities in an appropriate range, plot graphs, and perform calculations as required by the question paper.
4. The student needs to demonstrate good presentation skills.
5. The student will be required to obtain necessary results and answer questions related to or provide comments as mentioned in the question paper.
6. 10% weightage will be given to an open ended question at the end of the paper.

PROGRAM: T.Y.B.Sc.			SEMESTER:VI		
Course: Mechanics II			Course Code: WUSPHY601		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

1. To understand different classical systems using laws of mechanics.
2. To learn different techniques of analysing systems under varied conditions.
3. To be able to understand the behavior of model systems.

Course Outcomes: After completion of the course, learner will be able to
CO1: apply laws of mechanics to systems in 2 and 3 dimensions.
CO2: analyse systems consisting of many particles.
CO3: describe the motion of rigid bodies.
CO4: extend the laws of mechanics to the study of continuous systems.

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Single particle Systems**	15
	1.1	Kinematics and Dynamics in 2 and 3 dimensions. (KRS-3.1-3.12)	
	1.2	Motion of a particle under the influence of a central force.(KRS – 3.13-3.16)	
	1.3	Description of motion of a particle from moving frames of reference.(KRS – 7.1 -7.5)	
II		**Dynamics of a System of Particles.**	15
	2.1	System of particles, Center of Mass, Angular momentum, Torque and Conservation Laws. (KRS – 4.1-4.4)	
	2.2	Collisions and Variable mass systems.(KRS – 4.5-4.6)	
	2.3	D'Alembert's principle, Constraints, Generalised coordinates, Cyclic Coordinates, Lagrange's equations. (KRS – 9.1-9.7)	

III		**Rotation of a Rigid Body**	**15**
	3.1	Description of motion of a rigid body in space, Euler's Theorem, Euler Angles.(KRS- 11.1, 11.4, KK- 8.1-8.6)	
	3.2	The Inertia tensor, Angular momentum and Kinetic energy in terms of the Inertia Tensor, Principal axes of a body, Euler equations of motion.(KRS- 11.2,11.3)	
	3.3	Torque free motion of a rigid body, Heavy Symmetrical Top.(KRS- 11.5)	
IV		**Dynamics of Continuous Media**	**15**
	4.1	Non Rigid system of particles, elasticity and equilibrium conditions.(KRS-5.7-5.10)	
	4.2	Coupled oscillators, Vibrating strings and surfaces. (KRS – 5.10, 8.1 – 8.4)	
	4.3	Fluid Mechanics : Statics and Dynamics.(KRS – 8.6 – 8.9)	

References:

1. Mechanics by K. R. Symon, -Addision Wesely(KRS)
2. An Introduction to Mechanics by D. Kleppner and R. Kolenkow - Tata Mc Graw Hill(KK)

Additional Reference:

1. Classical Mechanics- a Modern Perspective by V. D. Barger and M. G.Olsson. - Mc Graw Hill International
2. Classical Mechanics by H. Goldstein, C.P. Poole, J .Safko - Pearson

PROGRAM: T.Y.B.Sc.			SEMESTER:VI		
Course: Molecular Physics and Nanoscience			Course Code: WUSPHY602		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

To learn basic molecular physics ideas.
To learn the application of molecular physics.
To learn some experimental methods of molecular spectra.
To learn basic nanoscience and nanotechnology.
To learn some synthesis methods of nanomaterials

Course Outcomes: After completion of the course, the learner will be able to
CO1: write concepts in basics of molecular physics and application of it.
CO2: explain the difference between nanoscience and nanotechnology.
CO3: discuss various synthesis methods to synthesize the nanomaterials.
CO4: synthesize some nanomaterials

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Molecules: general features**	15
	1.1	What is a molecule?, The Born – Oppenheimer approximation, Molecular bonding: Ionic bonding: the NaCl molecule, Covalent bonding: the H_2 molecule. (Atomic and Molecular Physics, A primer, Luciano Colombo, IOP Publishing, Bristol, UK, chapter 6)	
	1.2	Molecular spectra of diatomic molecules: Rotational energy levels, rotational Spectra, vibrational energy levels, vibrational - rotational spectra. (Arthur Beiser B: 14.1, 14.3, 14.5, 14.7	
II		**Electronic Spectra of molecules**	15
	2.1	Electronic spectra of diatomic molecules: The Born - Oppenheimer approximation,	
	2.2	Intensity of vibrational-electronic spectra: The Franck-Condon principle.	

