स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड.

SWAMI RAMANAND TEERTH MATHAWADA UNIVERSITY, NANDED

B. Sc. Final YearPhysics Syllabus (CBCS Pattern)

(Effective from 2018-2019)

Disclaimer

*The Syllabus of **B. Sc. Physics Final Year (Semester V and VI)** given in this document is prepared following the Choice Based Credit System (CBCS), adopted by the **S.R.T.M. University** as per the recommendations by the **UGC, New Delhi,** and has been duly approved by the Faculty, the Academic Council and the Management Council of the University.*

B. Sc. Physics T. Y. (CBCS) Course Structure and Marking Scheme Of Semester V

Semester	Paper No.	Name of the Course	Credits	Contact (instruction) hours		Assessment pattern (marking scheme)		
				per week	Total	End semester examination (ESE)	Continuous Assessment (CA)	Total Marks
Semester V	DSEP I (*Section A)* P-XII	Quantum Mechanics (P-XII)	02	03	45	40	10	50
	DSEP I *Elective* Course (*Section B*) P-XIII	Solid State Physics (P-XIII A) *OR* Solar Energy (P-XIII B) *OR* Astrophysics (P-XIII C)	02	03	45	40	10	50
Semester V Practical Course	DSEPP I P-XVI *(Section A)*	Practicals based on theory courses P-XII	01	04	06 practicals (24 Periods)	20	05	25 (*Annual Pattern*)
	DSEPP I P-XVII *(Section A)*	Practicals based on elective course P-XIII	01	04	06 practicals (24 Periods)	20	05	25 (*Annual Pattern*)
Semester V SEC	SEC III (*Skill Enhancement Course)*	Renewable energy & Harvesting *OR* Electrical Circuit Analysis Skill	02	---	45 Hands-on	25	25 (Test 15 + Seminar 10)	50

B. Sc. Physics T. Y. (CBCS) Course Structure and Marking Scheme Of Semester VI

Semester	Paper No.	Name of the Course	Credits	Contact (instruction) hours		Assessment pattern (marking scheme)		
				per week	Total	End semester examination (ESE)	Continuous Assessment (CA)	Total Marks
Semester VI	DSEP II (Section A) P-XIV	Atomic, Molecular and Nuclear Physics (P-XIV)	02	03	45	40	10	50
	DSEP II *Elective Course* (Section B) P-XV	Digital and Communication Electronics (P-XV A) *OR* Linear and Digital Integrated Circuits (P-XV B) *OR* Fiber Optics Communication (P-XV C)	02	03	45	40	10	50
Semester VI Practical Course	DSCPP II P-XVI *(Section B)*	Practicals based on theory courses P-XIV	01	04	06 practicals (24 Periods)	20	05	25 (*Annual Pattern*)
	DSEPP II P-XVII *(Section B)*	Practicals based on elective papers P-XV	01	04	06 practicals (24 Periods)	20	05	25 (*Annual Pattern*)
Semester VI SEC	SEC IV (*Skill Enhancement Course)* SEC IV	*Physics Workshop Skill* *OR* *Semiconductor Devices Application Skill*	02	---	45 Hands-on	25	25 (Test 15 + Seminar 10)	50

Preamble:

Swami Ramanand Teerth Marathwada University, Nanded, following the directives of the **University Grants Commission, New Delhi (UGC)**, has been trying hard to enhance the academic standard of this region and has taken several steps in recent past to improve the quality of higher education in its jurisdiction. These include the improvement and revision of the existing curricula in tune with the courses at national and international level, implementing innovative methods in teaching-learning processes, imparting skill based value added education, improvisation in the examination and evaluation processes, etc. These measures are very much useful in achieving **3Es, the *equity, efficiency and excellence*** in higher education of this region. However, the diversified approaches followed by different faculties and universities within India puts a limit on bringing the global equality in higher education across the country. This is because majority of universities within India follow conventional method of awarding percentage of marks for the performance of the students in their semester end examinations, in contrast to the grades awarded by the institutions of national reputes like IITs, IISERs, IISC and central universities. The scheme of conversion of the scores from percentage to point based grades and letter grades vary widely across the institutions and universities, which in turn produces a large range of disparity and difficulty in comparing performances of students graduating from different universities and institutes.

To overcome such anomalies in assessing performances of the candidates graduating from different universities UGC in recent past has undertaken an exercise of restructuring the curricula of different courses offered by various universities across the country. Though academic flexibility and autonomy is provided to the universities to design their own examination and evaluation methods best suiting the curricula and teaching–learning methods adopted in conducted and affiliated colleges, there is a global need to devise a sensible mechanism for awarding grades to the performance of students. As a result the UGC, New Delhi has suggested all the universities to adopt the grading system of computing the ***cumulative grade point average*** **(CGPA)** for assessing academic performance of the students in the university examinations. This is important not only to compare the performances of the students graduating from different universities but also provide mobility to the students in joining different institutions within India as well as in other countries. The common grading system followed by different universities also enables the potential employers to assess performances of candidates uniformly. As a result S.R.T.M.U. has adopted the ***cumulative grade point average*** **(CGPA)** system for assessing performance of students

studying in its jurisdiction from the academic year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and also to enhance the latent skills of the students SRTMU has also adopted the ***Choice Based Credit System*** **(CBCS)** at graduate as well as post-graduate level. The CBCS system offers flexibility to the students in choosing courses of their own choice from the exhaustive list comprising core, elective/minor or skill based components that are evaluated following the grading system. In the coming academic year 2018-2018 the university shall be implementing the same for the B. Sc. Third Year students. This document provides detailed information on metodology of choosing different components of B. Sc. Third Year (Semester V and Semester VI) Physics theory and practical courses.

