STAREX UNIVERSITY

SCHOOL OF PHYSICAL SCIENCES

B.Sc. Non-Medical & B. Sc. Chem. Hons.

(Undergraduate Program Effective From Year 2017-18)

Course Structure & Syllabus Outline

STAREX UNIVERSITY

GURUGRAM, HARYANA (122413)

PREAMBLE

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters. The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching–learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students.

Presently the performance of the students is reported using the conventional system of marks secured in the examinations or grades or both. The conversion from marks to letter grades and the letter grades used vary widely across the HEIs in the country. This creates difficulty for the academia and the employers to understand and infer the performance of the students graduating from different universities and colleges based on grades. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Outline of Choice Based Credit System:

1. **Core Course**: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

2. **Elective Course**: Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course**: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project**: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

2.3 **Generic Elective (GE) Course**: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course**: The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Science, (ii) English/MIL Communication) are mandatory for all disciplines. AEEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.1 **AE Compulsory Course (AECC)**: Environmental Science, English Communication/MIL Communication.

3.2 **AE Elective Course (AEEC)**: These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Details of Courses Under B.Sc. Non-Medical Undergraduate Programme

COURSE	CREDITS	
	Theory + Practical	Theory + Tutorials
1. Core Course (12 Papers in 3 years) 04 Courses from each of the 03 disciplines of choice	12X4= 48	12X5=60
Core Course Practical / Tutorial* (12 Practical/ Tutorials* in 3 years) 04 Courses from each of the 03 Disciplines of choice	12X2=24	12X1=12
2. Elective Course (6 Papers) Two papers from each discipline of choice including paper of interdisciplinary nature.	6x4=24	6X5=30
Elective Course Practical / Tutorials* (6 Practical / Tutorials*) Two Papers from each discipline of choice including paper of interdisciplinary nature	6 X 2=12	6X1=6
▪ Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester.		
3. Ability Enhancement Courses **a. Ability Enhancement Compulsory** (2 Papers of 2 credits each) Environmental Science English/MIL Communication	2 X 2=4 4 X 2=8	2X2=4 4 X 2=8

b. Ability Enhancement Elective (Skill Based) (4 Papers of 2 credits each)		
	Total credit= 120	Total credit= 120

***wherever there is practical there will be no tutorials and vice –versa.**

Structure of B.Sc. Non-Medical under CBCS

SEM	CORE COURSE(12)	Ability Enhancement Compulsory Courses (2)	Skill Enhancement Courses (SEC) (2)	Discipline Specific Elective DSE (4)
1	Mechanics (CC- I)			
2	Waves & Optics (CC- 4)			
3	Electricity & Magnetism (CC-7)		Physics Workshop Skill	
4	Thermal Physics & Statistical Mechanics (CC-10)		Basic Instrumentation Skills	
5			Digital & Analog Electronics 1	DSE- Solid State Physics **OR** Elements of Modern Physics
6			Digital & Analog Electronics 2	DSE- Quantum Mechanics **OR** Mathematical Physics

Semester I

MECHANICS

Paper Code: Time Allowed: 3 Hours
Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Newton's Laws of motion
2	Digital Aided Learning	Frames of reference
3	Digital and Classroom Learning	Vector algebra, Scalar and vector products, Derivatives of a vector with respect to a parameter. Ordinary Differential Equations: 1st order homogeneous differential equations, 2nd order homogeneous differential equations with constant coefficients.
4	Classroom & Lab Learning	Dynamics of a system of particles, Centre of Mass.

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Work and energy
2	Digital Aided Learning	Conservation of energy
3	Digital and Classroom Learning	Conservation of momentum, Motion of rockets, Conservation of angular momentum.
4	Classroom & Lab Learning	Angular velocity and angular momentum, Torque

Section -C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Newton's Law of Gravitation, Kepler's Laws (statement only), Basic idea of global positioning system (GPS)
2	Digital Aided Learning	Geosynchronous orbits, Weightlessness
3	Digital and Classroom Learning	Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant), Satellite in circular orbit and applications, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages
4	Classroom & Lab Learning	Simple harmonic motion, Damped oscillations.

