SWAMI RAMANAND TEERTH MATHAWADA UNIVERSITY, NANDED

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड.

B. Sc. Second Year Physics Syllabus
(CBCS Pattern)
(Effective from 2020-2021)

Disclaimer

*Syllabus of **B. Sc. Second Year (Semesters III and IV) Physics** given in this document was prepared following requirements of the **Choice Based Credit System (CBCS)** pattern, as recommended by **UGC, New Delhi,** and has been duly approved by the **Faculty of Science and Technology, the Academic Council** and the **Management Council** of **S.R.T.M. University**. The same has been implemented from the academic year **2020-2021**.*

The Board of Studies in Physics of S. R. T. M. University, Nanded

Dr. M. K. Patil, ***Chairman,*** Professor, School of Physical Sciences, S.R.T.M. University, Nanded Contact: 08308298063 Email: patil@associates.iucaa.in	**Dr. S. N. Keshatti,** Department of Physics, Shivaji Mahavidyalaya, Parbhani Contact No. 9422743448 Email: keshatti.shrinivas@gmail.com
Dr. K. S. Kanse, Department of Physics, Lal Bahaddur Shahstri Mahavidyalaya, Dharmabad, Dist. Nanded Contact No. 09850924426 Email: kskanse@gmail.com	**Dr. P. R. Mirkute,** Department of Physics, Yeshwant Mahavidyalaya, Nanded Contact No. 09420846627 Email: pravinmirkute@gmail.com
Dr. P. G. Gawali, Department of Physics, Bahirji Smarak Mahavidyalaya, Basmath, Dist. Hingoli Contact No. 09421387622 Email: pggawali_123@rediffmail.com	**Dr. H. V. Bakshi,** *Head,* Department of Physics, Arts, Commerce & Science College, Shankarnagar, Tq.Biloli,Dist. Nanded Contact No. 09860058507 Email: hvbakshi@rediffmail.com
Dr. B. D. Achole, Department of Physics, Shri Havagiswami College, Udgir, Dist. Latur Contact No. 09422652892 Email: b_achole1234@rediffmail.com	**Dr. B. S. Munde,** *Head,* Department of Physics, Katruwar Arts, Ratanlal Kabra Science & B.R.Mantri Commerce College, Manwath, Dist. Parbhani Contact No. 008668413490 Email: bhaskarmunde@yahoo.com
Dr. S. D. Misal, *Head,* Department of Physics, Shri. Kumarswami Mahavidyalaya, Ausa, Dist. Latur Contact No. 09403244677 Email: misalsubhash31@rediffmail.com	**Dr. A. S. Chaudhari,** Professor, Department of Physics, Govt. Vidarbha Institute of Science, Amravati Contact No. 09421869109 Email: ajaychau5@yahoo.com
Mr. Dayanand Mane, Yog Kunj, 15, Sudashan Nagar, Pipri Meghe, Wardha Contact No.	**Dr. K. M. Jadhav,** *Professor,* Department of Physics, Dr.B.A.M.University, Aurangabad Contact No. 09422686061 Email: drjadhavkm@gmail.com
Dr. Tarun Sourdeep Ghosh, *Professor H,* IUCAA, Ganeshkhind, Pune Contact No. 020 25604212 Email: tarun@iucaa.in	**Dr. A. G. Bidwe,** Professor & Registrar, Sharanbasawa University, Kalburgi, Karnataka Contact No. 09243219188, Email: agbidve@gmail.com
Ms. Aishwarya V. Patil, *Invitee Member, Student Representative (UG)*	**Mr. Nand Kiran Kishor,** *Invitee Member, Student Representative (PG)*

Preamble:

Swami Ramanand Teerth Marathwada University (SRTMU), Nanded, following the directives of the **University Grants Commission, New Delhi (UGC)**, has been taking several measures for improving quality of higher education in its jurisdiction. Few of the major steps in this regard include the improvement and revision of the curricula of various programmes offered by it 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.

Following directives of the UGC, New Delhi, SRTMU has decided to adopt the ***cumulative grade point average*** **(CGPA)** for assessing academic performance of the students in the university examinations from the academic year 2014-2015. Further, subsequent to the suggestions by 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. From the academic year 2020-2021 SRTMU shall be implementing the first revision of the **B. Sc. Second Year (Semester III and IV) Physics** syllabus in the colleges affiliated to it and will be based on the CBCS method. This document provides detailed information on the structure and content of B.Sc. S. Y. (Semester III and IV) Physics syllabus together with the evaluation process and the available choice to the science graduates with Physics as one of the course at the B. Sc. Program.

The revised courses given in this document are of student-centric nature and help the stakeholders to understand the basic laws of nature and develop necessary skills to apply them to the advanced areas of studies. There are few core or mandatory courses meant to provide adequate knowledge of the basic courses of physics such as principles of waves and oscillations, statistical mechanics, electromagnetism, optics and electronics and enable the students to apply them to the advanced courses as well as in industrial and research related fields. The theory courses are also supplemented by the respective laboratory / hands-

on courses, which provide the students with the first hand, do it yourself training and enable them to understand the Physics principles at deeper level. This also enables the students to develop their keen interest in studying Physics. In addition to the core courses there will be elective courses as well as skill enhancement courses of advanced nature and help the students to develop their skills through hands-on activities as they progress in the program. Details of the courses offered as a part of the B. Sc. Physics program are given below.