The courses offered by this university are of student-centric nature and help them to understand the basic laws of nature and develop necessary skills to apply them to the advanced areas of studies. There are two common or core or mandatory courses meant to provide adequate knowledge of various branches of physics and to prepare the students for applying them for advanced courses. In addition, there will be elective courses as well as few skill based courses, which are of advanced nature and help the students to develop their skills through hands-on activities. The details of the courses and activities are as follows:

Outline of the Choice Based Credit System:

1. Discipline Specific Compulsory (DSC) Courses: Every student graduating in Science faculty with Physics as one of the optional subject is required to **study t**hese theory and practical papers as core or compulsory courses. There shall be two such theory papers (P-XII and P-XIV, each of 02 credits), one each in Semester V and VI, whose performance shall be assessed at the end of the respective semesters. There shall be one practical course corresponding to both these compulsory courses, however, the performance of candidates in the practical course shall be assessed on the annual basis i.e., at the end of the Semester VI by a pair of external examiners.

2. Discipline Specific Elective (DSE) Courses: Students have freedom to choose an advanced course of their interest and inclination from a pool of courses made available by the university for a particular semester. These courses are of specific or specialized or advanced or supportive nature and are designed such that they provide extended scope to the students or enable them to expand their knowledgebase. Every student has a freedom to elect one of such theory course of 02 credits, whose performance will be assessed at the end of the corresponding semester. These elective courses will be supplemented by practical courses each of 01 credits, however, they will be assessed following annual pattern i.e., at the end of the academic year. Attempts will also be made to offer elective courses of interdisciplinary nature from some other

subjects, disciplines, or faculties; however, for the availability of such courses the students are required to consult their teachers.

3. Skill Enhancement Courses (SEC): These courses are aimed at providing hands-on-training, competencies, skills, etc. to the students. As these courses are primarily of hands-on-training type, therefore, students are expected to devote much of their time in laboratory activities rater than the conventional classroom teaching. Therefore, one-third of the time allocated to this course will be utilized for the classroom teaching, imparting instructions, etc., while remaining two-third will be utilized by the students in developing their skills through the hands-on exercises. The exercises to be undertaken for this purpose shall be of different nature than that of their regular laboratory / practical courses. There shall be two such skill enhancement courses, one each in semester V and VI, which shall be selected by the students depending on their choice and inclination. Performance of the students in these couses shall be assessed at the end of the semester VI following annual pattern by a pair of external examiners along with their practical courses. Students have freedom to choose the Skill Enhancement Courses (SEC III and IV) from either of their optinal paper at B. Sc. Third Year.

4. **Laboratory/Practical Courses**: Every students studying in B Sc final year (Semester V and VI) is required to complete two laboratory / practical courses (Paper Nos. P-XVI and P-XVII), which shall be assessed / examined at the end of the Semester-VI (annual pattern). Paper P-XVI comprises practicals based on the compulsory (DSC) papers P-XII and P-XIV, while P-XVII comprises those based on the elective (DSE) papers P-XIII and P-XV.

The B. Sc. Third Year (Semester V and VI) Physics syllabus given in this document has been prepared by different subcommittees constituted in the meeting of the BOS in Physics held on 10th April 2018 and is finalized after due consent from all the respected members. The BOS has invited comments, suggestion, corrections in the draft syllabus from all the Physics teachers affiliated to this university and has incorported those suggestions in the syllabus presented in this document.

(***Prof. M. K. Patil***)
Chairman, Board of Studies in Physics

Swami Ramanand Teerth Marathwada University Nanded
B. Sc. Third Year Physics (Semester – V) Syllabus
Choice Based Credit System (CBCS) effective from June -2018

P-XII DSEP I (Section A) - Discipline Specific Compulsory Paper:

Quantum Mechanics

***Credits:* 02**	***Periods*: 45**	***Total Marks:* 50 (*CA=10, ESE=40*)**

Learning objectives: *The objective of this course is to introduce the students to the world of microscopic particles such as molecules, atoms, atomic nuclei and elementary particles, study their dynamics employing wave analogy, and also to make the connections between the rules governing the microscopic particles with that of the macroscopic bodies around us. This course is the pre-requisite for several advanced courses in physics and chemistry and is necessary for understanding the behavior of molecules, atoms and elementary particles. The pre-requisite for this course is knowledge of calculus, wave theory and modern physics. This course is the core course and every student pursuing B Sc with physics as one of the optional is required to study this course.*

Unit I Particle Properties of Waves **(12 Periods)**
Introduction, Photoelectric Effect, Quantum Theory of Light, The Compton Effect, de Broglie waves, Wave function, de Broglie Wave Velocity, Wave and Group velocities, G. P. Thomson experiment, The Uncertainty principle and its applications.

Unit II Schrödinger's Equation **(12 Periods)**
Introduction, Schrödinger's Equation: Time dependent form, Probability current, Expectation Values, Operators, Schrödinger's Equation: Steady-state form, Eigen values and Eigen functions, Problems.

Unit III Applications of Quantum Mechanics **(09 Periods)**
Introduction, The particle in a box: energy quantization, The particle in a box: wave functions, The particle in a box: Momentum Quantization, The Harmonic Oscillator, The Harmonic Oscillator-Energy level, The particle in a three dimensional box

Unit IV Quantum Theory of Hydrogen Atom **(12 Periods)**
Schrödinger's equation for the Hydrogen Atom in spherical polar co- ordinates, separation of Variables, Quantum numbers –Total quantum number, Orbital quantum number, Magnetic quantum number, spin quantum number.

