Parvatibai Chowgule College of Arts & Science
(Autonomous)
Margao – Goa

MINUTES OF MEETING OF THE BOARD OF STUDIES IN PHYSICS HELD ON 26th February 2022 AT 11:00 am

Vide Chowgule College notice (F.133(C)/1504 dated 16th February, 2022) an online meeting of this BoS was convened on 26rd February, 2022 at 11:00 am. Since the members present represented the Quorum, the BoS began its proceedings.

Minutes are presented in the format.

Members present:

1. Mrs. Malati Dessai (Chairman)
2. Dr. Ananya Das
3. Mr. Yatin P. Desai
4. Dr. Ashish M. Desai (Member Secretary)
5. Ms. Pearl Oliviera
6. Dr. Tarun Kumar Jha (Academic Council Nominee)
7. Dr. Sudhir Cherukulappurath (Vice-Chancellor Nominee)
8. Prof. Ramesh V. Pai (Special Invitee)
9. Dr. Subrahmanyam Sappati (Special Invitee)

Members Absent:

1. Dr. Bholanath Pahari (Academic Council Nominee)
2. Mr. Mangrish Salelkar (Industry Representative)
3. Mr. Harison Cota (Postgraduate Alumni)

Proceedings
The Chairperson welcomed the members of the Board of Studies (BoS) and briefed about the course structure. The Chairperson introduced and explained the agenda of the meeting and Board transacted the following business:
Agenda Items:

1. To review and revise certain courses of B. Sc. Physics.
2. To approve syllabus of skill enhancement courses (SEC) offered by the department of Physics.
3. To identify the Generic Elective Courses (GEC)
4. Any Other Business (A.O.B.)

PART A: Resolutions

1. The syllabus of four undergraduate courses were presented and discussed at the meeting. Syllabi of theory and/or practical component of the following courses were revised.
    i. Mechanics -I
    ii. Introduction to Astronomy and Astrophysics
    iii. Electronics- II
    iv. Mechanics-II

    The revised syllabi approved by the members of BoS are presented in Annexure I.

2. Following are the syllabus of two new Skill Enhancement Courses which were presented and discussed at the meeting.
    i. Basics of Visualization and Scientific Word Processing.
    ii. Instrumentation

    The syllabus of the Skill Enhancement Courses approved by the members of BoS are presented in Annexure II. Also, the revised list of courses offered by the Department of Physics containing the approved Skill Enhancement courses in presented in Annexure III.

3. Following are the additional courses offered by the Department of Physics that were identified as General Elective courses:
    - Semester III: Modern Physics
    - Semester III: Introduction to Astronomy and Astrophysics
    - Semester IV: Quantum Mechanics
    - Semester VI: Mechanics II

    The complete list of courses to be offered by the Department of Physics as General Elective courses is presented in Annexure IV.

4. All the above recommended changes may be implemented from academic year 2022-23 onwards.

PART B: Resolutions/Recommendations of BoS that require consideration / approval of Academic Council:

1. The revised syllabi of certain core and elective courses presented in Annexure I.
2. The syllabus of Skill Enhancement Courses presented in Annexure II.
3. The revised list of courses offered by the Department of Physics presented in Annexure III.
4. Courses to be offered as General Elective courses presented in Annexure IV.

The Chairman thanked the members of Board of Studies in Physics for their valuable contribution and active participation. The meeting ended at 12:10 pm.
The foregoing minutes of the meeting are circulated by the Chairman on 11th March 2022.

Dr. Ashish M. Desai
Member Secretary
BoS (Physics)
Date: 11th March 2022

Mrs. Malati Dessai
Chairman
BoS (Physics)

PART C: The remarks of the Dean of the Faculty:-

a. The minutes are in order

b. The minutes may be placed before the Academic Council with remark, if any.

c. Important points of the minutes which need clear policy decision of the Academic council to be recorded.

Date:

Signature of the Dean: _____
(Faculty of Science) (Dr. Meghana Devli)

Annexure I

Revised syllabi of certain core and elective courses

Course Title : Mechanics I

Course Code : PHY-I.C-2

Marks : 75 (Theory) + 25 (Practical)

Credits : 3 (Theory) + 1 (Practical)

Course Objectives : This course provides an introduction to topics in mechanics, which are essential for advanced work in physics. An objective of this course is to train students to think about some of the physical phenomenon in mathematical terms.
Course Learning Outcomes: At the end of this course students will be able to:

CLO1: develop qualitative and quantitative understanding of Newtonian mechanics in one and two dimensions and solve the Newton equations for simple configurations.
CLO2: understand the Law of Conservation of Linear Momentum and Angular Momentum and apply these laws to understand elastic and inelastic collision.
CLO3: demonstrate the knowledge of work and energy in kinematics
CLO4: understand the Principle of Conservation of Mechanical Energy (for conservative forces) and apply this law to problems of objects moving under the influence of conservative forces.
CLO5: develop ideas of Newton's Law of gravity, gravitational field and potential energy by solving various problems.