Outline of the Choice Based Credit System:

1. Core or Compulsory Courses: Every student graduating in Science faculty with Physics as one of the optional subject is required to study these theory and practical papers as core or compulsory courses. There shall be two such theory papers in each Semester III and IV, 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 the candidates in the practical course shall be assessed on the annual basis i.e., at the end of the Semester IV by a pair of external examiners appointed by the University.

2. Elective 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. The elective courses are mostly offered from third semester onwards and are of specific or specialized or advanced nature designed such that the students after completing these courses shall be able to expand their knowledgebase. These elective courses will also be supplemented by practical courses.

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 rather 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 III and IV, which shall be selected by the students depending on their choice and inclination. Performance of the students in these courses shall be assessed at the end of the semester IV following annual pattern by a pair of external examiners along with their practical courses.

4. **Laboratory/Practical Courses**: Every students studying in B Sc Second Year (Semester III and IV) is required to complete two laboratory / practical courses (Paper Nos. P-X and P-XI) and shall be assessed / examined at the end of the Semester-IV (annual pattern).

B. Sc. Second Year Physics (Semester III and IV) syllabus given in this document was prepared by different subcommittees constituted in the meeting of the BOS in Physics held on 14th February 2020 and was finalized after due consent from all the respected members. The BOS has also invited comments, suggestions, corrections on the draft syllabus from all the Physics teachers affiliated to this university and also have taken feedback from the student representatives, which were then incorporated in the final draft of the B. Sc. Physics Second Year program and are given in this document. This syllabus was then put before and was approved by the Faculty of Science and Technology and the Academic Council of the University. This syllabus will be implemented from the academic year 2020-2021.

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

Structure and Marking Scheme of B. Sc. Physics Programme

B. Sc. Physics F. Y. (CBCS) Course Structure and Marking Scheme

Semester	Paper No.	Name of the Course	Contact		Assessment Scheme			Credits
			Lect/wk (L+T)	Total Hrs	MSA	ESA	Total Mark	
I	CCP I (Section A)	Mechanics and Properties of Matter (P-I)	03	45	10	40	50	2
	CCP I (Section B)	Mathematical Methods in Physics (P-II)	03	45	10	40	50	2
II	CCP II (Section A)	Heat and Thermodynamics (P-III)	03	45	10	40	50	2
	CCP II (Section B)	Electricity and Magnetism (P-IV)	03	45	10	40	50	2
Practical Paper	CCP P I (Annual Pattern)	P-V :Practicals based on Section A &B of CCP-I& II	04	60	20	80	100	4
	Total Credits of Semester I and II							12

B. Sc. Physics S. Y. (CBCS) Course Structure and Marking Scheme

Semester	Paper No.	Name of the Course	Contact		Assessment Scheme			Credits
			Lect/wk (L+T)	Total Hrs	MSA	ESA	Total Mark	
III	CCP III (Section A)	Waves and Oscillations (P-VI)	03	45	10	40	50	2
	CCP III (Section B)	Statistical Physics, Electromagnetics and Theory of Relativity (P-VII)	03	45	10	40	50	2
	CCPS I (Section A)	Skill Enhancement Course I (SEC I)	03	45	25	25	50	2
IV	CCP IV (Section A)	Optics and Lasers (P-VIII)	03	45	10	40	50	2
	CCP IV (Section B)	Basic Electronics (P-IX)	03	45	10	40	50	2
	CCPS I (Section B)	Skill Enhancement Course II (SEC II)	03	45	25	25	50	2
Practical Papers (Annual Pattern)	CCPP II (Annual Pattern)	P-X :Practicals based on Section A of CCP-III & IV	03	45	10	40	50	2
	CCPP III (Annual Pattern)	P-XI :Practicals based on Section B of CCP-III & IV	03	45	10	40	50	2
	Total Credits of Semester III and IV							16

MSA - Mid Semester Assessment
ESA – End Semester Assessment
CCP – Core Course Physics
CCPP – Core Course Physics Practical