Books Recommended:

1. Perspectives of Modern Physics-Arthur Beiser (McGraw-Hill Int.Edition)
2. Modern physics – R. Murugeshan.(S.Chand & Co.XIth Revised edition)
3. Text Book of Quantum mechanics – Kakani & Chandaliya ((S.Chand & sons)
4. Quantum Mechanics – Chatwal and Anand (Himalaya Publishing)
5. Quantum Mechanics- Ghatak and Loknathan

P-XIII A - DSEP I (Section B) – Discipline Specific Elective Paper:

A. Solid State Physics

***Credits:* 02**	***Periods*: 45**	***Total Marks:* 50 (*CA=10, ESE=40*)**

Learning Objective: *This course is designed to provide fundamental knowledge of the crystallography, principles behind the formation of matter, their structure and physical properties. This course also enables the students to understand the relationship between the internal structure and various properties of matter such as periodicity, structure and bonding in solids, making these solids an attractive material for the device applications. At the end of this course, students will be able to classify the materials in different classes based on their physical, thermal, electrical, and magnetic properties. This is an elective course of 02 credits offered at Semester V.*

Unit I Crystal structure **(10 Periods)**

Introduction, Crystal Lattices and Translation vectors, Unit cell, Basis, Symmetry operations, Point groups, space group, Types of lattices, Simple crystal structure (HCP, FCC, BCC, SC), Structure of Diamond, NaCl, Problems.

Unit II Bonding in Solids and X-Ray Diffraction **(10 periods)**

Inter atomic forces and types of bonding, ionic bond, covalent bond, metallic bond, hydrogen bond, Vander-waal's bond.

X-ray diffraction, Bragg's law, Laue's method, Rotating crystal method

Unit III Thermal properties of Solids **(12Periods)**

Specific heat of gases, Specific heat of solids, Classical theory of Lattice heat Capacity, Einstein's theory of heat Capacity, Debye's theory of specific heat of solids, Limitations of Debye model

Unit IV Free Electron Theory of Metals **(13 Periods)**

The outstanding properties of metals, Drude-Lorentz theory, Thermal conductivity, Electrical conductivity, Widemann- Franz relation, Sommerfeld Model, Electrical conductivity and Ohms law, Electronic specific heat, Thermoionic emission, escape of electrons from metal.

Books Recommended:

1. Solid State Physics and Electronics – R. K.Puri & V. K. Babar (S.chand & Co.)
2. Solid State Physics – Saxena,Gupta, Saxena (Pragati Prakashan Meerut)
3. Solid State Physics – Puri & Babar (S.chand & Co.)
4. Introduction to Solid State Physics -by Kittel, Wiley and Sons, 7th Edition.
5. Material Science by M. Arumguarn, Anuradha Publishers.
6. Solid state Physics – R.L.Singhal (Kedar Nath Ram Nath Co., Meerut)

P-XIII B - DSEP I (Section B) – Discipline Specific Elective Paper:

B. Solar Energy

Credits: **02**	***Periods*****: 45**	***Total Marks:*** **50 (*CA=10, ESE=40*)**

Learning Objective: *This course is aimed to introduce the students to the nature of the energy that originates from the Sun, capable enough to drive nearly all the systems found on the Earth. This course enables the students to realize importance and utilization of the abundantly available solar energy as an alternative non-conventional energy source. This course starts with an introduction to the nature and vastness of the solar energy radiation and then enables the students to know the methods to convert and store this abundantly available energy into usable form by employing devices like photovoltaic systems. This is an elective course of 02 credits.*

Unit I Nature of solar radiation **(10 Lectures)**

Energy generation in the Sun, Spectral distribution, extra-terrestrial radiation, its variation over a year, terrestrial radiation, beam, diffuse and global radiation, and angles used to define direction of solar radiation and orientation of surface

Unit II Solar Photovoltaics **(9 Lectures)**

Working principle of solar cell, Details of silicon solar cell manufacturing and structure, different types (generations) of solar cells, solar cell-solar module-solar string-solar array

Unit III Solar photovoltaic systems **(8 Lectures)**

Stand alone solar photovoltaic system: block diagram and description of each block, grid connected solar photovoltaic system: block diagram and description of each block
Example of one stand alone photovoltaic system

Unit IV Solar Thermal Conversion **(9 Lectures)**

Plank's law, Wien's law and Stephan's law, Concept of selective surface, conduction, radiation and convection; collectors used for solar thermal conversion: flat plate collectors, evacuated tube collectors and concentrators

Unit V Solar thermal system **(9 Lectures)**

Description of solar water heating system: components and working principle, flat plate collector: construction details, energy balance equation and efficiency, different loss mechanisms

Reference books:

1. Solar Photovoltaics – by Chetan Singh Solanki (Third Edn.)
2. Solar Energy – by S. P. Sukhatme and J. K. Nayak (Third Edn.)

P-XIII (C) DSEP I (Section B) – Discipline Specific Elective Paper:

C. Astrophysics

***Credits:* 02**	***Periods*: 45**	***Total Marks:* 50 (*CA=10, ESE=40*)**

Learning Objectives: *Astronomy and Astrophysics is the oldest branch of science, perhaps started with the origin of the humankind, and has evolved systematically with time. In the present era with the availability of the state-of-the-art observing facilities across the electromagnetic spectrum, thanks to the technological advancements, the scope of the study of the astronomical objects have became more interesting and challenging. This study involves the knowledge of Classical Mechanics, Quantum Mechanics, Nuclear physics, Statistical Mechanics, Electrodynamics, Spectroscopy, Mathematical Physics, Modern Electronics, Chemistry and even Biological sciences. At the end of course, the students will be able to understand the important concepts of astronomical objects and will be in a position to provide a fundamental connections between different fields of the science in general and physics in particular.*

Unit I Fundamentals of astronomy: (10 Periods)

Brief history of astronomy (geocentric universe, heliocentric universe), co-ordinate systems (celestial sphere, horizon, equatorial co-ordinate systems), Greenwich Sideral time, Local Sideral time, zonal time, Hour angle and mean solar time, Astronomical Distance, astronomical unit (AU), light year, parsec, distance measurement in astronomy-stellar parallax

Unit II The Solar Family (10 Periods)

Kepler's laws of planetary motion, the Earth's orbit and spin, the Moon's orbit and spin. the planets in the solar system - the terrestrial and Jovian planets, structure, composition and atmospheres of the planets, ring systems and satellites of the planes, asteroids, meteors and meteorites, comets and their origin, solar and lunar eclipses, Origin of the Solar System: The Nebular hypothesis.