		Raman effect: Quantum Theory of Raman effect, Pure Rotational Raman spectra: Linear molecules, symmetric top molecules, Asymmetric top molecules, Experimental set up of Raman Effect. Infrared spectrometer & Microwave spectrometer (Barnwell: Chapter 6.11, 6.1.3. 2. Chapter: 4.1.1, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.3.1. G Aruldhas: Chapter 8.6.1)	
III		**Introduction to Nanoscience and nanotechnology**	**15**
	3.1	Definition of Nanoscience and nanotechnologies, uniqueness of the nanoscale, nanoscience in nature; naturally occurring nanomaterials, nanoscience in action in the biological world.	
	3.2	Nanomaterials; nanoparticles, nanowires and nanotubes, nanolayers/nanocoatings, nanoporous materials.	
	3.3	Strategies for synthesis of nanomaterials, properties of nanomaterials, significance of nanoscience.	
	3.4	Commercial applications; food industry, cosmetics, textile, medicine, electrical and electronic goods	
	3.5	Potential health hazards and environmental risks. (Essentials In Nanoscience And Nanotechnology: Narendra Kumar, Sunita Kumbhat, Chapter 1)	
IV		**Nanomaterials: General Synthetic Approaches**	**15**
	4.1	Introduction, Top-Down Approach: Mechanical Milling, Mechanochemical Processing (MCP), Electro-Explosion, Sputtering, Etching, Laser Ablation, Lithography, Aerosol-Based Techniques, Electrospinning.	
	4.2	Bottom-Up Approaches: Chemical Vapor Deposition, Chemical Vapor Condensation (CVC), Plasma Arcing, Wet Chemical Methods, Hydrothermal/Solvothermal, Reverse Micelle Method, Sol–Gel Method, Sonochemical Method, Biomimetic Approaches, Molecular Self-Assembly. (Essentials In Nanoscience And Nanotechnology: Narendra Kumar, Sunita Kumbhat, Chapter 2)	

References:

1. Perspectives of Modern Physics : Arthur Beiser
2. Concepts of modern physics: Arthur Beiser
3. Fundamentals of Molecular Spectroscopy : C. N. Banwell & E. M. McCash (TMH).
4. Molecular structure and spectroscopy : G Aruldhas (2 nd Ed) PHI learning Pvt. Ltd.
5. Essentials In Nanoscience And Nanotechnology: Narendra Kumar, Sunita Kumbhat, John Wiley & Sons, Inc.

PROGRAM: T.Y.B.Sc.			SEMESTER:VI		
Course: Electronics			Course Code: WUSPHY603		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

1) To learn about new electronic components
2) To be able to build general electronic instrumentation lab
3) To analyse various electronic circuits
4) To understand synchronous digital circuits

Course Outcomes: After completing the course, learner will be able to

CO1: Read electronic circuit diagrams
CO2: Explain working of various electronic components
CO3: Choose right components for tuning circuit parameters
CO4: Read data sheets of electronic components
CO5: Design electronic circuits for the given purpose
CO6: Analyse electronic circuits for improvisation

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures (48 minutes)
I		**OpAmp applications and FET**	**15**
	1.1	voltage summing, voltage subtraction, voltage controlled voltage source, voltage controlled current source, DC millivoltmeter, AC millivoltmeter, Display driver, instrumentation amplifier	4
	1.2	Junction Field Effect transistors - construction and characteristics, transfer characteristics, Datasheet depletion and enhancement type MOSFETs, p-channel and n-channel MOSFETs - construction and characteristics, CMOS, MESFETs	6
	1.3	JFET small signal model - fixed bias configuration, self-bias configuration and voltage divider configuration, source follower configuration e-type MOSFET biasing: feedback biasing, voltage divider biasing, MOSFET relay driver e-MOSFET amplifiers	5