Theory:

Unit I: **Elements of Newtonian Mechanics, Motion of Particle in one dimension [15 h]**

1. **Elements of Newtonian Mechanics [7 h]**
Mechanics an exact science, Brief description of classical view of Space and Time. Kinematics, the description of motion. Dynamics, the concept of Mass and Force. Newton's First and Second Laws; Inertial frames. Equations of motion. Interpretation of Newton's third Law as Conservation of Momentum. Units and dimensions, Some elementary problems in Mechanics (Applications of Newton's Laws) - Atwood Machine, Forces acting on a brick sliding down an inclined plane.
[Symon 1.1,1.2,1.3,1.4,1.6,1.7, Taylor 1.1-1.7, Kleppner 2.4]

2. **Motion of Particle in one dimension [8 h]**
Momentum and Energy theorems, Discussion of the general problem of one dimensional motion, Applied force dependent on time, Damping force dependant on the velocity. Conservative force depending on position. Potential Energy, Falling bodies.
[Symon 2.1,2.2,2.3,2.4,2.5,2.6]

Unit II: **Motion of a particle in two dimensions** **[15 h]**

1. Motion of a particle in two dimensions **[15 h]**
Vector algebra, Applications to set of forces acting on a particle, differentiation and integration of vectors, kinematics in a plane, momentum and energy theorems, plane and vector angular momentum theorems, The harmonic oscillator in two dimensions, projectiles, potential energy.
[Symon 3.1,3.2,3.3,3.4,3.7,3.8,3.9,3.10,3.11,3.12]

Unit III: Motion of system of particles, Gravitation **[15 h]**
1. Motion of system of particles **[8 h]**
Conservation of linear momentum, conservation of angular momentum,conservation of energy.
[Symon 4.1,4.2,4.3]

2. Gravitation **[7 h]**
Centres of gravity for extended bodies, Gravitational field and gravitational potential, Gravitational field equations
[Symon 6.1,6.2,6.3]

Experiments: (Minimum Six)
1. Dimensions of different solid body
2. Moment of Inertia of a flywheel
3. Atwood Machine
4. Verification of Newton's Second Law using Air Track
5. Conservation of linear momentum using Air Track
6. Spring Mass System: Determining the Spring Constant
7. Simple Pendulum
8. Determining "g" using time of flight method using Python

References:
1. Symon Keith, 2016, Mechanics, Pearson Education
2. Taylor J. R., 2005, Classical Mechanics, University Science Books, USA
3. Kleppner, Kolenkow, 2013, Introduction to Mechanics, Cambridge University Press, UK

Additional References:
1. Kittle, Knight, 2011, Mechanics, Berkeley Physics Course, Vol. 1, McGraw Hill Education,
2. .Mathur D. S, 2005, Mechanics, S. Chand & Co., New Delhi
3. Takwale R. G., and Puranik P. S., 1997, Introduction to Classical Mechanics, Tata Mc-Graw Hill, New Delhi
4. Javier E. Hasbun, 2010, Classical Mechanics, Jones and Bartlett India Pvt. Ltd.
5. Atam Arya, 1997, Introduction to Newtonian Mechanics, Addison-Wesley
5. Symon K. R., 1971, Mechanics, Addison Wesley, New York
6. Brij Lal and N. Subramanyam, 2005, Mechanics and Electrodynamics, S. Chand and Company Ltd., New Delhi

Web References:

1. https://nptel.ac.in/courses/122106027/
2. https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/
3. https://www.khanacademy.org/science/ap-physics-1/
4. https://www.feynmanlectures.caltech.edu/I_13.html
5. http://hep.physics.wayne.edu/~harr/courses/5200/f07/lecture06.htm

Course Title: Introduction to Astronomy and Astrophysics

Course Code: PHY-E17

Marks: 75 (Theory) + 25 (Practical)

Credits: 3 (Theory) + 1 (Practical)

Course Objectives: The course aims to introduce the students to the Exciting World of Extragalactic Universe.

Course Learning Outcomes: At the end of the course, students will be able:

CLO1: Understand the various Extra-galactic objects.

CLO2: Understand the construction, working and mounting of modern telescopes.

CLO3: Understand co-ordinate system of Celestial Objects.

CLO4: Understand types of stars and their life cycle.