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

Semester	Paper No.	Name of the Course	Contact		Assessment Scheme			Credits
			Lect/wk (L+T)	Total Hrs	MSA	ESA	Total Mark	
V	DSEP I (Section A)	Quantum Mechanics (P-XII)	03	45	10	40	50	2
	DSEP II (Section B) (Elective Course)	Solid State Physics (P-XIII A) OR Solar Energy (P-XIII B) OR Astrophysics (P-XIII C)	03	45	10	40	50	2
	DSEPP I (Section A)	Practicals Based on P-XII (P-XVI)	03	6 pract 24 hours	05	20	25	1
	DSEPP II (Section A)	Practicals Based on P-XIII (P-XVII)	03	6 pract 24 hours	05	20	25	1
	SEC III	Renewable energy & harvesting OR Electrical Ckt Analysis Skill	03	45 Hands-on	25	25	50	2
VI	DSEP II (Section A)	Atomic and Molecular Physics (P-XIV)	03	45	10	40	50	2
	DSEP II (Section B) (Elective Course)	Digital & Communication Electornics (P-XV A) OR Linear & Digital Electronics Circuits (P-XV B) OR Fibre Optics Communication (P-XV C)	03	45	10	40	50	2
	DSEPP I (Section B)	Practicals Based on P-XIV (P-XVI)	03	6 pract 24 hours	05	20	25	1
	DSEPP II (Section B)	Practicals Based on P-XV (P-XVII)	03	6 pract 24 hours	05	20	25	1
	SEC IV	Physics Workshop Skill OR Semiconductor Devices Applications Skill	--	45 Hands-on	25	25	50	2
	Total Credits of Semester V and VI							16

MSA - Mid Semester Assessment

ESA – End Semester Assessment

DSEP – Discipline Specific Elective Paper

DSEPP – Discipline Specific Elective Paper Practical

SEC – Skill Enhancement Course

CCP III - (Section A) P-VI Core Paper: *Waves and Oscillations*

***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 concepts of mechanical waves, their properties, propagation and reflection properties, formation of standing waves, their applications in resonance tubes, energy distribution in the standing waves, free and forced vibrations, acoustics and acoustical designs and also introduces the students to the concepts of ultrasonic waves and their applications. This course is the pre-requisite for several advanced courses in physics and chemistry and is necessary for understanding the behavior of the mater when mechanical waves passes through them. Pre-requisite for this course is the knowledge of elementary mathematics and calculus, wave theory, etc. This forms the core course of the programmes and every student pursuing B Sc with physics as one of the optional is required to study this course.*

Unit –I Waves **(10 Periods)**

Wave velocity and particle velocity, Differential equation of wave motion, Energy of a plane progressive wave, Equation of motion of a vibrating string, Frequency and period of vibration of a string

Unit—II Stationary waves **(11 Periods)**

Analytical treatment of stationary waves (closed end & open end pipe at the other end), Investigation of pressure and density changes at displacement, Nodes and Antinodes, Distribution of Energy in a stationary wave, Energy is not transferred in a stationary waves.

Unit - III Free and Forced Vibrations **(12Periods)**

Free Vibrations, Undamped vibrations, Damped Vibrations. Damped SHM in an electrical circuit. Forced Vibrations, Resonance and Sharpness of Resonance, Phase of Resonance ,Examples of forced and resonant vibrations

Unit –IV Acoustics and Ultrasonics **(12 Periods)**

Reverberation, Reverberation time, Derivation of Reverberation Time (Sabine's formula), Absorption coefficient, Determination of absorption coefficient, Acoustic measurements, Conditions for good acoustical designs of an auditorium, Ultrasonics, Piezoelectric Oscillator, Magnetostriction Oscillator, Detection of ultrasonic waves, Acoustic grating, Application of Ultrasonic Waves

Books Recommended:

1. Waves and Oscillations – Brijlal and Subrahmanyam. (Vikas Publishing House)
2. Text Book of Sound with Theory of Oscillations and waves – D. R. Khanna and R. S. Bedi. (Atma Ram & Sons Delhi)
3. A text book of Sound - N. Subrahmanyam, Brijlal
4. Sound - M. Ghosh
5. Text Book of Sound - Sharma & Saxena (New Age international publishers)
6. Physics of Vibrations & Waves - H.J.Pain (John Wiley & Son)

CCP III - (Section B) P-VII Core Paper: *Statistical Physics, Electromagnetics and Theory of Relativity*

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 concepts of macroscopic world, statistical approaches for understanding properties of the macroscopic bodies, ensembles, their classification on the basic of macroscopic and microscopic basis, their applications to photonic and electronic gases, electromagnetism, Maxwell's equations and their applications in the electromagnetic waves, energy carried by the EM waves and theory of relativity. This course is the pre-requisite for several advanced courses in physics, chemistry, life sciences and the modern communication systems. Pre-requisite for this course is the knowledge of elementary mathematics and calculus. This forms the core course of the programmes and every student pursuing B Sc with physics as one of the optional is required to study this course.*

Unit -I: Statistical Basis and Thermodynamics (12 Periods)
Statistical basis, probability, probability and frequency, principle of equal a priori probability, additive and multiplication rule of probability, conditional probability, permutation and combinations, ensemble and average properties, micro and macro states, thermodynamic probability, entropy and probability and relation connecting them. **(Reference Book Sr. No. 1)**

Unit S-II: Classical Statistics and Quantum Statistics (12 Periods)
Phase space, Maxwell-Boltzmann Distribution law, Quantum Statistics-Bose- Einstein Distribution law, Fermi- Dirac Distribution law, comparison of M. B., B.E. and F. D. statistics, application of Quantum statistics to Photon gas and Electron gas **(Reference Books Sr. No. 2, 4 and 8)**

