K. C. E. Society's
Moolji Jaitha College
An 'Autonomous College' Affiliated to
K.B.C. North Maharashtra University, Jalgaon.
NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle)
UGC honoured "College of Excellence" (2014-2019)
DST(FIST) Assisted College

KNOWLEDGE IS POWER
ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय
क.ब.चौ. उत्तर महाराष्ट्र विद्यापीठ, जळगाव संलग्नित
'स्वायत्त महाविद्यालय'
नॅकद्वारा पुनर्मानांकित श्रेणी – 'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स' (२०१४-२०१९)
डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 25/04/2025

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Physics (Sem. III & VI)

Ref. :- Decision of the Academic Council at its meeting held on 22/04/2025.

The Syllabi of B. Sc. in Physics (Third and Fourth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2024 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2025-26.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

Near Samarth Colony, Jalgaon - 425 002. (Maharashtra, India) | Ph. : +91 257 - 2237363, 2234281 | e-mail : mjcollege@kces.in | Website : mjcollege.kces.in
समर्थ कॉलनी जवळ, जळगांव – ४२५ ००२. (महाराष्ट्र, भारत) । दूरध्वनी क्र. : +९१ २५७–२२३७३६३, २२३४२८१ । ई–मेलः mjcollege@kces.in । वेबसाईटः mjcollege.kces.in

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon-425001

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STRUCTURE AND SYLLABUS

B.Sc. Honours/Honours with Research (S.Y. B.Sc. Physics)

Under Choice Based Credit System (CBCS)

and

as per NEP-2020 Guidelines

[w.e.f. Academic Year: 2025-26]

Preface

In order to achieve skill and knowledge, higher education system establish NEP in 2020. The Moolji Jaitha College (Autonomous) adopt department-specific model as per NEP-2020, guideline of UGC, and Government of Maharashtra.

The National Education Policy (NEP) framework's S.Y. B.Sc. Physics curriculum aims to give students a substantial foundation in both basic and applied physics. To ensure a well-rounded educational experience, this curriculum integrates core principles with advanced fields of study and technology.

As a fundamental field of study, physics is essential to comprehending both technology developments and natural events. The updated curriculum offers flexibility and interdisciplinary learning possibilities while adhering to the Choice-Based Credit System (CBCS). Students can improve both theoretical knowledge and practical abilities through the combination of core courses, discipline-specific electives, skill enhancement courses, On-Job training (OJT), internship and research-based projects.

The course is designed to equip students with experimental techniques, computational methods, and practical applications, preparing them for higher education, research, and industry careers. Core subjects include Solid state physics, Quantum Mechanics, Nuclear Physics, Electronics, and Computational Physics, Renewable and sustainable energy sources complemented by elective courses that reflect modern scientific advancements.Each course in the syllabus has been thoughtfully designed to maintain a balance between theoretical knowledge and practical application. Our experienced faculty, experts in their respective domains, will lead you through interactive lectures, laboratory experiments, and research projects that enhance critical thinking, problem-solving skills, and a deeper grasp of the subject.

We believe this syllabus will train students with essential critical thinking, problem-solving skills, and practical experience, enabling them to thrive in their careers. We sincerely appreciate the contributions of academic experts, educators, and stakeholders who played a vital role in shaping this curriculum to align with the ever-evolving landscape of science and technology.

Our hope is that this syllabus ignites curiosity, fosters creativity, and cultivates a deep passion for physics, guiding students toward becoming future scientists, researchers, and innovators.

Hence, **Board of Studies in Physics** in its online meeting held on **22nd March 2025, Saturday** resolved to accept therevised syllabus for S. Y. B. Sc. (Physics) based on Choice Based Credit System (CBCS)ofUGC, NEP-2020 and the Government of Maharashtra guidelines.

Program Outcomes (PO) for B.Sc. Program:

Program outcomes associated with a B.Sc. degree are as follows:

PO No.	PO
1	Graduates should have a comprehensive knowledge and understanding of the fundamental principles, theories, and concepts in their chosen field of study.
2	Graduates should possess the necessary technical skills and competencies related to their discipline, including laboratory techniques and data analysis.
3	Graduates should be able to identify, analyze, and solve complex problems using logical and critical thinking skills. They should be able to apply scientific methods and principles to investigate and find solutions.
4	Graduates should be proficient in effectively communicating scientific information, both orally and in writing.
5	Graduates should have a basic foundation in research methods and be capable of designing and conducting scientific investigations.
6	Graduates should be able to work effectively as part of a team, demonstrating the ability to collaborate with others, respect diverse perspectives, and contribute to group projects.
7	Graduates should recognize the importance of ongoing learning and professional development. They should be equipped with the skills and motivation to engage in continuous learning, adapt to new technologies and advancements in their field, and stay updated with current research.