Section -D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Constancy of speed of light
2	Digital Aided Learning	Stress-strain diagram
3	Digital and Classroom Learning	Hooke's law, Postulates of Special Theory of Relativity, Length contraction, Time dilation, Relativistic addition of velocities
4	Classroom & Lab Learning	Elastic moduli-Relation between elastic constants, Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants, Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional pendulum-Determination of Rigidity modulus and moment of inertia - q, η and σ by Searle's method

Semester II

WAVES AND OPTICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section- A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Spherical waves, Plane waves, Wave intensity
2	Digital Aided Learning	Transverse waves on a string, Travelling and standing waves on a string, Normal Modes of a string
3	Digital and Classroom Learning	Group velocity, Phase velocity
4	Classroom & Lab Learning	**Superposition of Two Collinear Harmonic oscillations:** Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats), **Superposition of Two Perpendicular Harmonic Oscillations:** Graphical and Analytical Methods, Lissajous Figures with equal an unequal frequency and their uses.

Section- B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Surface Tension: Synclastic and anticlastic surface, Simple harmonic motion, forced vibrations and resonance
2	Digital Aided Learning	Excess of pressure, Application to spherical and cylindrical drops and bubbles
3	Digital and Classroom Learning	variation of surface tension with temperature, Physics of low pressure, production and measurement of low pressure, Rotary pump, Diffusion pump, Molecular pump, Knudsen absolute gauge, penning and pirani gauge , Detection of leakage, Intensity and loudness of sound, Decibels, Intensity levels, musical notes , musical scale, Sabine‟s formula - measurement of reverberation time

4	Classroom & Lab Learning	Jaegar‟s method, Viscosity: Viscosity - Rate flow of liquid in a capillary tube, Poiseuille's formula, Determination of coefficient of viscosity of a liquid, Variations of viscosity of a liquid with temperature lubrication, Fourier's Theorem, Application to saw tooth wave and square wave, Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient, Acoustic aspects of halls and auditoria

Section- C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle
2	Digital Aided Learning	Interference: Division of amplitude and division of wavefront
3	Digital and Classroom Learning	Phase change on reflection: Stoke's treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes)
4	Classroom & Lab Learning	Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism, Newton's Rings: measurement of wavelength and refractive index, **Michelson's Interferometer:** Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Section- D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Transverse nature of light waves
2	Digital Aided Learning	Plane polarized light: Introduction
3	Digital and Classroom Learning	Plane polarized light – production and analysis, Circular and elliptical polarization.
4	Classroom & Lab Learning	Fraunhofer diffraction: Single slit, Double Slit, Multiple slits & Diffraction grating, Fresnel Diffraction: Half-period zones, Zone plate, Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

Semester III

ELECTRICITY AND MAGNETISM

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one questionfrom each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors(statement only).
4	Classroom & Lab Learning	

Section -B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Electrostatic Field, electric flux
2	Digital Aided Learning	
3	Digital and Classroom Learning	Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Paralle lplate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field.

4	Classroom & Lab Learning	

Section -C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Dielectric medium, Polarization, Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.
2	Digital Aided Learning	
3	Digital and Classroom Learning	Displacement vector, Gauss's theorem in dielectrics, Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil,solenoid carrying current
4	Classroom & Lab Learning	Parallel plate capacitor completely filled with dielectric, Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil,solenoid carrying current, Ampere's circuital law

Section –D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Transverse nature of EM waves, polarization
2	Digital Aided Learning	Electromagnetic wave propagation through vacuum and isotropic dielectric medium
3	Digital and Classroom Learning	Energy stored in magnetic field, **Maxwell`s equations and Electromagnetic wave propagation:** Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field
4	Classroom & Lab Learning	Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils

SEMESTER III

SEC- II

PHYSICS WORKSHOP SKILL

Paper Code: Time Allowed: 3 Hours

Max. Marks: 50 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e., selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	Measuring units, conversion to SI and CGS
4	Classroom & Lab Learning	Familiarization with meter scale, Vernier caliper, Screw gauge and their utility, Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet etc., Use of Sextant to measure height of buildings, mountains etc.