UNIT –III: Electromagnetic Theory and Maxwell's Equations (11 Periods)
Ampere's Law and Steady State current, Generalization of Ampere's Law and displacement current, Maxwell's Equations, Derivation of Maxwell's Equations, The electromagnetic Energy and Poynting Vector, The wave Equation for free space. **(Reference Books Sr. No. 4,5,6,9)**

Unit IV: Relativity (10 Periods)
Introduction, frame of reference, Postulates of Special Theory of Relativity, Galilean Transformations, Lorentz Transformations, Length Contraction, Time dilation, Velocity addition, relativity of mass, Mass energy relation. **(Reference Books Sr. No. 7 and 8)**

Books Recommended:

1. Heat Thermodynamics and statistical Physics – Brij Lal, Dr. N. Subrahmanyam, P. S. Hemne (Sultan Chand & Company Ltd).
2. Thermodynamics and Statistical Physics- S.L.Kakani (Sultan Chand & Sons)
3. Thermodynamics, Kinetic Theory, and Statistical Thermodynamics – Sears
4. Foundation of Electromagnetic Theory – John R Reitz & Frederic J. Milford (Narosa Publishing House)
5. Classical Electrodynamics- Gupta, Singh, Kumar (Pragati Prakashan, Meerut)
6. Introduction to Electrodynamics- David J. Griffiths (Prentices Hall, India)
7. Perspectives of Modern physics – Arthur Beiser
8. Modern Physics- R Murugeshan, K Shivaprasath (S.Chand Publications)
9. Electromagnetic Theory and Electrodynamics- Satya Prakash

CCPS I - (Section A) SEC-I Skill Enhancement Course I

A. Computational Physics

Credit: 02 **45 Lectures (Theory + Lab)**	**Maximum Marks: 50** **C. A. (Internal): 25** **ESE OR Skill Exam:25**
Students are required to maintain project file or dissertation and need to submit the same while assessing analytic skills/ problem solving in skill exam	

Learning objectives: *This is a skill based course and is aimed to impart skills related to the use of computer and allied software and encourage them to employ that software as a part of the Physics Learning. This course introduces the students to perform their own algorithms and flow chart, write computer programs to solve mathematical expressions using computers, make decisions, etc. As this is a skill based course therefore it is expected that students need to spend nearly half of the time in laboratory, hands-on training. This course is the pre-requisite for several advanced courses in physics, chemistry, and in almost all other disciplines. Pre-requisite for this course is the knowledge of elementary mathematics and calculus.*

UNIT-I: Algorithms and Flowcharts **(10 Lectures)**

Algorithm- definition and development, Flowchart Concept, Symbols, Algorithm and Flowcharts for roots of quadratic equation, sum of two matrices, sum and product of finite series, calculation of Sin (x) as series.

UNIT-II: Scientific Programming **(10 Lectures)**

Fortran: character set, Constants, Variables, Arithmetic expressions, Library functions, Arithmetic statements, Structure of program, FORMAT specification, READ, WRITE, Terminating a program, programming style, Unformatted I/O statements.

UNIT-III: Control Statements **(10 lectures)**

Unconditional GOTO, Computed GOTO, Arithmetic IF, Logical if, IF-THEN-ELSE, Nested IF-THEN-ELSE, ELSE-IF-THEN, Rules for DO loops, CONTINUE, Nested Do loops, DATA Statement, Double precision, Logical data, CPMPLEX data, String manipulation, WHILE structure, Array declarative statements, Implied Do loops, One & multidimensional array, Function subprograms, Subroutine subprograms, COMMON, EQUIVALENCE, Data file organization, OPEN a file, READ from a file, WRITE in a file, Closing a file, File creation programs, File processing programs**.**

Hands on Exercises: Write programs for the following and get the results **(15 Lectures)**

1. Centigrade to Fahrenheit conversion.
2. Area of a triangle.
3. Velocity and acceleration.
4. Fibonacci Numbers
5. Quadratic equation.
6. Sum of series.
7. Sum of sine series.
8. Greatest common divisor.
9. Matrix addition.
10. Matrix multiplication.

Reference Books:

1. Introduction to Numerical Analysis, S S Sastry, 5th edition, 2012, PHI Learning Pvt. Ltd.
2. Computer programming in Fortran 77, V. Rajaraman, PHI Publisher
3. Computational Physics: An Introduction, R. C. Verma, New Age International Publisher, New Delhi.