Theory:

Unit I: Fundamentals of Astronomy and General Relativity [15 h]

1. Fundamentals of Astronomy: [11 h]

Introduction: Components of the Universe; Stars, Planets, Asteroids, Meteors, Comets, Galaxies. Solar System: Age, Origin ; Basic measurements: Planetary orbits, distances, physical size, mass, density, temperature, rotation period determination, Kepler's laws, black body radiation and curves, doppler effect.

[Freedman & Kaufmann III: Chapter 1, Chapter 17: 17.4], [Shu: Chapter 18; Section - Age of the Earth and the Solar System, Origin of the Solar System], [Kutner: Chapter 2, Chapter 5: 5.2, 5.4], [Carroll & Ostlie: 2.1, 2.3]

2. General Relativity [4 h]

Curved space-time, Principle of Equivalence, Tests of general relativity, Approaching black holes.

[Kutner: Chapter 8]

UNIT II: Observational Astronomy and Astronomical Instruments [15 h]

1. Observational Astronomy [7 h]

Co-ordinate system, Celestial hemisphere, Concept of time, Magnitudes: apparent and absolute, constellations. Star dial, Observation of Sun, Eclipses, Moon, planets, meteor showers, transits, occultation's.

[Carroll & Ostlie: Chapter 1: 1.3, Chapter 3: 3.2, Chapter 20, 21, 22]; [Freedman & Kaufmann III: Chapter 3]

2. Astronomical Instruments: [8 h]

Optical telescopes, mounts, light gathering power, magnification, resolution.

Spectroscopes, CCD camera, photometer, filters, radio telescopes, interferometry, UV, IR, X-ray and gamma ray telescopes.

Modern telescopes: HST, Chandra.

[Freedman & Kaufmann III: Chapter 6]; [Carroll & Ostlie: 3.6]

Unit III: Star Systems and Galaxies, Dark Matter and The Big Bang [15 h]

1. Star and Star Systems [8 h]

Stars life cycle, Neutron stars, black holes, white dwarf, Chandrasekhar limit. Spectral classification of stars, O, B, A, F, G, K, and M. Sytem of stars: Binaries / Cepheids / RR Lyrae, HR diagram, sun and solar system.

[Carroll & Ostlie: Chapter 8 upto pg. 224; Chapter 11: 11.1-11.2 (upto pg. 374), 11.3; Chapter 16: 16.2, 16.4, 16.6; Chapter 17: 17.3], [Kutner: Chapter 5: 5.1, 5.3; Chapter 10: 10.2]

2. Galaxies, Dark Matter and Dark Energy [4 h]

Galaxies, classification of galaxies, Hubble's tuning fork diagram, Open and Globular clusters, ISM,

[Kutner: Chapter 13, 14, 16, 17]

3. The Big Bang **[3 h]**

Cosmology: Scale of the universe, expansion of the universe, The Big Bang: Cosmic background radiation

[Chapter 20: 20.1, 20.2; Chapter 21: 21.1]

Experiments: (Minimum six)

1. Resolving power of telescope.
2. Study of scattering of light (Diameter of Lycopodium powder).
3. Study of Diffraction using plane grating.
4. To find radius of curvature of a convex lens using optical lever.
5. Measurement of the solar constant.
6. To obtain proper motion of Barnard's star using Aladin.
7. Draw constellation map of a) Orion b) Auriga c) Taurus d) Ursa Major (Big Dipper) marking of pole star.
8. To determine the elements in sun using Frauhoffer spectra.
9. To estimate Astronomical Unit using Venus transit data by parallax method.
10. Data analysis technique using virtual observatory.
11. Determine the period of revolution of sun using virtual laboratory.

References:

1. Freedman, R. A. & Kaufmann III, W. J., 2008. *Universe*, Eighth Edition. New York: Clancy Marshall
2. Shu, F. H., 1982. *The Physical Universe An Introduction to Astronomy*. Sausalito, California: University Science Books.
3. Kutner, M. L., First published in 2003. *Astronomy A Physical Perspective*. Second ed. New York: Cambridge University Press.
4. Carroll, B. W. & Ostlie, D. A., n.d. *An Introduction to Modern Astrophysics*. Second ed. San Francisco: Addison Wesley.

Additional References:

1. Roy A.E., Clarke D., 1989, *Astronomy structure of the Universe*, Adam Hilger Pub.
2. Glasstone S., 1965, *Source book on the Space Sciences*, Van Nostrand Reinhold Inc., U.S
3. Bhatia V. B., 2001, *Textbook of Astronomy and Astrophysics* with Elements of Cosmology, Narosa Publishers, New Delhi.
4. Narlikar J.V., 1976, *Structure of the Universe*, Oxford Paperbacks.
5. Badyanath and Basu, 2010, *An Introduction to Astrophysics*, 2nd Edition, Prentice Hall India Learning Private Limited
6. Abhyankar K.D., 2001, *Astrophysics - Stars and Galaxies*, Tata McGraw Hill, New Delhi
7. Sule, A., 2013. *A Problem Book in Astronomy and Astrophysics.* [Online]
8. Palen, S. E., 2002. *Schaum's Outline Series, Astronomy*. United States of America: McGraw Hill.