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood
2	Digital Aided Learning	Concept of workshop practice, Overview of manufacturing methods: casting, foundry, machining, forming and welding, Types of welding joints and welding defects
3	Digital and Classroom Learning	Concept of machine processing
4	Classroom & Lab Learning	introduction to common machine tools like lathe, shaper, drilling, milling and surface machines, cutting tools, lubricating oils, cutting of a metal sheet using blade, smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block, use of bench vice and tools for fitting, make funnel using metal sheet.

Section-C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	
4	Classroom & Lab Learning	Use of Multimeter, soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB, Operation of oscilloscope, Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

Section-D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	**Introduction to prime movers**: Mechanism, gear system
3	Digital and Classroom Learning	Working principle of power generation systems
4	Classroom & Lab Learning	Fixing of gears with motor axel, Lever mechanism, lifting of heavy weight using lever, braking systems, pulleys, Demonstration of pulley experiment

Semester IV

THERMAL PHYSICS AND STATISTICAL MECHANICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Zeroth Law of thermodynamics and temperature. First law and internal energy, Reversible & irreversible processes, Second law & Entropy
2	Digital Aided Learning	Various Thermodynamical Processes
3	Digital and Classroom Learning	Conversion of heat into work, Applications of First Law: General Relation between CP &CV, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams
4	Classroom & Lab Learning	

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Third law of thermodynamics, Unattainability of absolute zero, Enthalpy, Gibbs, Helmholtz and Internal Energy functions
2	Digital Aided Learning	
3	Digital and Classroom Learning	Maxwell's relations, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.
4	Classroom & Lab Learning	Joule-Thompson Effect

Section-C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation), Blackbody radiation, Spectral distribution, Concept of Energy Density
2	Digital Aided Learning	
3	Digital and Classroom Learning	Derivation of Maxwell's law of distribution of velocities and its experimental verification, application of law of equipartition of energy to specific heat of gases; mono-atomic and diatomic gases Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.
4	Classroom & Lab Learning	

Section-D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Phase space, Macrostate and Microstate, Entropy
2	Digital Aided Learning	
3	Digital and Classroom Learning	Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity, Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics
4	Classroom & Lab Learning	

SEMESTER IV

SEC- III

BASIC INSTRUMENTATION SKILLS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 50 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 8 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	**Basic of Measurement:** Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. **Electronic Voltmeter:** Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity, Principles of voltage, measurement (block diagram only), **AC millivoltmeter:** Type of AC milli voltmeters: Amplifier- rectifier, and rectifier- amplifier, Block diagram ac milli voltmeter
4	Classroom & Lab Learning	**Multimeter :** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance, Specifications of a multimeter and their significance, **Electronic Voltmeter:** Specifications of an electronic Voltmeter/Multimeter and their significance, **AC millivoltmeter:** specifications and their significance

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor,

		visual persistence & chemical composition, Time base operation, synchronization, Front panel controls, Specifications of a CRO and their significance, introduction to digital oscilloscope, probes, Digital storage Oscilloscope: Block diagram and principle of working.
4	Classroom & Lab Learning	Use of CRO for the measurement of voltage (dc and ac frequency, time period, Special features of dual trace

Section-C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	**Signal Generators and Analysis Instruments:** Block diagram, explanation, Distortion factor meter, wave analysis, **Impedance Bridges & Q-Meters:** Block diagram of bridge, working principles of basic(balancing type) RLC bridge, Block diagram & working principles of a Q- Meter
4	Classroom & Lab Learning	**Signal Generators and Analysis Instruments:** specifications of low frequency signal generators, pulse generator, and function generator, Brief idea for testing, specifications, **Impedance Bridges & Q-Meters:** Specifications of RLC bridge, Digital LCR bridges

Section-D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	
4	Classroom & Lab Learning	**Digital Instruments:** Principle and working of digital meters, Comparison of analog & digital instruments, Characteristics of a digital meter, working principles of digital voltmeter, **Digital Multimeter:** Block diagram and working of a digital multimeter, Working principle of time interval, frequency and period measurement using universal counter/frequency counter, time-base stability, accuracy and resolution.