Programme Specific Outcome (PSO) for B.Sc. Physics Honours/Honours with Research:

After completion of this program, students are expected to learn/understand the:

PSO No.	PSO
1	Strong conceptual foundation in core areas of physics, including solid state physics, Quantum Mechanics.Utilize mathematical approaches to examine physical phenomena and tackle intricate scientific challenges.
2	Exposure to emerging fields such as nanotechnology, renewable energy, electronics, and computational modeling.
3	Scientific challenges with logical reasoning, problem-solving abilities, quantitative analysis& develop innovative solutions by integrating knowledge by collaborating other disciplines.
4	Research-driven skills in Physics bydesigning experiments, and conducting scientific investigations to foster innovation and technological advancements through interdisciplinary collaborations.
5	Practical expertise in advanced experimental methods, gathering data, analyzing outcomes, and interpreting findings using statistical and computational techniques.
6	To address societal and environmental challenges, promoting sustainable development& cultivate a mindset for continuous learning to advancements in Quantum Mechanics, material science, modern physics and space research.

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours **Or** Bachelor's Degree- Honours with Research	160	176	8	4

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

F.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1)	Subject-II (M-2)	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT, RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
I (4.5)	I	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	DSC-1(2T) DSC-2(2P)	OE-1(2T)	---	AEC-1(2T) (Eng) VEC-1(2T) (ES) IKS(2T)	CC-1(2T)	22	**UG Certificate**
	II	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	DSC-3(2T) DSC-4(2P)	OE-2(2T) OE-3(2P)	---	AEC-2(2T) (Eng) VEC-2(2T) (CI)	CC-2(2T)	22	
	Cum. Cr.	**8**	**8**	**8**	**6**	**---**	**10**	**4**	**44**	
Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										

S.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major*		Subject-II (M-2) Minor #	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
2 (5.0)	III	DSC-5(2T) DSC-6(2T) DSC-7(2P)	---	MIN-1(2T) MIN-2(2T) MIN-3(2P)	---	OE-4(2T)	SEC-1(2T)	AEC-3(2T) (MIL)	CC-3(2T) CEP(2)	22	UG Diploma
	IV	DSC-8(2T) DSC-9(2T) DSC-10(2P)	---	MIN-4(2T) MIN-5(2P)	---	OE-5(2T)	SEC-2(2T) SEC-3(2P)	AEC-4(2T) (MIL)	CC-4(2T) ⚙FP(2)	22	
	Cum. Cr.	**12**	**---**	**10**	**---**	**4**	**6**	**4**	**8**	**44**	
	Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major & Minor.										

***** Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year

#Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)

⚙ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

T.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major		Subject-II (M-2) Minor	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
3 (5.5)	V	DSC-11(2T) DSC-12(2T) DSC-13(2T) DSC-14(2P) DSC-15(2P)	DSE-1A/B (2T) DSE-2A/B (2P)	---	---	---	VSC-1(2T) VSC-2(2P)	---	OJT/Int (4)	22	UG Degree
	VI	DSC-16(2T) DSC-17(2T) DSC-18(2T) DSC-19(2T) DSC-20(2T) IKS DSC-21(2P) DSC-22(2P)	DSE-3A/B (2T) DSE-4A/B (2P)	---	---	---	VSC-3(2T) VSC-4(2P)	---	---	22	
	Cum. Cr.	**24**	**8**	**---**	**---**	**---**	**8**	**---**	**4**	**44**	
	Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

Fourth Year B.Sc. (Honours)

Year (Level)	Sem	Major Core Subjects		ResearchMethodology(RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-25(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	---	22	UG Honours Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	OJT/Int (4)	22	
	Cum. Cr.	**28**	**8**	**4**	**---**	**---**	**---**	**4**	**44**	
Four Year UG Honors Degree in Major and Minor with 176 credits										

Fourth Year B.Sc. (Honours with Research)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-23(4T) DSC-24(4T) DSC-26(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	RP(4)	22	UG Honours with Research Degree
	VIII	DSC-27(4T) DSC-28(4T) DSC-30(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	RP(8)	22	
	Cum. Cr.	**20**	**8**	**4**	**---**	**---**	**---**	**12**	**44**	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Sem- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **OE/GE**- Open/Generic elective, **VSC**- Vocational Skill Course, **SEC**- Skill Enhancement Course, **VSEC**- Vocation and Skill Enhancement Course, **AEC**- Ability Enhancement Course, **IKS**- Indian Knowledge System, **VEC**- Value Education Course, **T**- Theory, **P**- Practical,**CC**-Co-curricular **RM**- Research Methodology, **OJT**- On Job Training, **FP**- Field Project, **Int**- Internship, **RP**- Research Project, **CEP**- Community Extension Programme, **ENG**- English, **CI**- Constitution of India, **MIL**- Modern Indian Laguage