Web References:

1. https://youtu.be/QJjT9QPlnJs
2. https://youtu.be/vDv3iSMdYyc
3. https://youtu.be/Upy-jNpQW_0
4. https://youtu.be/nzmFc2gjUo4
5. https://youtu.be/0b7-4tfx3J4
6. https://ocw.mit.edu/courses/physics/8-282j-introduction-to-astronomy-spring-2006/
7. https://ocw.mit.edu/courses/physics/8-901-astrophysics-i-spring-2006/
8. https://ocw.mit.edu/courses/physics/8-902-astrophysics-ii-fall-2004/

Course Title : Electronics-II

Course Code : PHY-E11

Marks : 75 (Theory) + 25 (Practical)

Credits : 3 (Theory) + 1 (Practical)

Pre-requisite : Electronics-I (PHY-E5)

Course Objectives : This course aims at introducing students to analog and digital circuits.
Course Learning Outcomes: At the end of this course, students will be able to:
CLO1: Analyse AC circuits and apply the techniques in designing circuits.
CLO2: Generate different kinds of waves using OP-Amp
CLO3: Understand the basic concepts of 555 timer.
CLO4: Apply binary operations to different digital circuits
CLO5: Understand the clocked digital electronics and its applications in different types of Counters

Theory

Unit I: [15 h]

1. **AC Models (BJT) [4 h]**

Base-Biased amplifier, Emitter-Biased amplifier, Small signal operation, analyzing an amplifier.
[Malvino: Article 9.1 to 9.7]

2. Transistor Multivibrators [4 h]

Transistor as a switch, switching times, Multivibrators – Astable, Monostable, Bistable and Schmitt Trigger.
[Mottershed: Article 18.1 to 18.5]

3. FET's and MOSFET's [7 h]

Basic structure of the JFET, Principles of operation, Characteristic curves and parameters, Common source amplifiers, Common gate amplifier, MOSFET: Depletion Mode and Enhancement mode, Dual-Gate MOSFET. FET Phase shift oscillator, FET as VVR and its applications in Attenuator, AGC and Voltmeter circuits.
[Malvino: Article 13.1 to 13.9, 14.1 to 14.5]

Unit II: [10 h]

1. OPAMP Applications [5 h]

Active diode circuits, Comparator, Window comparator, Schmitt Trigger, Waveform generator – Square wave, Triangular and Ramp Generator and monostable.
[Malvino: Article 22.7, 22.8]

2. Timers [5 h]

The 555 Timer, Basic concept, 555 block diagram, Monostable, Astable, Bistable, Schmitt Trigger and Voltage controlled oscillator (VCO) using 555 timer.
[Malvino: Article 23.7, 23.8]
[Malvino and Bates: 24.4, 24.5]

Unit III **[20 h]**

1. Digital Circuits **[10 h]**

Binary number system, Binary to Decimal and Decimal to Binary conversion, Basic logic gates, AND, OR, NOT(realization using Diodes and Transistor), NAND, NOR as universal building blocks in logic circuits, EX-OR and Ex-NOR gates. Boolean Algebra:De Morgan's Law's, Boolean Laws, NAND and NOR gates, Sum of Products methods and Product of Sum methods of representation of logical functions. Half adder and Full adder, Data Processing Circuits: Multiplexer and Demultiplexer, Encoders and decoders.
[Jain: Article 5.1 to 5.8.1, 6.1, and 6.2]

2. Sequential Circuits [10 h]

Basic RS FF, Clocked RS FF, JK FF, D-type and T-type FF, Master Slave Concept. Shift Registers:Serial-in-Serial-Out, Serial-in-Parallel-out, Parallel-in-Serial-out, Parallel-in-Parallel-out Shift registers (upto 4 bits), Counters: Applications of FF's in counters, binary ripple counter, Modulus of counter (3,5) BCD Decade Counter, Cascade BCD Decade counters.
[Jain: Article 7.1 to7.9, 8.1, 8.2, 8.4]

Experiments (Minimum Six):

1. Astable Multivibrator
2. Monostable Multivibrator
3. Bistable Multivibrator
4. Schmitt Trigger
5. F.E.T Characteristics
6. IC LM 317 Voltage Regulator
7. IC 555 Timer as Astable Multivibrator and its use as Voltage Controlled Oscillator
8. IC 555 Timer as Monostable Multivibrator
9. Digital Multiplexer
10. Verification of De Morgan’s Theorems and Boolean Identities
11. NAND and NOR Gates as Universal Building Blocks
12. Binary Addition –Half Adder and Full Adder Using Gates
13. JFET as a common source amplifier.