Unit III Astronomical Techniques (15 Periods)

Photon and non-photon astronomy, Photons (electromagnetic waves), Wavelength and frequency, Photon energy, Temperature, electromagnetic frequency bands – windows in astronomy
Black body radiation- Planck laws, Wien displacement law, Brightness, Radiant Flux and Luminosity. Magnitude systems: Apparent and absolute magnitudes, Distance Modulus; Determination of Temperature and Radius of a star

Atmospheric effects (absorption, seeing) - Basics of telescopes - Noise and statistics - Photon detectors - Basics of photometry - Spectroscopy and polarimetry.

Unit IV The sun as a star (10 Periods)

The Sun as a star, Solar Parameters, Solar Atmosphere, Solar Photosphere, Chromosphere, Corona, Solar Activity, Sunspots and sunspot cycle, solar limb darkening, solar neutrino puzzle.

Reference Books:

1. Modern Astrophysics – B.W. Carroll and D.A. Ostlie, 1996, Addison-Wesley Publishing Co., Inc.
2. The Physical Universe: An Introduction to Astronomy – Frank H. Shu, 1982, University Science Books, Sausalito, California
3. Astrophysics by Baidyanath Basu
4. Introduction to Astrophysics by K D Abhyankar

SEC III (A) Skill Enhancement Course: *A. Renewable Energy and Harvesting*

Credits: 02	*Periods*: 45	*Total Marks:* 50 (*CA=25, ESE=25*)

Learning Objectives: *Aim of this course is to introduce and create awareness among the students about use of the non-conventional energy sources such as solar energy, wind energy, tidal energy, biomass, etc. After completing this course the students will not only gain knowledge of various non-conventional energy sources but also get hands-on experience of utilizing them in real life. As this course is primarily of hnads-on trianing type, therefore, the students will be trained to harvest these non-conventional energy sources and design their own gadgets to convert and use them for their house hold purposes.*

Uuit 1 Fossil Fuels and Alternate Sources of Energy (12 Lectures)
Fossile fuels and Nuclear Energy, Need of renewable energy, Non-conventional energy sources, Wind Energy, Tidal Energy, Solar Energy, Biomass Energy.

Unit 2 Solar Energy and Harvesling (12 Lectures)
Importance, Storage of Solar Energy, Applications of Solar Energy, Solar Water Heater, Solar Distillation, Solar Cooker, Solar Greenhouses, Solar cell charecterstics of Photovoitaic (pv) Systems.

Unit 3 Wind Energy Harvesling (11 Lectures)
Fundameials of Wind Energy, Wind Turbines and Different Electrical Machines in Wind Turbines, Power Eleclronic Interfaces and Grid Interconnection Technologies.

Unit 4 Ocean Energy (10 Lectures)
Oscean Enersy Potential against Wind and Solar Enevgy, Wave Energy Devices. Geothermal Energy Technologies, Hydropower Technologies.

Hands on Exercises:

1. Studying basics of solar energy
2. Assemble solar cooker
3. Studying basics of solar electricity
4. Installation of solar panels and solar energy harvesting
5. Studying basics of Biomass Energy as an alternative source
6. Generating electricity from wind energy and its storage
7. Studying the construction ans working of a solar lantern
8. Desigining and constructing photovoltaic system for a domestic house requiring 5kVA power
9. Designing and constructing wind turbine system to power a house requiring 2kVA

Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004,
Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

SEC III (B) Skill Enhancement Course: *B. Electrical Circuit Analysis Skill*

Credits: 02	*Periods*: 45	*Total Marks:* 50 (*CA=25, ESE=25*)

Learning Objectives: *Aim of this course is to create awareness among the students about the electrical circuits, wiring of the electrical appliances and enable them to check for troubleshoots through hands-on exercises. This course introduces the students to various electrical components including their characteristics and power losses. As this course is of skill based, therefore, after completing this course students will not only be able to check the electrical connections at house-hold but will also learn the skill to repaire the electrical appliances for the general troubleshoots and wiring faults.*

Unit I Understanding Electrical Circuits (15 Lectures)

Main electric circuit elements and their combinations, rules of analyzing the DC electrical circuits, quantifying current and voltage drops across the circuit elements. A.C. Circuits: Single-phase and three-phase alternating current sources, rules to analyze the AC electrical circuits, understanding real, imaginary and complex power components of the AC source, power factor and approaches to save energy and money.

Electrical circuit drawing symbols, blueprints, reading schematics, ladder network diagrams. Electrical Schematics, Power circuits, Control circuits and reading the circuit schematics. Tracking the connections of elements and identifying current flow and voltage drop.