CCPS I - (Section A) SEC-I Skill Enhancement Course I

B. Electrical Measurements

Credit: 02 **45 Lectures (Theory + Lab)**	**Maximum Marks: 50** **C. A. (Internal): 25** **ESE OR Skill Exam:25**
Students are required to maintain project file or dissertation and need to submit the same while assessing analytic skills/ problem solving in skill exam	

Learning objectives: *This is a skill based course and is aimed to acquire skills related to characteristics and usage of the instruments for measurement of the electrical quantities like voltage, current, impedance and various other quantities using analogue and digital meters. The students will learn the skills selecting meters of proper scales, connecting and handling them and also to use them. As this is a skill based course therefore it is expected that students will spend nearly half of the time in laboratory for gaining hands-on training. This course is the pre-requisite for several advanced courses in physics, chemistry, and in almost all other disciplines. Pre-requisite for this course is the knowledge of physical quantities and their measurement.*

UNIT-I Basic of Measurement **(3 Lectures)**

Instruments accuracy, Precision, Sensitivity, Resolution range, Errors in measurements, Loading effect**.**

UNIT-II Multimeter **(4 Lectures)**

Principle of measurement of dc voltage and dc current, ac voltage, ac current, Resistance, Specifications of a Multimeter and their significance.

UNIT-III Voltmeter **(5 Lectures)**

Principles of voltage measurement (block diagram only), Sensitivity, Specifications of an electronic voltmeter and its significance, Ac millivoltmeter, Types of ac millivoltmeter.

UNIT-IV Milliammeters **(5 Lectures)**

Principle of current measurement, Measurements of dc current, Ac current, Micro ammeters

UNIT-V Impedance Bridges **(6 Lectures)**

Block diagram of bridge, Working principles of basic (balancing type) RLC bridge, Specifications of RLC bridge.

UNIT-VI Digital Instruments **(7 Lectures)**

Principle and working of digital meters, Comparison of analogue and digital instruments, Characteristics of digital meter, Working principle of digital voltmeter, Block diagram and working of digital Multimeter**.**

Hands on Exercises **(15 Lectures)**

1. Measurement of ac and dc voltages by using analogue multimeter.
2. Measurement of resistance using colour code and analogue multimeter.
3. Measurement of ac and dc currents by using multimeter.
4. Measurement of ac and dc voltages by using AC/DC Voltmeters.
5. Measurement of ac and dc currents by using AC/DC Milliammeters.
6. Determination of value of L and C using bridge circuit.
7. Measurement of ac and dc voltages by using digital multimeter.
8. Measurement of resistance using digital multimeter.
9. To study testing of diode and transistor with multimeter.

Reference Books:

1. A Text book in Electrical technology, B L Theraja, S Chand & Co
2. Digital Circuits & Systems, Venugopal, 2011, Tata McGraw Hill
3. Electronic Circuits: Handbook of design and applications, U. Tietze, Ch. Schenk, 2008, Springer
4. Electronic Devices & Circuits, S. Salivahanan & N S Kumar, 3rd edition, 2012, Tata McGraw Hill

Notes:

1. *Students may select either of the **Two Skill Enhancement Courses (SEC) A or B***
2. **Assessment of the Skill Enhancement (SEC) papers:** *The SEC courses (SEC I and II) will be assessed in both Continuous as well as End Semester mode. The Continuous Assessment (CA) includes Test/Tutorial on theory part of the course for 15 marks, one seminar of 10 marks (a total of 25 marks); while the End Semester Assessment (ESE) of 25 marks will be conducted at the end of the year (on annual basis) along with their practical examinations by a pair of external examiners. The ESE shall be either in the form of a presentation, demonstration or practical work.*
3. **Students have a choice of selecting SEC courses from either of their optional subjects (i.e. Physics, Mathematics, Chemistry, Electronics or Computer Science) as per the allotment.**

CCP IV - (Section A) P-VIII Core Paper: *Optics and Lasers*

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

Learning objectives: *This course is aimed to introduce the students to important core subject* ***optics and its applications****. This course begins with the introduction to the concepts of geometrical optics, properties of optical instruments, interference and diffraction of light, polarization of light and finally introduces to the advanced source like LASERS and conditions for the lasing action. This course is the advanced course having applications in nearly all the branches of science. Pre-requisite for this course is the knowledge of light waves and their properties in different media and requires the knowledge of EM waves. This forms the core course of the programmes and every student pursuing B Sc with physics as one of the optional is required to study this course.*

Unit–I Geometrical Optics (09 Periods)

Cardinal Points of an Optical System (six points), Coaxial Lens System (equivalent focal length and cardinal points), Huygens Eyepiece, Ramsden Eyepiece and their cardinal points. ***(Ref. Book No. 1)***

Unit–II Interference and Diffraction (14 Periods)

Interference: Newton's Rings, Determination of wavelength of Sodium light, Michelson Interferometer, Determination of wavelength of monochromatic light.