References :

1. Malvino A.,1996, Electronic Principles, 5thedition,Tata McGraw Hill.
2. Jain R. P. 2003, Digital Electronics, 3rd edition, Tata McGraw Hill.
3. Mottershed A. 1997, Electronics Devices and Circuits an Introduction, PHI
4. Malvino A. and Bates D.J., 2007, Electronic Principles, 7th edition, Tata McGraw Hill

Additional References:

1. Malvino A. and Leach D. 1986, Digital Principles and Applications,4th edition Tata McGraw Hill.
2. Millman J. and Halkias C., 1972, Integrated Electronics, Tata McGraw Hill.
3. Millman J. and Halkais C., 1967, Electronic Devices and Circuits, Mc Graw Hill.
4. Mehta V.K., 2003, Principles of Electronics, 8th edition, S. Chand & Company.

Web References:

1. https://nptel.ac.in/courses/117/107/117107094/
2. https://www.electronics-tutorials.ws
3. https://www.electronicshub.org/
4. https://nptel.ac.in/courses/108/105/108105132/
5. https://www.khanacademy.org/science/electrical-engineering

Course Title : Mechanics – II

Course Code : PHY-E13

Marks : 75 (Theory) + 25 (Practical)

Credits : 3 (Theory) + 1 (Practical)

Pre-requisite : Mechanics – I (PHY-I.C-2)

Course Objectives : To acquaint students with a higher-level Mechanics which includes advanced concepts through topics like central force problems, mechanics in non-inertial frames, motion of rigid bodies, collision theory and Lagrangian formulation.

Course Learning Outcomes: At the end of this course, students will be able to:

CLO1: Separate two body problem into two equivalent single body problems
CLO2: Establish equation of orbit for the motion under inverse square law force and study different types of orbits.
CLO3: Establish the relation between time derivative of a vector in a fixed frame of reference with respect to moving frame of reference.
CLO4: Comprehend the occurrence of some pseudo forces due to relative motion between frames of references such as Coriolis's force, centrifugal force
CLO5: Understand the motion of rigid bodies by solving Euler's equations of motion.
CLO6: Understand the advantages of Lagrangian formulation over Newtonian formulation.
CLO7: Solve various mechanical problems using Lagrangian equation of motion.

Theory

Unit I: Motion Under a Central Force and Collisions of Particles [15 h]

Motion Under a Central Force [10 h]
Center of mass coordinate, equivalent one body problem, general features of motion in a central force field, motion in an inverse square law force field, equation of the orbit, nature of orbits, elliptical orbits: the Kepler problem, hyperbolic orbits, parabolic orbits.
Symon: 3.13, 3.14, 3.15, 3.16 [pg. 122-140]
Takwale: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 [pg. 133-153]

Collisions of Particles [5 h]
Elastic and inelastic cross section, scattering in a central force field, scattering cross section, Rutherford scattering cross-section.
Symon: 4.6 [pg.175-182], 3.16 [pg. 137-140]
Takwale:7.5, 7.6 [pg. 202-211]

Unit II: Moving Coordinate Systems and The Rotation of a Rigid Body [20 h]

Moving Coordinate Systems [10 h]

Moving origin of coordinates, rotating coordinate system, laws of motion on rotating earth, effect of Corioli's force on freely falling particles, the Foucault pendulum.

Symon: 7.1, 7.2, 7.3, 7.4 [pg.271-284]

Takwale:9.1,9.2, 9.3, 9.4, 9.5 [pg. 246-257]

The Rotation of a Rigid Body [10 h]

Euler's theorem, angular momentum and kinetic energy, the inertia tensor, Motion of a rigid body in space, Euler's equations of motion for a rigid body, torque free motion, Euler's angles, qualitative discussion of the symmetric top.

Symon: 11.1, 11.2, 11.3\4, 11.5 [pg. 444-460]

Takwale:10.1,11.2, 11.3, 11.4, 11.5, 11.6, 11.7[pg. 262-283]

Unit III: Lagrangian Formulation [10 h]

Lagrangian Formulation [10 h]

Constraints, generalized coordinates, D'Alembert's principle, Lagrange's equations, a general expression for kinetic energy, symmetries and law of conservation, cyclic or ignorable coordinates.