II		**Thyristors and Power supplies**	**15**
	2.1	Basic SCR, SCR characteristics and ratings, SCR constructions and terminal identifications, SCR applications, SC switches, Gate turn-off switch, Light activated SCR, Shockley diode, DIAC, TRIAC	7
	2.2	Filters, capacitor filter, RC filter, Transistor Voltage Regulation, IC voltage regulators LM 317/337, 78xx and 79xx series	8
III		**Linear ICs**	**15**
	3.1	Comparator ICs, DAC ladder network, ADC - dual slope conversion, ladder network conversion,	5
	3.2	IC 555 timer: Astable, monostable, ramp generator, voltage controlled oscillator	5
	3.3	IC 566 VCO, Phase Lock Loop (PLL) - Basic PLL, Frequency demodulation, Frequency synthesis, FSK decoder	5
IV		**Digital circuits**	15
	4.1	Flip flops: RS, JK, JK-M/S, Registers: Shift register: serial and parallel	5
	4.2	Counters: binary, decade, hex	3
	4.3	Semiconductor memories - volatile and static memory, CMOS memory unit	4
	4.4	Semiconductor memory: Read/write cycle. address and decoding	3

References:

Nashelsky L, Boylestad R; Electronic Devices and Circuit Theory, 11th Edition (2017), Pearson Education

Leach, Malvino, Saha; Digital Principles and Applications, 8th Edition, McGraw Hill

Gayakwad R; Op-Amps and Linear Integrated Circuits; 4th Edition (2015 reprint), Pearson Education

PROGRAM: T.Y.B.Sc.			SEMESTER:VI		
Course: Special Relativity			Course Code: WUSPHY604		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
3.2	-	-	3	40	60

Learning Objectives:

1. To understand the significance of Michelson Morley experiment and failure of the existing theories to explain the null result
2. To understand the importance of postulates of special relativity, Lorentz transformation equations and how it changed the way we look at space and time, Absolutism and relativity, Common sense versus Einstein concept of Space and time.
3. To understand the transformation equations for: Space and time, velocity, frequency, mass, momentum, force, Energy, Charge and current density, electric and magnetic fields.
4. 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.

Course Outcomes: After completion of the course, the learner will be able to
CO1: recognize the concepts of special relativity
CO2: examine how electromagnetism and special relativity are linked
CO3: apply the understanding gained to solve problems

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**The Experimental Background of the Theory of Special Relativity; The Geometric Representation of Space-Time**	15
	1.1	Introduction (to be read by learners)	
	1.2	Galilean Transformations (to be read by learners)	
	1.3	Newtonian Relativity (to be read by learners)	
	1.4	Electromagnetism and Newtonian Relativity	

	1.5	Attempts to Locate the Absolute Frame; the Michelson-Morley Experiment	
	1.6	Attempts to Preserve the Concept of a Preferred Ether Frame; the Lorentz-Fitzgerald Contraction Hypothesis	
	1.7	Attempts to Preserve the Concept of a Preferred Ether Frame; the Ether-Drag Hypothesis	
	1.8	Attempts to Modify Electrodynamics	
	1.9	The Postulates of Special Relativity Theory	
	1.10	Einstein and the Origin of Relativity Theory (to be read by learners)	
	A-1	Space-Time Diagrams	
	A-2	Simultaneity, Contraction, and Dilation	
	A-3	The Time Order and Space Separation of Events	
II		**Relativistic Kinematics; The Twin Paradox**	**15**
	2.1	The Relativity of Simultaneity	
	2.2	Derivation of the Lorentz Transformation Equations	
	2.3	Some Consequences of the Lorentz Transformation Equations	
	2.4	A More Physical Look at the Main Features of the Lorentz Transformation Equations	
	2.5	The Observer in Relativity	
	2.6	The Relativistic Addition of Velocities	
	2.7	Aberration and Doppler Effect of Relativity	
	2.8	The Common Sense of Special Relativity	
	B-1	Introduction	
	B-2	The Route Dependence of Proper Time	
	B-3	Space-Time Diagram of the "Twin Paradox"	
	B-4	Some Other Considerations (to be read by learners)	
	B-5	An Experimental Test (to be read by learners)	