Diffraction: Fresnel and Fraunhofer diffraction, Fraunhofer's diffraction due to single and double slit, Plane diffraction grating, Determination of wavelength of Sodium light, Rayleigh criterion, Resolving power of grating. ***(Ref. Book No. 1)***

Unit–III Polarization (12 Periods)

Polarization by Reflection, Brewster's law, Malus law, Double refraction, Nicol prism, Nicol prism as an analyzer, Huygen's explanation of double Refraction in Uniaxial crystals , Quarter wave plate, Half wave plate, Optical Activity , Specific rotation, Laurent's half shade polarimeter. ***(Ref. Book No. 1 & 2)***

Units–IV Lasers (10 Periods)

Spontaneous & stimulated emission, absorption, Einstein coefficients (definitions), Population inversion, Optical & electrical pumping, Properties of lasers, He-Ne laser. ***(Ref. Book No. 3)***

Books Recommended:

1. A Text Book of Optics - Brijlal and Subrahmanyam. (S. Chand & Co.)
2. B.Sc.Physics Volume –I-- C.L.Arora (S.Chand)
3. Lasers and Nonlinear Optics – B.B.Laud (Willey .Eastern limited)
4. Optics and Atomic Physics – D.P. Khandelwal. (Himalaya Publishing House)
5. Optics (Second edition) – A.K.Ghatak
6. Geometrical & Physical optics by D. S. Mathur.

CCP IV - (Section B) P-IX Core Paper: *Basic Electronics*

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

Learning Objectives:

1. *To understand basic concepts of semiconductors, semiconductor diodes and their characteristics.*
2. *To know construction, working of transistors and their applications*
3. *To understand basics and applications of operational amplifiers.*
4. *To use transistors in different combinations as oscillators for generating sinusoidal waves of different frequencies.*

Learning Outcome: *After completing this course students will be able to*

1. *Identify and understand construction and properties of different types of P-N junction diodes*
2. *Apply knowledge of semiconductor devices to use them in different combinations to see their applications as amplifiers and oscillators*
3. *Design different circuits using semiconductor devices and demonstrate their usage.*

Unit – I Semiconductor Diodes **(10 Periods)**

Semiconductor, Types of semiconductor, P-N Junction diode, Zener diode, Light Emitting Diode, Photodiode, Varactor diode and their V/I characteristics

Unit–II Bipolar Junction Transistors (BJT): **(13 Periods)**

Transistor Connections: Common base, common emitter, common collector, Characteristics of common base, common emitter, common collector connections, Hybrid parameters (or h parameters) Determination of h-parameters, Analysis of common emitter amplifier and common collector amplifier using h-parameters (current gain, voltage gain, power gain, input resistance and output resistance)

Unit–III Operational Amplifier **(12 Periods)**

Basic circuit of differential amplifier, common Mode and differential mode signals, block diagram of Op-Amp, schematic symbol, ideal Characteristics, input offset voltage; input offset current, input bias current, input impedance, Output impedance, open loop gain, CMRR, Slew rate, Inverting amplifier and non-inverting amplifier

Unit IV: Sinusoidal Oscillators: **(10 Periods)**

Oscillator, Types of sinusoidal Oscillators, Oscillatory circuit, Positive feedback Amplifier- Oscillator, Barkhausen Criterion, Hartley oscillator, Colpitt's oscillator, R-C Network, Phase shift oscillator

Books Recommended:

1. Principles of Electronics – V. K. Mehta Rohit Mehta (S.Chand & Co.)
2. Principles of Electronics – V. K. Mehta Rohit Mehta (multicolour Illustrative Edition
1. 2000 and2013) (S.Chand & Co.)
2. Electronic Principles- A. P. Malvino
3. Basic Electronics (Solid State) – B.L.Thereja (S.Chand & Co.)
4. Basic Electronics & Linear Circuits—N.N.Bhargava,D.C.Kulshreshtha(TMH)
5. Op-Amps and Linear Integrated Circuits-Ramakant Gayakwad, (PHI Delhi)
6. Electronic fundamentals and Applications – J. D. Ryder.(TMH publications).
7. Digital & Analogue Techniques—Navneet , Gokhale & Kale (Kitab Mahal)
8. Introduction to Electronics-K.J.M.Rao, (Oxford and IBH Publishing Co.).
9. Solid State Pulse Circuits-David A Bell, Fourth edition, (PHI)
10. Electronics and Radio Engineering-M.L.Gupta, (Dhanpat Rai and sons).

CCPS I - (Section B) SEC-II Skill Enhancement Course II

A. Electronic Devices and Equipments

Credit: 02 **45 Lectures (Theory + Lab)**	**Maximum Marks: 50** **C. A. (Internal): 25** **ESE OR Skill Exam:25**
Students are required to maintain project file or dissertation and need to submit the same while assessing analytic skills/ problem solving in skill exam	

Learning objectives: *This is a skill based course and is aimed to educate students about the working and usage of electrical appliances and other electrical devices. This course enables the students to know the behavior of active and passive devices under ac and dc conditions and also to use them for designing various circuits such as signal generators and amplifiers. As this is a skill based course, therefore, after completing this course the students will be able to acquire skills and apply them in daily hood purpose. As this course is of do-it-yourself nature, therefore, the students are required to spend more than half of the time in laboratory. This course is the pre-requisite for several advanced courses in physics, chemistry, and in almost all other disciplines. Pre-requisite for this course is the knowledge of semiconductor physics, knowledge of the semiconductor devices and their characteristics.*

UNIT-I Basic Electricity Principles (6 Lectures)