Takwale: 8.1,8.2, 8.3, 8.4, 8.5, 8.6, 8.7 [pg. 217-238]

List of Experiments: (Minimum Six)

1. Study of Compound Pendulum as a Reversible Pendulum: Kater's Pendulum
2. Measurement of Moment of Inertia of Uniform Rigid Bodies: Bifilar Suspension
3. Principle of conservation of linear momentum using linear air track
4. Value of "g" by Rod pendulum
5. To Study the different oscillation modes of the coupled pendulum
6. To determine the moment of inertia of Gyroscope disc
7. Equation of Orbit (bounded orbit) simulation experiment
8. Equation of Orbit (unbounded orbit) simulation experiment

References:

1. Symon K. R., 1971, *Mechanics*, 3rd Edition, Pearson, India
2. Takwale R. G., and Puranik P. S., 1992, *Introduction to Classical Mechanics*, Tata Mc-Graw Hill, New Delhi

Additional Reference:

1. Taylor J. R., 2005, *Classical Mechanics*, University Science Books, USA

Web References:

1. http://www.dept.aoe.vt.edu/~lutze/AOE4134/4OrbitSolution.pdf
2. http://web.mit.edu/12.004/TheLastHandout/PastHandouts/Chap03.Orbital.Dynamics.pdf
3. http://twister.ou.edu/PM2000/Chapter7.pdf
4. http://www.southampton.ac.uk/~stefano/courses/PHYS2006/chapter4.pdf
5. https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/
6. https://nptel.ac.in/courses/115/105/115105098/

Annexure II

Syllabus of Skill Enhancement Courses

Course Title : Basics of Visualization and Scientific word processing

Course Code : PHY-SEC.1

Marks : 100

Credits : 4

Course Objectives : To develop basic competence in Linux environment, Data visualization, scientific word processing and Crystal visualization.

Course Outcomes : At the end of this course students will be able to:

CO1: familiarize with the Linux environment

CO2: design crystal structures using crystal visualizers

CO3: understand basic mechanisms of Latex and prepare high quality type setting.

CO4: plot and visualize data to explore data sets graphically or create high quality graphs for presentation and publication purpose.

Unit I **[20 h]**

Introduction to Linux Environment:

- Installation of Virtual Box.
- Navigation: Current working directory, Listing the Contents of a Directory. Changing the Current Working Directory.
- Exploring the system: Determining A File's Type With file. Viewing File Contents With less.
- Manipulating files and directories: Creating, deleting, copying and moving of directories and files.
- Filters: grep, head/tail, tee, awk, sed, more, less.
- Vi Editor: Appending text. Deleting text. Cutting, Copying, And Pasting Text. Saving work.
- Simple bash scripting: Introduction and executable permissions, if-then-else, do-while and for loops.

[Shotts: Chapter 2, 3 (pg.13-19), **4, 6** (pg. 59-66), **12** (pg. 136-147, 154-155), **24** (Pg:354-358), **27** (pg. 381-389), **29** (pg. 409-413)**, 33** (pg. 450-452)**]**

Unit II **[10 h]**

Crystalline and molecular structure visualisation

Introduction to crystal structures. Installing Vesta. designing crystal structures. Simulate XRD pattern. visualizing lattice planes and drawing lattice vectors. creating supercell.

Unit III **[20 h]**

Scientific word processing:

- **Introduction to LaTeX**: Preparing a basic LaTeX file. Input Files and File structure.
- **Typesetting Text**: The structure of text and language, Line breaking and page breaking. Readymade strings. Special characters and symbols. Titles, chapters and symbols. Cross references, Foot notes, emphasised words.
- **Environments**: Itemize, enumerate and description. Flushleft, Flushright, and Centre. Tabular
- **Typesetting mathematical formulae:** General. Grouping in math mode. Building blocks of a mathematical formula. Math spacing. Vertically aligned material.
- **Graphics and Bibliography:** EPS graphics, Bibliography and Indexing.
- **Creating Presentations:** Introduction to Beamer. Setting up a beamer document. Enhance a beamer presentation.

[Oetikar: 1.1-1.3, 2.1-2.4, 2.7-2.11, 3.1-3.5, 4.1-4.3][Binder: 11.1-11.5]

Unit IV

Data Visualization: **[10 h]**

Introduction to gnuplot. Simple plots, plotting data from a file, abbreviations and defaults. Saving commands and exporting graphs. Plotting functions and data. Math with gnuplot. multiple data sets per file. Different plot styles. Multiple axis. Plot range. Tic marks.

[Janert: 1.3, 2.1-2.2, 3.1,3.2, 4.1- 4.2, 6.1-6.3.1, 8.1-8.3.4.]