Unit II Electrical Transformers, Generators and Motors (10 Lectures)

DC Power sources, AC and DC generators, characteristics of the circuit elements inductance, capacitance, and impedance, transformer workings and characteristics

Working of electric motors, single-phase, three-phase AC and DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

Unit III Electrical Circuit Protection (15 Lectures)

Relays, fuses and disconnect switches, circuit breakers, overload protection devices, electrical ground-fault protection, grounding and isolating electric circuits, phase reversal, surge protection. Interfacing DC or AC sources to control elements (relay protection device)

Unit IV Electrical Wiring (10 Lectures)

Different types of conductors and cables, basics of wiring: star and delta connections, voltage drops and electrical losses across the connecting cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays.

Hands on Exercises:

1. Awareness of electrical safety tools and rescue of person in contact with live wire
2. Studying electrical performance and power consumption of a given number of bulbs connected in series and parallel circuits
3. Checking specific gravity of lead acid batteries in home UPS and toping-up with distilled water
4. Practicing soldering and de-soldering of various electrical and electronic components

5. Identifying Phase, Neutral and Earth on power sockets and checking the healthiness of mains using a test lamp

6. Identifying primary and secondary windings and measuring primary and secondary voltages in various types of transformers

7. Connecting an ELCB and testing the leakage of an electrical motor control circuit

8. Connecting battery and load to an UPS and testing its performance in battery mode

9. Studying construction and working of AC and DC motors

10. Trouble shooting electrical circuits

11. Studying electrical circuit protection using relays, fuses and circuit breakers

12. Dismantle electric fan / motor and identify the damaged / burnt part of winding in it

13. Drawing blueprints and wiring of single phase electrical circuit for a house hold supply

Books Recommended:

1 A text book in Electrical Technology - B L Theraja - S Chand & Co.
2 A text book of Electrical Technology - A K Theraja
3 Performance and design of AC machines - M G Say ELBS Edn.

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Choice Based Credit System (CBCS) Course effective from June -2018

P-XIV DSCP II (Section A) - Discipline Specific Compulsory Paper: *Atomic, Molecular & Nuclear Physics*

***Credits:* 02**	***Periods*: 45**	***Total Marks:* 50 (*CA=10, ESE=40*)**

Learning Objectives: *Aim of this course is to introduce the students to the world of physics of atoms, molecules and nuclei, their structures, emission of Gamma rays, X-rays, optical and microwave spectra from these systems, the interaction of atoms and molecules with electric and magnetic fields. This course also provides adequate knowledge on the nuclear energy sources and reactions with its application in establishing nuclear reactors.*

Unit I Atomic Physics **(15 Periods)**
The Vector Atom Model, Quantum numbers associated with the vector atom model, LS and J-J coupling, The Pauli's exclusion Principle, Selection rules, Intensity rules, Interval rule, Normal Zeeman effect, Anomalous Zeeman effect, Stark effect.

Unit II Molecular Spectra **(10 Periods)**
Regions of Electromagnetic Spectra, Classification of Molecular Spectra, Theory of pure rotational spectra, Theory of rotation-vibration spectra, Raman Effect, Experimental study,

Unit III Nuclear Fission and Nuclear Reactions **(10 Periods)**
Nuclear Fission, the fission products, energy release in fission, nuclear transmutation reactions, Conservation laws, Nuclear reaction kinematics

Unit IV Nuclear Fusion and its applications **(10 Periods)**
Nuclear fusion, p-p chain reaction as the source of energy in the Sunlike stars, thermal nuclear reactor, the neutron cycle, controlled and uncontrolled thermonuclear reactions.

Recommended Books:

1. Modern physics- R. Murugeshan, Kruthigaprasath. (S.Chand & Co.)
2. Atomic physics – J.B.Rajam. (S.Chand & Co.)
3. Nuclear Physics – D.C.Tayal (Himalaya Publishing House)
4. Nuclear Physics – Irving Kaplan
5. Introduction to Atomic Spectra: H E White, McGraw Book Company, Inc.
6. Basic Nuclear Physics- B. N. Shrivastav.

P-XV A - DSEP II (Section B) - Discipline Specific Elective Paper

A. Digital and Communication Electronics

Credits: 02	*Periods*: 45	*Total Marks:* 50 (*CA=10, ESE=40*)

Learning Objectives: *This course enabels the students to understand the importance and interconvertibility of various number systems, principles of digital gates, and working principle of communication systems. After completing this course students will be in a position to know the working of communication systems i.e., modulators, demodulators, transmitters and receivers, etc.*

Unit I Number Systems **(12 Periods)**

Number System:- Decimal numbers, Binary numbers, Binary arithmetic, Ones complement representation, Twos complement representation, Octal Numbers, Hexadecimal numbers, Inter-conversions of number systems, Binary coded decimal (BCD), Gray code, Excess-3 code.

Unit II Logic Gates **(12 Periods)**

AND gate, OR gate, NOT gate, NAND gate, NOR gate, EX-OR and EX-NOR gates, Universal properties of NAND and NOR gates.

Boolean operations, logic expressions for 2,3 & 4 inputs, laws of Boolean algebra, De -Morgen's theorems, SOP form of Boolean expressions, simplification of Boolean expressions using K- maps (up to 4 variables),Half adder, Full adder

Unit III Modulation and Demodulation **(12 Periods)**

Introduction, Types of Modulation, Expression for A. M. voltage, AM waves, Frequency spectrum of AM wave, Power Output in AM, Expression for frequency modulated voltage, Principle of demodulation, linear diode AM detector or demodulator.

Unit IV Communication Electronics: (book5, 6) (09Periods)

Introduction, Block diagram of basic communication system, Essential elements of A.M. Transmitter. A.M. receiver: Turned Radio Frequency (TRF) Receiver, Super heterodyne receiver, Characteristics of radio receivers: sensitivity, selectivity, fidelity & their measurements.