Classroom & Lab Learning

- **The test of lab skills will be of the following test items:**

- Use of an oscilloscope.
- CRO as a versatile measuring device.
- Circuit tracing of Laboratory electronic equipment,
- Use of Digital multimeter/VTVM for measuring voltages
- Circuit tracing of Laboratory electronic equipment
- Winding a coil / transformer.
- Study the layout of receiver circuit.
- Trouble shooting a circuit
- Balancing of bridges

- **Laboratory Exercises:**

- To observe the loading effect of a multimeter while measuring voltage across alow resistance and high resistance.
- To observe the limitations of a multimeter for measuring high frequency voltageand currents.
- To measure Q of a coil and its dependence on frequency, using a Q- meter.
- Measurement of voltage, frequency, time period and phase angle using CRO.
- Measurement of time period, frequency, average period using universal counter/frequency counter.
- Measurement of rise, fall and delay times using a CRO.
- Measurement of distortion of a RF signal generator using distortion factor meter.
- Measurement of R, L and C using a LCR bridge/ universal bridge.

- **Open Ended Experiments:**

- Using a Dual Trace Oscilloscope
- Converting the range of a given measuring instrument (voltmeter, ammeter)

Semester V

DSE- 1A

SOLID STATE PHYSICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Solids: Amorphous and Crystalline Materials
2	Digital Aided Learning	
3	Digital and Classroom Learning	Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones, Atomic and Geometrical Factor.
4	Classroom & Lab Learning	Diffraction of X-rays by Crystals. Bragg's Law

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Dia-, Para-, Ferri- and Ferromagnetic Materials
2	Digital Aided Learning	Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains.
3	Digital and Classroom Learning	Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids, Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids, Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains.
4	Classroom & Lab Learning	Hysteresis and Energy Loss

Section-C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	**Dielectric Properties of Materials:** Polarization, Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability
2	Digital Aided Learning	

3	Digital and Classroom Learning	Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons
4	Classroom & Lab Learning	

Section-D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors, mobility
2	Digital Aided Learning	Conductivity of Semiconductors
3	Digital and Classroom Learning	Kronig Penny model, **Superconductivity:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.
4	Classroom & Lab Learning	Hall Effect, Hall coefficient

DSE- 1A

ELEMENTS OF MODERN PHYSICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one questionfrom each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	De Broglie wavelength and matter waves, Wave-particle duality, Heisenberg uncertainty principle
2	Digital Aided Learning	
3	Digital and Classroom Learning	Planck's quantum, Planck's constant and light as a collection of photons, **Problems with Rutherford model:** instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. Heisenberg uncertainty principle-impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.
4	Classroom & Lab Learning	Photo-electric effect and Compton scattering, Davisson Germer experiment, gamma ray microscope thought experiment

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Matter waves and wave amplitude
2	Digital Aided Learning	
3	Digital and Classroom Learning	Linear superposition principle as a consequence; Schrodinger equation for non-relativistic particles, Momentum and Energy operators; stationary states; physical interpretation of wave function, probabilities and normalization; Probability and probability current densities in one dimension.
4	Classroom & Lab Learning	Two slit interference experiment with photons

Section-C

S. No.	Terms under which topics to be identified	Topics

1	Digital Self Learning	Size and structure of atomic nucleus and its relation with atomic weight
2	Digital Aided Learning	Nature of nuclear force
3	Digital and Classroom Learning	One dimensional infinitely rigid box- energy eigenvalues and eigen functions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier, Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle, NZ graph, semi-empirical mass formula and binding energy.
4	Classroom & Lab Learning	

Section-D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	**Radioactivity:** stability of nucleus; Law of radioactive decay
2	Digital Aided Learning	
3	Digital and Classroom Learning	Mean life & half-life; α-decay; β-decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission, **Fission and fusion -** mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions.
4	Classroom & Lab Learning	

SEC- III

DIGITAL AND ANALOG ELECTRONICS 1

Paper Code: Time Allowed: 1.5 Hours

Max. Marks: 50 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 1.5 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion
4	Classroom & Lab Learning	AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	De Morgan's Theorems, Boolean Laws, Simplification of Logic Circuit using Boolean Algebra. Fundamental Products, Minterms and Maxterms.
4	Classroom & Lab Learning	Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map

Section-C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	Binary Addition, Binary Subtraction using 2's Complement Method)
4	Classroom & Lab Learning	Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor.