- Number in bracket indicate credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

Details of S.Y. B.Sc. (Physics)

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks			
					T	P	Total	Internal		External	
								T	P	T	P
Semester III, Level – 5.0											
DSC-5	DSC	PHY-DSC-231	Heat and Thermodynamics	2	2	---	2	20	---	30	---
DSC-6	DSC	PHY-DSC-232	Basic Electronics	2	2	---	2	20	---	30	---
DSC-7	DSC	PHY-DSC-233	Practical on Thermodynamics and Electronics	2	---	4	4	---	20	---	30
SEC-1	SEC	PHY-SEC-231	Basic Instrumentation Skills	2	2	---	2	20	---	30	---
CEP	CEP	PHY-CEP-231	Community Engagement Program	2	---	4	4	50	---	---	---
MIN-1	MIN	PHY-MIN-231	Modern Physics	2	2	---	2	20	---	30	---
MIN-2	MIN	PHY-MIN-232	Mathematical Tools in Physics	2	2	---	2	20	---	30	---
MIN-3	MIN	PHY-MIN-233	Practical on Modern and Mathematical tools in Physics	2	---	4	4	---	20	---	30
OE-4	OE	PHY-OE-231	Battery Technologies	2	2	---	2	20	---	30	---
Semester IV, Level – 5.0											
DSC-8	DSC	PHY-DSC-241	Waves and Oscillations	2	2	---	2	20	---	30	---
DSC-9	DSC	PHY-DSC-242	Optics	2	2	---	2	20	---	30	---
DSC-10	DSC	PHY-DSC-243	Practical on Waves, Oscillations and Optics	2	---	4	4	---	20	---	30
SEC-2	SEC	PHY-SEC-241	Electrical Circuits and Network Skills	2	2	---	2	20	---	30	---
SEC-3	SEC	PHY-SEC-242	Practical on Electrical Circuits and Network Skills	2	---	4	4	---	20	---	30
FP	FP	PHY-FP-241	Field Project	2	---	4	4	50	---	---	---
MIN-4	MIN	PHY-MIN-241	Semiconductor Devices	2	2	---	2	20	---	30	---
MIN-5	MIN	PHY-MIN-242	Practical on Semiconductor Devices	2	---	4	4	---	20	---	30
OE-5	OE	PHY-OE-241	Solar Cell Technologies	2	2	---	2	20	---	30	---

Examination Pattern

Theory Question Paper Pattern:

- 30 (External) +20 (Internal) for 2 credits
    - External examination will be of 1½ hours duration
    - There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
    - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
    - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

i. Individual Assignments
ii. Seminars/Classroom Presentations/Quizzes
iii. Group Discussions/Class Discussion/Group Assignments

iv. Case studies/Case lets
v. Participatory & Industry-Integrated Learning/Field visits
vi. Practical activities/Problem Solving Exercises
vii. Participation in Seminars/Academic Events/Symposia, etc.
viii. Mini Projects/Capstone Projects
ix. Book review/Article review/Article preparation
x. Any other academic activity
xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT.The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations.The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation conditionis required.
- There shall be 05 marks for journal and viva-voce. Certified journal is compulsory to appear for practical examination.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.
- For internal practical examination student must produce the laboratory journal of Practical completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular Practical. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-III

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-DSC-231: Heat and Thermodynamics