Books Recommended:

1.Modern Digital Electronics- R.P. Jain, Tata McGraw Hill Pub. Company (Third edition)
2.Digital Fundamentals-Thomas L. Floyd, Universal Book Stall
3.Digital Principles and Applications- A. P. Malvino, (McGraw Hill International Editions(Fourth Edition)
4.Digital Electronics with Practical Approach- G. N. Shinde, Shivani Pub., Nanded
5.Electronics and Radio Engineering – M. L. Gupta
6.Communication Engineering – J.S. Katre (Tech Max Pub – Second revi. edition)

P-XV B - DSEP II (Section B) - Discipline Specific Elective Paper

B. Linear and Digital Integrated Circuits

Credits: 02	*Periods*: 45	*Total Marks:* 50 (*CA=10, ESE=40*)

Learning Objectives: *This course enabels the students to understand the importance of Operational Amplifier for various applications, importance and interconvertibility of various number systems, principles of digital gates, and working principle of digital gates. After completing this course students will be in a position to know the working of various types of flip-flps and counters used in barious applications.*

Unit I Operational Amplifier & Its applications (12 Periods)

Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open and closed loop configuration, Frequency Response. CMRR. Slew Rate and concept of Virtual Ground.

Inverting and non-inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator

Unit II Digital Electronics Concepts (15 Periods)

Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, BCD code. Binary, octal and hexadecimal arithmetic; addition, subtraction by 2's complement method

Truth Tables of OR, AND, NOT, NOR, NAND, XOR, XNOR, Universal Gates, Basic postulates and fundamental theorems of Boolean Algebra

Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh map minimization up to 4 variables for SOP).

Binary Addition, Half and Full Adder, Half and Full Subtractor, 4-bit binary Adder / Subtractor.

Unit III Combinational and Sequential Circuits (9Periods)

Multiplexers, De-multiplexers, Decoders, Encoders.

SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master-slave JK Flip-Flop.

Unit IV Registers and Counters (9Periods)

Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

Reference Books:

1. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
2. Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, Oxford University Press.
3. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw Hill Publications
4. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
5. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
6. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
7. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
8. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

P-XV C - DSEP II (Section B) - Disciplne Specific Elective

C. Fiber Optical Communication

Credits: **02**	***Periods*****: 45**	***Total Marks:*** **50 (*CA=10, ESE=40*)**

Learning Objectives*: This course is aimed to offer a broad view on the fundamentals and salient features of the modern communication technique i.e., fiber optical communication, which revolutionized communication technology and has become integral part of the Engineering and related technologies. This course provides a deep understanding of the fiber optical communication and salient features of designing and developing different types of optical fibers to be used for specific purposes. Through this course the students will learn the concepts of propagation and behavior of light rays through the optical fibers of different refractive indices. The pre-requisite for this is that the students must know characteristics of different light sources including monochromatic sources like LASERS, and electromagnetic wave theory.*

Unit I **(12 Lectures)**

Introduction to Fiber optics, Snell's law, Total Internal Reflection, Transmission of light in optical fiber, Concept of Acceptance angle, Relation between acceptance angle and refractive indices of the media (i.e. Numerical Aperture of the fiber), Meridional rays and skew rays.

Unit II **(10 Lectures)**

Types of fibers and their transmission ray characteristics, Step index single mode and multimode optical fiber waveguides, Guided modes or mode volume of step index multimode fibers, Normalized frequency

Unit III **(13 Lectures)**

Graded index fibers, Refractive index profiles with α parameters, Ray transmission in graded index fibers, Comparison of Intermodal dispersion in Graded index and Step index fibers, Mode volume or Guided modes in Graded index fibers.

Unit IV **(10 Lectures)**

Single mode fibers, maximum core diameter for single mode operation, cutoff wavelength.

Reference Books:

1. Optical Fiber Communications: Principles and Practice, John M Senior
2. Optical Fibers & Fiber Optical Communication Systems, S. K. Sarkar
3. Introduction to fiber optics, R S Khairnar

SEC IV (A) Skill Enhancement Course
A. Physics Workshop Skills

***Credits:* 02**	***Periods*: 45**	***Total Marks:* 50 (*CA=25, ESE=25*)**

Learning Objectives: *Aim of this course is to create awareness among the students about the mechanical, electrical and electronic tools through hands-on activities. This course introduces the students to the workshop skills like cutting, drilling, filing, different types of AC and DC generators, soldering-desoldering of electrical and electronics components, constructing regulated power supplies, etc., therefore, after completing this course students will gain skills of using various workshop tools and also to find faults and general troubleshoots and wiring faults.*

Unit I Introduction **(4 Lectures)**

Measuring units. Conversion to SI and CGS. 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.

Unit II Mechanical Skill **(10 Lectures)**

Concept of workshop practice. Concept of machine processing. Introduction to common machine tools like shaper, drilling, 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.. Make funnel using metal sheet.

Unit III Electrical Skills **(08 Lectures)**

DC Power sources. AC/DC generators. Inductance, capacitance, and impedance. Response of inductors and capacitors with DC or AC sources. Operation of transformers..