References:

1. William Shotts JR., 2013, *The Linux Command Line* 2nd Edition, No Starch Press, USA

2. Kochi Momma, Fujio Izumi, 2019, VESTA: a Three-Dimensional Visualization System for Electronic and Structural Analysis (https://jp-minerals.org/vesta/archives/VESTA_Manual.pdf)

3. Tobias Oetiker, Hubert Partl, Irnen Hyna and Elisabeth Schlegl, 2001, *The Not so Short Introduction to LateX*, Free Software Foundation, USA (https://tobi.oetiker.ch/lshort/lshort.pdf)
4. Donald Binder and Martin Erickson, 2011, *A students guide to the study practice and tools of Modern Mathematics*, CRC Press, USA

5. Phillip Janert, 2016, *Gnuplot in Action: Understanding data with graphs* 2nd Edition, Manning Publications, USA

Web References:

1. https://maker.pro/linux/tutorial/basic-linux-commands-for-beginners
2. https://www.youtube.com/playlist?list=PLS1QulWo1RIb9WVQGJ_vh-RQusbZgO_As
3. https://www.youtube.com/playlist?list=PL1D4EAB31D3EBC449
4. https://www.youtube.com/playlist?list=PLAiKNYrUqmyKvRtKRYaZ6Ylwcj977r0lw
5. https://www.youtube.com/playlist?list=PLfIFNJ1DPG4nRLP5qsXn1UWTgAyysZE6-

Course Title : Instrumentation

Course Code : PHY-SEC.2

Marks : 100

Credit : 4

Pre-requisite : ---

Course Objectives : The objective of this course is to understand basic concepts related to the various types of measuring instruments and measuring techniques.

Course Learning Outcomes: At the end of the course, students will be able to:

CLO1: Design and construction of regulated power supply
CLO2: Understand the working and use of Signal Generators
CLO3: Understand basic concepts related to the various types of measuring instruments and measuring techniques.
CLO4: Comprehend basic principles involved in measuring instruments like Ammeter, Voltmeter, Ohmmeter and Multimeters.
CLO5: Understand the working and usage of the various types of transducers.

Theory:

Unit I: Regulated Power Supplies and Signal Generator [10 h]

1. **Regulated Power Supplies [6 h]**
   Supply characteristics, Shunt regulators, Series regulators, Monolithic linear regulators: Basic types of IC regulators, LM7800 series, LM79XX series, Regulated dual supplies, Adjustable regulators, LM-317 as a voltage regulator.
   [Malvino and Bates: Chapter 24: 24-1 to 24.4]

2. **Signal Generator: [4 h]**
   Standard Signal Generator, AF Sine and Square Wave Generator, Function Generator.
   [Kalsi: Chapter 8.4, 8.5, 8.7, 8.8]

Unit- II: Measuring Devices [10 h]

1. **Measuring Instruments [10 h]**
   DC Ammeter, Multirange Ammeter, Universal Shunt, Requirements of a Shunt, Extending of Ammeter Ranges. Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter, Extending Voltmeter Ranges, Loading, Transistor Voltmeter (TVM), FET DC Voltmeter. AC Voltmeter using Rectifiers, Multirange AC Voltmeter, AC current measurements using AC Voltmeter and a series Resistor. Ohmmeter: Series type and Shunt type, Multimeter.

Digital voltmeter: Ramp Technique, Digital Multimeters and Frequency meter (with help of Block Diagrams), Q meter.
[Kalsi: Chapter 3.1 to 3.5, 4.2 to 4.7,4.12to 4.15, 4.21, 4.22, 4.25, 5.2, 6.2,6.3,10.7 and Mottershead: Chapter 22: 22-9]

Unit-III: Introduction to Transducers and its applications [10 h]

1. **Transducers [10 h]**

Introduction, Electrical Transducer, Selecting a Transducer, Strain Gauges, Resistance Wire Gauge, Types of Strain Gauges(Wire), Foil Strain Gauge, Semiconductor Strain Gauge, Inductive Transducer, Differential Output Transducers, Linear Variable Differential Transducers (LVDT), Capacitive Transducer, Piezo-Electric Transducer, Semiconductor Diode Temperature Sensor, Temperature Transducers: Resistance Temperature Detectors, Thermistors, Thermocouples.
[Theraja: Chapter 36.1 to 36.3, 36.12 to 36.15] [Kalsi: Chapter 13.1 to 13.3, 13.6, 13.6.1 to 13.6.4, 13.9,13.9.1, 13.9.2, 13.10, 13.11,13.13, 13.15, 13.20.7]

Unit-IV: Practicals: **(Minimum six) [30 h]**

1. Design and construction of regulated power supply using LM78XX series (XX = +5, +6, + 8, + 10, + 12, + 15).
2. Design and construction of regulated power supply using LM79XX series (XX = -5, -6, - 8, - 10, - 12, - 15).
3. Design and construction of regulated dual power supply using LM78XX and LM79XX series.
4. Study of IC LM 317 voltage regulator.
5. Construction and design of analog two ranges Voltmeter.
6. Construction and design of analog two ranges Ohmmeter.
7. Crystal Oscillator: Determination of velocity of ultrasonic waves in a liquid medium.
8. Study of strain Gauges
9. Study of LVDT (including calibration) and its use in any one application.
10. Calibration of Thermocouple
11. Thermistor as a temperature sensor.
12. Application of Pt 100 as a temperature sensor.