Resistance, Inductance, Capacitor, Colour code, Voltage, Current, Power, Ohm's law, Kirchhoff's law, Junction diode, Transistor

UNIT-II Understanding Electronic circuits (6 Lectures)

AC and DC sources, Rules to analyze DC sourced electronic circuits, Current and voltage drops across the DC circuit elements, Rectifiers (half wave, full wave & bridge)**,**Voltage regulator using Zener diode

UNIT-III Transistor applications (6 Lectures)

CE amplifier, its analysis and performance, CB amplifier, its analysis and performance, Hartley oscillator, Colpitts oscillator and their performance, Wien bridge oscillator and its performance

UNIT-IV Signal Generators (6 Lectures)

Block diagram, explanation and specification of low frequency signal generators, Pulse generator, Function generator

UNIT-V Cathode Ray Oscilloscope (6 Lectures)

Block diagram of basic CRO, construction of CRT, electron gun, electrostatic focusing and acceleration (only explanation), Use of CRO for measurement of ac and dc voltages, time period, frequency, special features of dual trace CRO, study of Lissajous figures

Hands on Exercises: (15 Lectures)

1. Measurement of voltage, time period and frequency using CRO.
2. Measurements of rise and fall time using CRO.
3. To study dual trace CRO.
4. Study of full wave rectifier.

5. Study of Lissajous figures.
6. Study of Zener diode voltage regulator.
7. To study of performance of single stage CE amplifier.
8. Determination of resistance and capacitor values using colour code.
9. To study wave forms generated by a function generator.
10. Study of Wien Bridge oscillator

Reference Books:

1. A Text Book in Electrical Technology, B. L. Theraja, S Chand & Co.
2. Electronic Circuits: Handbook of design and applications, U. Tietze, Ch. Schenk, 2008, Springer.
3. Electronic devices, 7/e Thomas L. Floyd, 2008, Pearson India.
4. Electronic Devices & Circuits, S. Salivahanan& N S Kumar, 3rd edition, 2012, Tata McGraw Hill

CCPS I - (Section B) SEC-II Skill Enhancement Course II

B. Applied Optics

Credit: 02 **45 Lectures (Theory + Lab)**	**Maximum Marks: 50** **C. A. (Internal): 25** **ESE OR Skill Exam:25**
Students are required to maintain project file or dissertation and need to submit the same while assessing analytic skills/ problem solving in skill exam	

Learning objectives: *This is a skill based course and is aimed to impart advanced skills related to the optical and photonic devices. This course also enables the students to verify various facts that they have learned in the theory course on optics. They will also be introduced and allowed to work on various optical devices including LASERS. After completing this course students will be able to understand the working properties of various optical and photonic devices. As this is a skill based course, therefore, students are required to spend more than half of the time in laboratory for doing hands-on activities. This course is of applied nature and helps the students to use this knowledge in optical and allied laboratories. Pre-requisite for this course is the knowledge of optics.*

UNIT-I Refraction Through Lenses **(10 Lectures)**

Types of lenses, The sign convention, Principal foci, Deviation produced by a thin lens, Power of a lens, Principal planes and Focal planes, Dispersion by prism, Dispersive power, Huygens eyepiece, Ramsden eyepiece

UNIT-II Photonic Devices **(10 Lectures)**

Construction of LED**,** Working principle of LED, Types of LED, Construction of LDR, Working principle of LDR, Construction of photovoltaic cell & its working principle.

Polarization of Light: Polarization of transverse wave, Plane of polarization, Brewster law, Malus law, Specific rotation, Laurent's half shade Polarimeter.

UNIT-III Lasers **(10 Lectures)**

Lasers, spontaneous and stimulated emission, Theory of laser action, Einstein's coefficients, Light amplification, laser beam characteristics, He-Ne laser, Semiconductor diode laser

Hands on Exercises: (15 Lectures)

1. Determination of focal length of a biconvex lens.
2. Determination of radius of curvature of a lens using a spherometer.
3. Determination of power of a lens.
4. Determination of the grating radial spacing of a compact disc (CD) by reflection using a laser source.
5. To find the width of the slit using diffraction pattern obtained by a laser
6. To find angle of polarization using Brewster law.
7. To study V-I characteristics of LED.
8. Study the characteristics of solid state laser.