III		**Relativistic Dynamics**	**15**
	3.1	3.1 Mechanics and Relativity (3.1)	
	3.2	The Need to Redefine Momentum (3.2)	
	3.2	Relativistic Momentum (3.3)	
	3.4	Alternative Views of Mass in Relativity (3.4)	
	3.5	The Relativistic Force Law and the Dynamics of a Single Particle (3.5)	
	3.6	The Equivalence of Mass and Energy (3.6)	
	3.7	The Transformation Properties of Momentum, Energy, Mass, and Force (3.7)	
IV		**Relativity and Electromagnetism**	**15**
	4.1	4.1 Introduction	
	4.2	The Interdependence of Electric and Magnetic Fields	
	4.3	The Transformation for E and B	
	4.4	The Field of a Uniformly Moving Point Charge	
	4.5	Forces and Fields near a Current-Carrying Wire	
	4.6	Forces between Moving Charges	
	4.7	The covariance of Maxwell's Equations	
	4.8	The Possible Limitations of Special Relativity (to be read by learners)	

NOTE: All references cited in the syllabus are representative. Any other book / source can be used. Sections quoted are from reference 1.

References:

(1) Introduction to Special Relativity - Robert Resnick (Section numbers refer to sections in this book)

Additional Reference:

(2) Special Relativity - A. P. French

PROGRAM(s): T.Y B.Sc.			SEMESTER: VI		
Course: Physics Applied Component - Electronic Instrumentation 2			Course Code: WUSPHY605		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA)	Semester End Examination
3.2	-	-	3	40	60

Learning Objectives:

1) To develop logic circuit design and implementation.
2) To develop object oriented programming skills and programming in C++.
3) To master Programming and interfacing skills of microcontroller using Arduino.
4) To make embedded systems using Arduino.

Course Outcomes:

After completing this course, learner will be able to:

1) describe working of combinational and sequential electronic circuits
2) describe the hardware and peripheral connections of Arduino.
3) design combinational logic circuits using K-map.
4) write programmes in programming Language C++.
5) perform basic data analysis using C++.
6) programme Arduino board
7) interface peripheral components like sensors and actuators to it.

DETAILED SYLLABUS

Unit	Sub-Unit	Course/ Unit Title	Lectures
I		**Digital Electronics**	**15**
	1.1	**Combinational Logic Design:** Introduction, Boolean identities, K – map (2, 3 and 4 variables).	6
	1.2	**Design and implementations of:** Decoders, Encoders, Multiplexers, Demultiplexers, Use of MUX and DEMUX in Combinational Logic design. Tri-State logic, buffers, D latch.	9
II		**Basic Concepts of Object Oriented Programming and C++**	**15**
	2.1	**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,	5

		More C++ Statements, Example with Class, Structure of C++ Program, Creating the Source File, Compiling and Linking.	
	2.2	**Tokens and Expressions in C++:** Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Symbolic Constants, 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.	5
	2.3	**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.	5
III		**Data Analysis using C++**	**15**
	3.1	Reading data from external files and writing data/ storing results to external files.	7
	3.2	Statistical analysis of data - descriptive statistics	8
IV		**Arduino**	**15**
	4.1	**Introduction to Arduino:** Platform, Hardware (Board), Software (IDE).	4
	4.2	**Arduino programing:** Structure, Constants, Variables, Control Structures, Operators (Arithmetic, Boolean Comparison), Input - Output functions.	6
	4.3	**Interfacing with Arduino:** Reading data from sensor modules, and switches. Driving Leds, relays, motors, LCD displays.	5

References:

Unit 1:

NGP - 5.1 (only introduction), 5.3, 7.1 -7.6 (except 7.5)
RPJ - 4.20.
RG - 3.5.1, 3.5.2, 3.5.3, 3.5.4 & 3.5.5
NGP: Digital Electronics and Logic design by N G PALAN,
RG: Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 5th Edition.
RPJ: R. P. Jain, Modern Digital Electronics, Tata McGraw Hill, 4th Edition.

Unit 2 & 3:

EB: 3.24, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 & 4.11

1) **EB:** Object Oriented Programming with C++ by E Balagurusamy, Third/Fourth Edition, Tata McGraw-Hill Publishing Company Limited.
2) Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publishing Company Limited.
3) Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company.

Unit 4:

1) Programming Arduino: Getting Started with Sketches, third edition by Simon Monk
2) Getting started with Arduino by By Massimo Banzi, Michael Shiloh.