References:

1. Malvino A. and Bates D.J., 2007, *Electronic Principles*, 7th edition, Tata McGraw Hill
2. Kalsi H S, 2010, *Electronics Instrumentation*, 3rd Edition, Tata McGraw Hill Education Pvt. Ltd. New Delhi
3. Mottershead Allen, 2000, *Electronics Devices and Circuits: An Introduction*, Prentice-Hall of India Pvt. Ltd., New Delhi
4. Theraja B. L., 2005, *Basic Electronics (Solid State)*, 1stMulticolour Edition, S. Chand and Company Ltd., New Delhi

Additional References:

1. Boylestad R., and Nashelsky L., 2000, *Electronic Devices and Circuit Theory*, 6th Edition Prentice-Hall of India Pvt. Ltd., New Delhi
2. Helfrick A. D., Cooper W. D., 1994, *Modern Electronic instrumentation as Measurement Techniques*, 2nd Edition Prentice-Hall of India Pvt. Ltd., New Delhi

Web References:

1. https://www.electroniclinic.com/voltage-regulators-78xx-and-79xx-family-specifications-and-uses/
2. https://www.youtube.com/watch?v=LFeVswEe_dw
3. https://electronics-diy.com/Function_Generator_XR2206.php
4. https://www.electronics-tutorials.ws/io/io_1.html
5. http://www.mwftr.com/netw1/06%20dArsonval.pdf

Annexure III

Revised list of courses

SEMESTER	CORE		ELECTIVE				
I	PHY-I.C-1 Introduction to Mathematical Physics	PHY-I.C-2 Mechanics-I	-------	-------	-------	-------	-------
II	PHY-II.C-3 Heat and Thermodynamics	PHY-II.C-4 Electricity and Magnetism	-------	-------	-------	-------	-------
III	PHY-III.C-5 Electromagnetic Theory-I	-------	PHY-E1 *Optics	PHY-E2 Modern Physics	PHY-E3 Oscillations, Waves and Sound	PHY-E17 Introduction to Astronomy and Astrophysics	PHY-SEC.1 Basics of Visualization and Scientific word processing.
IV	PHY-IV.C-6 Quantum Mechanics	-------	PHY-E5 *Electronics-I	PHY-E18 Introduction to Error Analysis	PHY-E4 Properties of Matter and Acoustics	PHY-E7 Computational Physics	PHY-SEC.2 Instrumentation
V	PHY-V.C-7 Electromagnetic Theory-II	-------	PHY-E9 *Solid State Physics	PHY-E10 Thermodynamics and Statistical Mechanics	PHY-E11 Electronics-II	PHY-E12 Mathematical Physics	PHY-E6 Solid State Devices
VI	PHY-VI.C-8 Atomic and Molecular Physics	-------	PHY-E13 *Mechanics II	PHY-E14 Nuclear and Elementary Particle Physics	PHY-E15 Introduction to Special Theory of Relativity	PHY-E16 Introduction to Material Science	

* BoS Physics recommends these elective courses to be taken by students as a prerequisite to the M.Sc. (Physics) Program.

COURSES FOR STUDENTS OPTING PHYSICS AS MINOR SUBJECT

Semester	Course
I	Mechanics-I
II	Electricity and Magnetism Or Heat and Thermodynamics
III	Modern Physics Or Electromagnetic theory -I
IV	Computational Physics Or Quantum Mechanics
V	Thermodynamics and Statistical Mechanics Or Electromagnetic theory -II
VI	Mechanics II Or Introduction to Materials Science

COURSES OFFERED AS SKILL ENHANCEMENT COURSE (SEC)

[2022-2023 onwards]

Semester	**Course Title**	**Course code when offered as SEC**
III	Basics of Visualization and Scientific word processing	PHY-SEC.1
IV	Instrumentation	PHY-SEC.2

Annexure IV

Following courses to be offered by the Department of Physics as General Elective courses:

- Semester I: PHY-I.C-1 Mechanics I
- Semester II: PHY-I.C-3 Heat and Thermodynamics
- Semester III: PHY-E2 Modern Physics
- Semester III: PHY-E17 Introduction to Astronomy and Astrophysics
- Semester III: PHY-E3 Oscillations, Waves and Sound
- Semester IV: PHY-IV.C-6 Quantum Mechanics
- Semester IV: PHY-E4 Properties of Matter and Acoustics
- Semester VI: PHY-E13 Mechanics II