Section-D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	p and n type semiconductors
2	Digital Aided Learning	
3	Digital and Classroom Learning	Barrier Formation in PN Junction Diode, Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode
4	Classroom & Lab Learning	PN junction and its characteristics, Static and Dynamic Resistance, Principle and structure of (1) LEDs (2) Photodiode (3) Solar Cell.

Semester VI

DSE- 2A

QUANTUM MECHANICS

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one questionfrom each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Linearity and Superposition Principles
2	Digital Aided Learning	
3	Digital and Classroom Learning	**Time dependent Schrodinger equation:** Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle. **Time independent Schrodinger equation**: Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to the spread of Gaussian wavepacket for a free particle in one dimension; wave packets, Fourier transforms and momentum space wavefunction; Position-momentum uncertainty principle.
4	Classroom & Lab Learning	

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	

3	Digital and Classroom Learning	**General discussion of bound states in an arbitrary potential**: continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method.
4	Classroom & Lab Learning	

Section-C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and C lassroom Learning	**Quantum theory of hydrogen**: like atoms: time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wavefunctions from Frobenius method; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells (idea only), **Atoms in Electric and Magnetic Fields:** Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment, Gyromagnetic Ratio and Bohr Magneton.
4	Classroom & Lab Learning	Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy

Section-D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	Pauli's Exclusion Principle
2	Digital Aided Learning	Periodic table
3	Digital and Classroom Learning	**Atoms in External Magnetic Fields:** Normal and Anomalous Zeeman Effect, **Many electron atoms:** Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total Angular Momentum. Vector Model. Spin-orbit coupling in atoms-L-S and J-J couplings.
4	Classroom & Lab Learning	

DSE- 2A

Mathematical Physics

Paper Code: Time Allowed: 3 Hours

Max. Marks: 75 Credits: 4

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 15 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.

2. The candidate will be required to attempt five questions in all i.e. selecting one questionfrom each section including the compulsory question. The duration of the examination will be 3 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers, **Fourier Series:** Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series.
4	Classroom & Lab Learning	

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	**Frobenius Method and Special Functions:** Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations.
4	Classroom & Lab Learning	

Section-C

S. No.	Terms under which topics to be identified	Topics

1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	**Some Special Integrals:** Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral)**, Partial Differential Equations:** Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry, **Complex Analysis:** Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula.
4	Classroom & Lab Learning	

SEC- IV

DIGITAL AND ANALOG ELECTRONICS 2

Paper Code: Time Allowed: 1.5 Hours

Max. Marks: 50 Credits: 2

Note for Examiners and Students:

1. The question paper will consist of four sections A, B, C & D. Examiner will set nine questions in all, selecting two questions from section A, B, C, and D of 15 marks each and may contain more than one part. Question 1 will be of 8 marks and consists of short answer type questions of 2 to 3 marks each covering the entire syllabus.
2. The candidate will be required to attempt five questions in all i.e. selecting one question from each section including the compulsory question. The duration of the examination will be 1.5 hours.

Section-A

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	
4	Classroom & Lab Learning	**Bipolar Junction transistors:** n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations, Active, Cutoff, and Saturation Regions, Current gains α and β, Relations between α and β, Load Line analysis of Transistors, DC Load line and Q-point

Section-B

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	
4	Classroom & Lab Learning	Voltage Divider Bias Circuit for CE Amplifier, H-parameter Equivalent Circuit.Analysis of a single-stage CE amplifier using Hybrid Model, Input and Output Impedance, Current, Voltage and Power Gains, Class A, B, and C Amplifiers.

Section-C

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	

2	Digital Aided Learning	
3	Digital and Classroom Learning	
4	Classroom & Lab Learning	**Operational Amplifiers (Black Box approach):** Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop & Closed-loop Gain, CMRR, concept of Virtual ground, Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero Crossing Detector.

Section-D

S. No.	Terms under which topics to be identified	Topics
1	Digital Self Learning	
2	Digital Aided Learning	
3	Digital and Classroom Learning	**Sinusoidal Oscillators:** Barkhausen's Criterion for Self-sustained Oscillations, Basic idea about capacitor filter
4	Classroom & Lab Learning	Determination of Frequency of RC Oscillator, **Power Supply:** Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, Zener Diode and Voltage Regulation