MZUZU UNIVERSITY
FACULTY OF SCIENCE, TECHNOLOGY & INNOVATION
Department of Physics & Electronics

1.	**Programme**	**:**	Bachelor of Science
2.	**Subject**	**:**	Physics
3.	**Level of Study**	**:**	4
4.	**Course Title**	**:**	Fundamentals of Solid State Physics
5.	**Course Code**	**:**	PHYS 4801
6.	**Duration**	**:**	16 weeks
7.	**Presented to**	**:**	Senate
8.	**Presented by**	**:**	The Dean, FoSTI
9.	**Lecturer hours per week**	**:**	3
10.	**Tutorial hours**	**:**	1
11.	**Practical hours per week**	**:**	3
12.	**Student Independent Learning Hours**	**:**	9
13.	**Total Course Credits**	**:**	12
14.	**Pre-requisite course code(s)**	**:**	PHYS 1201, PHYS 3502
15.	**Co-requisite course code (s)**	**:**	
16.	**Delivery methods:**		
	16.1 Mode of delivery	**:**	Face-to-face and ODeL
	16.2 Teaching methods	**:**	Lectures, seminars, tutorials, practical, Industrial attachment
17.	**Assessment Methods**	**:**	Continuous Assessment – Assignments, tests and laboratory reports

: End of Semester Examination – 3 hour

18. Assessment weighting : Continuous assessment – 40 %
End of semester examination – 60 %

19. Aim (s) : To provide an introduction to the basic concepts in Solid State Physics

20. Learning Outcomes: On successful completion of this course students should be able to:

a. Explain fundamental principles and theories of solids.
b. Describe properties of solids
c. Solve problems in solid state physics
d. Design experiments in solid state physics.

21. Topics of the Course:

- **Crystal structure**
  - ✓ Lattice translation vectors
  - ✓ Basis and the crystal structure
  - ✓ Primitive lattice cell
  - ✓ Two-dimensional lattice types
  - ✓ Three- dimensional lattice types
  - ✓ Index systems for crystal planes
  - ✓ Simple crystal structures
  - ✓ Reciprocal lattices

- **2 Crystal binding**
  - ✓ Review of Ionic, covalent, metallic and hydrogen bonding
  - ✓ Van der Waals- London interaction
  - ✓ Repulsive interaction (Pauli exclusion principle)
  - ✓ Madelung (electrostatic) energy

- **X-ray diffraction**
  - ✓ Braggs law
  - ✓ Rotating crystal and the powder method
  - ✓ Neutron diffraction
  - ✓ Scattered wave amplitude (Laue equations, diffraction conditions, reciprocal lattice vectors, Fourier analysis)

- **Specific Heat**
  - ✓ Lattice vibrations – phonons

- ✓ Experimental facts and the classical model
- ✓ Einstein model and Debye model of specific heat

- **Electrical properties of metals**
  - ✓ Free electron model (electrical and thermal conductivity, Wiedermann Franz law)
  - ✓ Quantum free electron model (density of states, electron distribution, Fermi Dirac statistics and mean energy of electrons
  - ✓ Band theory (Bloch function, effect of periodic lattice potential and existence of energy bands).
  - ✓ Conduction in transition metals

- **Semi-conductors**
  - ✓ Semiconductor theory
  - ✓ Dynamics of extra electron on chain of atoms
  - ✓ Valance, Conduction bands and the forbidden region
  - ✓ Concentration of holes and electrical resistivity.
  - ✓ Hall effect
  - ✓ Thermostats and photo conductivity

- **Superconductivity**
  - ✓ Superconductors
  - ✓ Meissner effect
  - ✓ Type 1 and Type 2 superconductors
  - ✓ Specific heats
  - ✓ Vortex state
  - ✓ The London equation and penetration depth
  - ✓ BCS theory (Cooper pairs, energy gap Intermediate state coherence)
  - ✓ High temperature superconductors

31. Prescribed Texts:

- Kittel, C. (2004). *Introduction to Solid State Physics (8th Ed.).* New York: John Willey and Sons

23. Recommended Texts:

- Huebener, R.P. (2014) *Conductors, Semiconductors, Superconductors: An Introduction to Solid State Physics*, Cham, Switzerland: Springer International Publishing AG.
- Patterson, J.D. & Bailey, B.C. (2018) *Solid-State Physics: Introduction to the Theory* (3rd Ed). Cham, Switzerland: Springer International Publishing AG.

- Kumar, A. (2015) *Introduction to Solid State Physics* (2nd Ed). Delhi, India: PHI Learning.
- De Gennes, P.G. (2018) *Superconductivity of Metals and Alloys*, London: Taylor & Francis Ltd.

This course outline was approved by Senate on ……