Modality of Assessment

Theory Examination Pattern:

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	**Evaluation Type**	**Marks**
1	Class Test	20
2	Assignment/ Case study/ field visit report/ presentation/ project	20
	Total	**40**

B. **External Examination- 60%- 60 Marks per paper**

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:
   a. There shall be 4 questions each of 15 marks one on each unit.
   b. All questions shall be compulsory with internal choice within the questions.

Paper Pattern:

Question	**Options**	**Marks**	**Questions Based on**
1	100%	15	Unit I
2	100%	15	Unit II
3	100%	15	Unit III
4	100%	15	Unit IV
	TOTAL	**60**	

PROGRAM: T.Y.B.Sc.			SEMESTER:VI		
Course: Physics Practical Course 7			Course Code: WUSPHY6P1		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
-	6.4	-	4	40	60

Learning Objectives:

1. To understand experimental techniques in physics.
2. To learn the building of different electronic circuits required in physics experiments.
3. To know how to use various measuring instruments.

Course Outcomes: After completing the course, the learner will be able to
CO1: use different kinds of electronic equipment.
CO2: design and connect simple circuits.
CO3: perform accurate measurements of different physical quantities.
CO4: troubleshoot electronic circuits.

DETAILED SYLLABUS

Sr. No.	Experiments	Credits/Hours (60 Hours)
	Skills	
1	Advanced use of CRO	
2	Amplification of signals	
3	Calibration of instruments/devices	
4	Filters	
	Experiments	
5	Kater's pendulum	
6	Coupled Oscillators	
7	Torsional Pendulum	
8	Absorption spectrum of Iodine	
9	LM 317 voltage regulator	
10	IC 566 PLL	

11	Transistor series Regulator	
12	Counters Mod 2, 5, 10 (2 x 5, 5 x 2)	
13	IC 555 Astable Multivibrator	
14	IC 555 Monostable Multivibrator	
15	Shift Register(IC 7495)	
16	PWM and PPM(Using IC555)	

A Manual will be provided for the above experiments.

References:

1. Practical Physics by C. L. Squires – (3rd Edition) Cambridge University Press.
2. Advanced Practical Physics by Worsnop & Flint.
3. Integrated Electronics by Millman and Halkias - Mcgraw Hill

Modality of Assessment

Practical Examination Pattern for Practical Course 5:

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	Evaluation Type	Marks
1	Completion of procedure, readings, calculations and result in the Journal for all experiments	20
2	Relating the experiment to theory, performing required error analysis, proper plotting of graph, drawing proper circuit diagrams in the journal for respective experiments	10
3	Viva Voce on all experiments performed	10
	Total	**40**

B. **External Examination- 60%- 60 Marks per course**

Semester End Theory Examination:

1. Duration - These examinations shall be of **four hours** duration.
2. The Journal will be certified and the student allowed to sit for the examination only if 12 (inclusive of skills) experiments have been entered in the journal.
3. The student will be required to ask for and arrange the apparatus properly, connect circuits wherever required(on a breadboard), obtain readings of physical quantities in an appropriate range, plot graphs, and perform calculations as required by the question paper.
4. The student needs to demonstrate good presentation skills.
5. The student will be required to obtain necessary results and answer questions related to or provide comments as mentioned in the question paper.
6. 10% weightage will be given to an open ended question at the end of the paper.

PROGRAM: T.Y.B.Sc.			SEMESTER:VI		
Course: Physics Practical Course 8			Course Code: WUSPHY6P2		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
-	6.4	-	4	40	60

Learning Objectives:

1. To develop advanced experimental skills.
2. To learn scientific report writing.
3. To be able to independently work on an experimental idea in physics.

Course Outcomes: After completing the course, the learner will be able to
CO1: design an experiment independently.
CO2: write a scientific report of an experiment as per accepted standards.
CO3: use reference material to design an experiment.
CO4: prepare a detailed study of a particular topic.

This paper will be an experimental project for 100 marks. The student will use the practical turns to set up and run an experiment independently. The student will then report and present the findings of the experiment. The student may choose from one of the topics given below.