Unit IV Electronic Skill **(08 Lectures)**

Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Timer IC: IC 555 Pin diagram and its application as Astable & Monostable Multivibrator Electronic switch using transistor and relay

Hands on Exercises:

1. Measure dimensions of solid blocks of different sizes using Vernier Calliper
2. Making funnel using metal sheet
3. Designing and constructing a transistorized regulated power supply
4. Constructing voltage regulating circuits using IC LM 317
5. Soldering and de-soldering of circuits using discrete components (R, L, C, Diodes, transistors, etc)
6. Designing and making of printed circuit boards (PCBs)
7. Soldering of ICS on PCB
8. Constructing and testing working of IC 555 Timer
9. Winding a coil or transformer of different number of turns and testing their performances
10. Wiring of simple circuits using Bread Board

Reference Books:

1. A text book in Electrical Technology - B L Theraja – S. Chand and Company.
2. Performance and design of AC machines – M.G. Say, ELBS Edn.
3. Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
4. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
5. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

SEC IV (A) Skill Enhancement Course

B. Semiconductor Devices Application Skill

***Credits:* 02**	***Periods*: 45**	***Total Marks:* 50 (*CA=25, ESE=25*)**

Learning Objectives: *This course is aimed to introduce the students to the working characteristics comparing the performances of various types of semiconductor devices. Therefore, after completing this course they will gain experience of soldering of electronics circuits, constructing DC regulated power upplies, etc.*

Unit I Semiconductor Diodes (10 Lectures)

Construction, working and characteristics of different types of P-N junction diodes, Construction, working and characteristics of Zener diode, Construction, working and characteristics of Photo diode and Varactor diode.

Unit II Field Effect Transistors (5 Lectures)

Construction, working and characteristics of JFET, Construction, working and characteristics of MOSFET

Unit III Rectifiers (5 Lectures)

Block diagram of power supply, half wave rectifier, Full wave rectifier, ripple factor and efficiency of half and Full wave rectifiers

Unit IV Thyristor and UJTs (10 Lectures)

Construction, working and characteristics of SCR and Construction, working and characteristics of UJT.

Hands on Exercises:

1. Study and compare the V-I Characteristics of various types of P-N junction diodes (e.g. general purpose, LEDs, Zener Diode, etc.)
2. Study and compare the working of Photo diode and Varactor diode
3. Study and compare the working properties of the *n*-channel and *p*-channel JFETs
4. Study and compare the working properties of the *n*-channel and *p*-channel MOSFETs
5. Construct and test the performance of a FET Amplifier
6. Study the working of half wave rectifier and determine ripple factor for different R, L, C filters
7. Study the working of full wave rectifier and determine ripple factor for different R, L, C filters
8. Study of SCR characteristics
9. Study of UJT characteristics
10. Construct UJT based free running oscillator and change its frequency.
11. Construct a test circuit of SCR using UJT triggering

Reference Books:

1. Electronic Principles: *A P Malvino*, Tata Mc. Graw Hill Pub. Co. Ltd.
2. Basic Electronics (Solid State): *B L Theraja*, S. Chand Publishing
3. Principles of Electronics: *V K Mehta and Rohit Mehta*, S. Chand Publishing
4. Thyristors and their Applications*: M. Ramamoorty,* Macmillan Press Limited 1977

P-XVI DSCPP I (Section A & B): Practicals Based on Theory Paper Nos. P-XII & XIV (*Assessment to be done at the end of VIth Semester i.e., Annual Pattern*)

Credits: 02	*Periods*: 45	*Total Marks:* 50 (*CA=10, ESE=40*)

1. Coefficient of viscosity by oscillating disc method
2. Determination of Rydberg's constant
3. Hartmann's dispersion formula
4. Temperature of flame
5. Cauchy's constant by using spectrometer
6. Conductivity by Forbe's method
7. Determination of Planck constant (h) by photo cell.
8. e / m by Thomson's method
9. Determination of resolving power of prism
10. Diffraction at Cylindrical Object: Determination of Wavelength
11. Thermal conductivity of an insulator by Lee's disc method.
12. Resolving power of grating
13. Y By Konings Method
14. To Study the Spectral Characteristics of a photovoltaic solar cell
15. To determine the wavelength of H-alpha emission line in Hydrogen spectrum

Note: Every student is required to perform **at least twelve (12) practicals** out of seventeen experiments in semesters V and VI. They have to complete the record book / journal listing atleast 12 experiments and have to submit/present before the panel of examiners at the time of their practical examination.

P-XVII DSEPP I (Section A & B) - Practicals Based on Theory Paper Nos. P-XIII & XV
(*Assessment to be done at the end of VIth Semester i.e., Annual Pattern*)

Credits: **02**	***Periods*****: 45**	***Total Marks:*** **50 (*CA=10, ESE=40*)**

Practicals Based on Discipline Specific Elective DSEP I (Section A)

i. Elective – A: Solid State Physics (P-XIII A)

1. To study the Hysteresis curve of the transformer core
2. Study of variation of thermo e.m.f. as a function of temperature
3. Study of CRO Measurement of frequency and voltage sensitivity
4. Determination of electrical conductivity of graphite rod
5. Determination of temperature coefficient of thermister
6. Study of energy bad gap of a semiconductor
7. Determination of Planck constant (h) by LED
8. Comparison of capacity by Method of mixture
9. I-H curve by Magnetometer method
10. To measure resistivity of semiconductor by four probe method
11. Determination of crystal structure using Laue pattern
12. Determination of crystal structure by rotating crystal method

ii. Elective – B: Solar Energy (P-XIII B)

1. V-I characteristics of a solar panel
2. Characteristics of silicon solar cell
3. Studying performance of solar flat plate collectors
4. Studying working of solar water heating system
5. Characteristics of solar cooker
6. Study of Power versus load characteristics of Solar Photovoltaic panel.
7. Conversion of solar energy into voltage using thermoelectric modules
8. Study of Series combination of Solar Photovoltaic panels
9. Study of Parallel combination of Solar Photovoltaic panels

iii. Elective –C: Astrophysics (P-XIII C)

1. To determine mass of the Jupiter by studying revolution of its moons using the CLEA software
2. To study radiation pattern of the Sun and hence estimate effective surface temperature and luminosity of the Sun.
3. Estimating first-order atmospheric extinction of starlight using given data
4. Measuring sky brightness using solid state photometer
5. Studying solar limb darkening effect
6. Temperature of an artificial star
7. Photoelectric photometry of stars using CLEA software
8. Measuring distance to Moon by parallax method.
9. Identifying and measuring diameters of Craters on the Moon surface.
10. Measurement of distance of star clusters by main sequence fit method
11. Observing Sun sun-spots and measuring their diameter