9. Study the characteristics of LDR.
10. Study characteristics of a photovoltaic cell.

Reference Books:

1.Fundamentals of optics, F. A. Jenkins & H. E. White, 1981**,** Tata McGraw Hill.
2.LASERS: Fundamentals & applications, K. Thyagrajan& A. K. Ghatak, 2010, Tata McGraw Hill.
3.A Text Book of Optics**,** Brij Lal & Subramanyam, 1989, S Chand & Co
4.Laser & Non- linear optics, B. B. Laud, New Age International Publisher

Notes:

1. *Students may select either of the **Two Skill Enhancement Courses (SEC) A or B***
2. **Assessment of the Skill Enhancement (SEC) papers:** *The SEC courses (SEC I and II) will be assessed in both Continuous as well as End Semester mode. The Continuous Assessment (CA) includes Test/Tutorial on theory part of the course for 15 marks, one seminar of 10 marks (a total of 25 marks); while the End Semester Assessment (ESE) of 25 marks will be conducted at the end of the year (on annual basis) along with their practical examinations by a pair of external examiners. The ESE shall be either in the form of a presentation, demonstration or practical work.*
3. **Students have a choice of selecting SEC courses from either of their optional subjects (i.e. Physics, Mathematics, Chemistry, Electronics or Computer Science) as per the allotment.**

CCPP-II P-X: Practicals Based on Section A of CCP III & IV (Papers P-VI & VIII)
(*Assessment to be done at the end of the IVth Semester i.e., Annual Pattern*)

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

Practicals Based on Theory Papers VI and VII (Section A of CCP III & IV)

Learning Objectives: *Objective of this Laboratory course is to introduce the students to the practical applications of the core courses **Section A of CCP III & IV** in Physics that the students have studied in Semester III and IV. This laboratory course also includes experiments based on the computational methods applicable for solving problems in physical situations. After completing this course students will get insight of the theory course they have undergone and will understand the importance and applications of the courses. Each student appearing for examination must produce a journal showing that he has completed **at least 12** experiments of this paper during the year.*

Practicals based on paper -VI

1. Moment of Inertia of a flywheel
2. Kater's pendulum
3. Y by Cantilever (Oscillation method)
4. η by torsional pendulum
5. Y and η by Searle's method
6. Surface tension by Fergusson method
7. Frequency of A.C. by Sonometer
8. Helmholtz's resonator
9. Study of Lissajous figures using CRO

Practicals based on paper-VIII

1. Calibration of Spectrometer(between μ and $1/\lambda^2$) for different colors
2. Determination of 'μ'by i-δ curve using spectrometer
3. Determination of **λ** of Sodium light by Newton's ring
4. **13** To determine Radius of curvature of (R)of planoconvex lens by Newton's Ring
5. Diffraction grating normal incidence
6. Resolving power of Telescope
7. Specific rotation by Laurent's half shade Polarimeter
8. To Estimation the concentration of sugar in the solution.
9. Wave Length of Laser source by Diffraction Grating
10. To study the Spectral Characteristics of a Photovoltaic Cell
11. To study the Characteristics of solar cell.

Note: Every student is required to perform **at least twelve (12) experiments (six from each paper)** out of the list given above during semesters III and IV. They have to complete the record book / journal listing at least 12 experiments and have to submit/present before the panel of examiners at the time of their practical examination, which will be conducted at the end of the IVth semester (annually), by a panel of examiners.

CCPP-III P-XI: Practicals Based on Section B of CCP III & IV (Papers P-VII & IX)
(*Assessment to be done at the end of the IVth Semester i.e., Annual Pattern*)

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

Practicals Based on Theory Papers VII and IX (Section B of CCP III & IV)

Learning Objectives: *Objective of this Laboratory course is to introduce the students to the practical applications of the core courses* ***Section B of CCP III & IV*** *in Physics that the students have studied in Semester III and IV. This laboratory course also includes experiments based on the computational methods applicable for solving problems in physical situations. After completing this course students will get insight of the theory course they have undergone and will understand the importance and applications of the courses. Each student appearing for examination must produce a journal showing that he has completed* ***at least 12*** *experiments of this paper during the year.*

Practicals based on paper-VII

1. Potentiometer- measurement of Low resistance
2. C_1/C_2 by Proportional kick method
3. C_1/C_2 by Method of Mixture
4. Maximum velocity of electron using photocell
5. To determine the capacitance of a capacitor by discharging it through a sensitive galvanometer.
6. Determination of self inductance by Owen's bridge.
7. To determine resistance of a thermister.
8. Calibration of ammeter using potentiometer.
9. Stefan's Constants

Practicals based on paper-IX

1. To Study the Zener Diode as voltage regulator
2. LED characteristics
3. Photo diode characteristics
4. Transistor characteristics (C-B mode)
5. Transistor characteristics (C-E mode)
6. Characteristics of photo transistor
7. Power supply using Pi -filter (Full Wave rectifier)
8. Transistorized regulated power supply.
9. Study of transistorized CE amplifier (Frequency response, gain & 3db band width.)
10. Op-Amp as an inverting amplifier
11. Hartley Oscillator
12. Colpitt's Oscillator
13. Phase shift oscillator. Measurement of frequency and amplitude of waveforms.

Note: Every student is required to perform **at least twelve (12) experiments (six from each paper)** out of the list given above during semesters III and IV. They have to complete the record book / journal listing at least 12 experiments and have to submit/present before the panel of examiners at the time of their practical examination, which will be conducted at the end of the IVth semester (annually), by a panel of examiners.

Question Paper Pattern for Practical Course
B. Sc. Second Year (Semester III and IV) Physics
(Annual Pattern)
Practical Paper Nos. P-X and P-XI

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***

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