Topics

Unit	Course/ Unit Title
1	Computer Simulation of a Dynamical System.
2	In depth study of elastic properties of a material.
3	Detailed study of an electronic device.
4	Design of an electronic instrument for measuring some physical parameter.
5	Setting up an electronic data acquisition system for an experiment.
6	Interpreting and analysing scientific data.
7	Computer simulation solutions of a Quantum System
8	Making a Model for demonstration.
9	Reading and interpreting a scientific paper.

Modality of Assessment

Practical Examination Pattern for Practical Course 6:

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	**Evaluation Type**	**Marks**
1	Maintaining a regular Log of laboratory work in the Journal.	20
2	Report of the experiment	20
	Total	**40**

B. **External Examination- 60%- 60 Marks per course**

Semester End Theory Examination:

1. The student will be allowed to be present during the examination only if the log maintained in the Journal covers 75% of the total practical turns available for the project.
2. The examiner will examine the student based on various parameters as shown in the table below.
3. The presentation will be for 15 minutes.
4. The student will partly demonstrate the experimental setup/simulation.
5. A rubric will be prepared by the teacher incharge at the start of the term after the student has chosen the topic, the final evaluation will be as per this rubric.

PROGRAM: T.Y.B.Sc.			SEMESTER:VI		
Course: Physics Applied Component Practical 2			Course Code: WUSPHY6P3		
Teaching Scheme			Evaluation Scheme		
Lectures (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Internal Assessment (CIA) (Marks- 40)	Semester End Examination (Marks- 60)
-	3.2	-	2	40	60

Learning Objectives:

1) To develop logic circuit design and implementation.
2) To develop object oriented programming skills and programming in C++.
3) To master Programming and interfacing skills of microcontroller using Arduino.
4) To prepare embedded systems using Arduino.

Course Outcomes: After completing this course, learner will be able to:

1) describe working of combinational and sequential electronic circuits
2) describe the hardware and peripheral connections of Arduino.
3) design combinational logic circuits using K-map.
4) write programmes in programming Language C++.
5) perform basic data analysis using C++.
6) programme Arduino board
7) interface peripheral components like sensors and actuators to it.

Note: **1)** Perform a minimum of Three Experiments from each group.
2) All experiments should be performed on a breadboard.

Group A: C++ Programming	
1.	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).
2.	Program based on Control Statements a) Program based on if-else statement b) Program based on nested if statement
3.	Program based on for loop, while loop and do-while loop.
4.	Program using switch statements and if-else ladder.
5.	Program to study function declaration, function calling and function prototype.
6.	Program for file processing using C++.
7.	Program for file processing using C++.
8.	Program for data analysis using C++.

9.	Program for data analysis using C++.
Group B: Digital Electronics, Arduino Programming and Interfacing	
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 Demultiplexer (74LS155) and their applications.
4.	Study of unidirectional buffer (74LS244) and bidirectional buffer (74LS245).
5.	Design using K –map and implement 4:1 MUX, 1:4 DEMUX, 2bit comparator, Full adder and Full subtractor. [Note: Use suitable circuit simulator for implementation]
6.	Interfacing LEDs, DC motor, Servo motors, Relays.
7.	Interfacing Switches and sensors modules.
8.	Interfacing LCD display.

Modality of Assessment

Practical Examination Pattern for Physics AC Practical course:

A. **Internal Assessment- 40%- 40 Marks per paper**

Sr. No.	Evaluation Type	Marks
1	Completion of procedure, readings, calculations and result in the Journal for all experiments	20
2	Relating the experiment to theory, performing required error analysis, proper plotting of graph, drawing proper circuit diagrams in the journal for respective experiments	10
3	Viva Voce on all experiments performed	10
	Total	**40**

B. **External Examination- 60%- 60 Marks per course**

Semester End Practical Examination:

1. Duration - These examinations shall be of **four hours** duration.
2. The Student's journal will be certified and allowed to sit for the examination only if a **minimum of 13** experiments have been satisfactorily performed and entered in the journal.
3. The student will be required to ask for and arrange the apparatus properly, connect circuits wherever required, write codes and execute them successfully as required by the question paper.
4. The student needs to demonstrate good presentation skills.
5. The student will be required to obtain necessary results or code outputs and answer questions related to or provide comments as mentioned in the question paper.
6. 10% weightage will be given to an open ended question at the end of the paper.