Note: Every student is required to perform **at least six (06) experiments** from the list given above corresponding to the elective paper (Elective I) offered to him for semester V. This will form half part of the practical paper P-XVII (**DSEP I), while the remaining half will be the laboratory work corresponding to the elective paper offered to him during semester VI. Performance of the students for both these electives as a practical paper P-XVII will be assessed at the end of semester VI by a panel of external examiners. They are required to submit the journal / record book indicating atleast 12 experiments, o6 from each elective at semester V and VI, at the time of practical examination.**

Practicals Based on Discipline Specific Elective DSEP I (Section B)

i. Elective – A: Digital and Communication Electronics (P-XV A)

1. Verification of truth table of basic gates (AND, OR, NOT) using ICs.
2. Construction of basic gates (AND, OR, NOT) using NAND gates
3. Construction of basic gates (AND, OR, NOT) using NOR gates
4. Construction and study of half adder using NAND gates.
5. Construction and study of full adder using NAND gates.
6. Implementation of Boolean expression from the given truth table using K- map.
7. Study of Colpits oscillator
8. Study of Hartley Oscillator
9. Study of low pass and high pass filter using resistance and capacitance
10. Clipper and Clamper circuits
11. Study of A.M. Modulator
12. Study of A.M. Demodulator

ii. Elective – B: Linear and Digital Integrated Circuits (P-XV B)

1. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
2. To design inverting amplifier using Op-amp (741,351) & study its frequency response
3. To design non-inverting amplifier using Op-amp (741,351) & study frequency response
4. To add two dc voltages using Op-amp in inverting and non-inverting mode
5. To investigate the use of an op-amp as an Integrator.
6. To investigate the use of an op-amp as a Differentiator.
7. To construct 4- bit binary adder
8. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
9. To build JK Master-slave flip-flop using gates
10. To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.
11. To make a Shift Register (serial-in and serial-out) using D-type/JK Flip-Flop ICs.
12. To construct 4- bit binary subtractor

iii. Elective – C: Fiber Optic Communication (P-XV C)

1. Demonstrate the use of fiber optic trainer kit
2. Identify the recourses and their uses on the given fiber optical trainer kit
3. Make optical fiber setup to transmit and receive analog and digital data
4. Demonstrate FM modulation and demodulation using OFC trainer kit using audio signal and voice link
5. Demonstrate PWM modulation and demodulation using OFC trainer kit using audio signal and voice link
6. Demonstrate PPM modulation and demodulation using OFC trainer kit using audio signal and voice link
7. Studying loss pattern of power due to transmission of signal through fibers of different lengths
8. Studying loss of power due to the bending of optical fibers

Note:

1. Every student is required to perform **at least six (06) experiments** from the list given above corresponding to the elective paper (Elective II) offered to him for semester VI. This will form half part of the practical paper P-XVII (**DSEPP I), while remaining half will form the laboratory work corresponding to the elective paper offered to him during semester V. Performance of the students for both these electives as a practical paper P-XVII will be assessed at the end of semester VI by a panel of external examiners. They are required to submit the journal / record book indicating atleast 12 experiments, o6 from each elective at semester V and VI, at the time of practical examination.**

2. **Assessment of the Skill Enhancement (SEC) papers: Continuous Assessment** of the SEC I and II includes Test / Tutorial of 15 marks on the theory aspect and Seminar of 10 marks (Test 15 + Seminar 10 =25), while remaining 25 marks will be on the basis of the performance of the student in the End Semester Examination (ESE) in the form of seminar / practical work to be conducted by a pair of external examiners at the end of Semester IV

(***Dr. M. K. Patil***)
Chairman, BOS in Physics

Question Paper Pattern
B. Sc. Third Year Semester V and VI

Time: 02 Hrs **Total Marks: 40**

Note: All questions are compulsory and carry equal marks

Question 1 – Attempt any FOUR (each of 2 marks) **8 marks**

i.
ii.
iii.
iv.
v.
vi.

(Note: This question will be based on the entire syllabus and must contain at least one sub-question from each unit)

Question 2 – Attempt any TWO of the following (each of 4 marks) **8 marks**

a.
b.
c.

(Note: This question will be based on Unit I and Unit II, with a minimum of 1 sub-question and a maximum of 2 sub-questions from each unit)

Question 3 – Attempt any ONE of the following (each of 8 marks) **8 marks**

a.
b.

(Note: This question will be based on Unit I and Unit II, one sub-question from each unit)

Question 4 – Attempt any TWO of the following (each of 4 marks) **8 marks**

a.
b.
c.
(Note: This question will be based on Unit III and Unit IV, with a minimum of 1 sub-question and a maximum of 2 sub-questions from each unit)

Question 5 – Attempt any ONE of the following (each of 8 marks) **8 marks**

a.
b.
(Note: This question will be based on Unit III and Unit IV, one sub-question from each unit)

Question Paper Pattern for Practical Course
Of B. Sc. Third Year Semester V and VI
(Annual Pattern)
Practical Paper Nos. P-XVI and P-XVII

Time: 03 Hrs **Total Marks: 40**

Note: ***i. Every student is required to complete one experiment in the final examination***
ii. The distribution of the 40 marks will be as given below

Q-1 (a) Experimental work will carry *25 marks*

(b) Calculations, Units, Results, Graphs, etc. will carry *10 Marks*

(c) Viva-voce will be for *05 marks*