Total Hours: 30 **Credits: 2**

Course objectives	▪ To develop comprehension of fundamental thermodynamic concepts and principles. ▪ To enhance the knowledge of thermodynamic laws. ▪ To understand thermodynamic relations and cycles. ▪ To impart knowledge of thermodynamic concepts through experimental applications.	
Course outcomes	After successful completion of this course, students are expected to ▪ apply the concepts of thermodynamics to real life problems. ▪ Study different thermodynamic cycles through demonstrations. ▪ Estimate entropy change in reversible and irreversible processes& able to explain Universe expansion. ▪ Working principles of electric appliances based on laws of thermodynamics.	
Unit	**Content**	**Hours**
Unit I	**Basics of Heat & Thermodynamics** ▪ Thermodynamic system Description, ▪ Thermodynamic preliminaries: Extensive and intensive properties, ▪ Thermodynamic Variables, ▪ Thermodynamic Equilibrium, P-V indicator diagram. ▪ Work done in terms of P and V	**05**
Unit II	**Laws of Thermodynamics & Entropy** ▪ Zeroth Law of thermodynamics and temperature. First Law, Second and Third Law of Thermodynamics ▪ Entropy:Reversible and irreversible Processes, Entropy changes, Entropy-temperature diagrams, Unattainability of Absolute zero. ▪ Applications of Thermodynamic Laws: Thermometers, Calibration of temperature scale (Zeroth law),Batteries and power systems (First law), Heat transfer systems (pumps, radiators, heaters), efficiency of machines (Second Law)	**09**
Unit III	**Thermodynamic relations and cycles** ▪ Introduction to Carnot's cycle,Carnot's theorem, Carnot's Engine, Otto Engine and Cycle, Diesel Engine and Cycle, Efficiencies of all heat Engines ▪ Applications: Steam power plants, Internal Combustion (IC) engines in automobiles,Jet engines	**09**
Unit IV	**Refrigeration and Air Conditioning** ▪ Vapor Compression & Absorption Refrigeration ▪ Psychrometry and Air Conditioning Cycles ▪ Applications:Household refrigerators and freezers, HVAC systems in buildings, Cryogenics in medical and space applications	**07**
Study References	▪ Jean Phillipe Ansermet and Sylvain D Brechet, (28th Feb 2019)Principles of Thermodynamics 1st Edition,Cambridge University Press. ▪ S. Garg, R. Bansal and C. Ghosh (1993)Thermal Physics, TataMcGrawHill. ▪ Meghnad Saha, and B.N. Srivastava (1969) A Treatise on Heat, Indian Press. ▪ Enrico Fermi (1956) Thermodynamics, Courier Dover Publications. ▪ M. W. Zemasky and R. Dittman (1981) Heat and Thermodynamics,McGraw Hill ▪ F.W. Sears & G. L.Salinger (1988) Thermodynamics, Kinetic theory & Statistical thermodynamics, Narosa. ▪ Ronald Lane Reese (2003) University Physics, Thomson Brooks/Cole. ▪ A. Kumar and S. P. Taneja (2014) Thermal Physics, R. Chand Publications	

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-DSC-232: Basic Electronics

Total Hours: 30 **Credits: 2**

Course objectives	▪ To understand the concept of semiconductors and various semiconductor diodes. ▪ To understand the concept of transistor. ▪ To understand the basic knowledge of digital gates and Boolean algebra. ▪ To know the industrial applications of diode, transistor and digital gate.	
Course outcomes	After successful completion of this course, students are expected to ▪ Understand and identify the basic electronic components like diodes and transistors. ▪ Understand the various logic gates and design the logic circuit using Boolean algebra. ▪ Developing the ability to design and build simple electronic circuits based on schematics and understanding. ▪ Understand how electronic principles and components are used in various industrial applications.	
Unit	**Content**	**Hours**
Unit I	**Semiconductor diodes:** ▪ Revision on metal, insulator and semiconductors, Intrinsic and Extrinsic semiconductor. ▪ P and N type semiconductors, Barrier Formation in PN Junction Diode, Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode, PN junction and its characteristics, Static and Dynamic Resistance. ▪ Principle, Construction, Working and Characteristics of (1) LEDs (2) Solar Cell (P-N Junction), (3) Zener Diode. ▪ Applications of Diode as a Rectifiers, Types: Half-wave & Full-Wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, Zener Diode as a voltage regulator.	**09**
Unit II	**Bipolar junction transistor :** ▪ Bipolar Junction transistors: n-p-n and p-n-p Transistors. ▪ Characteristics of CB, CE and CC configurations. Active, Cutoff, and Saturation Regions. Current gains α and β. Relations between α and β. ▪ Load Line analysis of Transistors. DC Load line and Q point. ▪ Applications of Transistor as Switch, amplifiers and oscillators.	**07**
Unit III	**Number Systems** ▪ Introduction to Number Systems: Binary, Octal, Decimal, and Hexadecimal, Conversions of Number Systems. ▪ Addition and subtraction of binary numbers. ▪ Subtraction of binary number using 1's and 2's Complements. ▪ Applications of number systems.	**07**
Unit IV	**Logic Gates:** ▪ Fundamental logic gates: AND, OR and NOT Gates (Realization using Diodes and Transistor) ▪ NAND, NOR, XOR and XNOR Gates (Concept, Symbol and Truth tables), NAND and NOR gate as a universal gates, Demorgan's theorems. ▪ Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Half adder and Full Adder. ▪ Applications of Logic Gates.	**07**

Study References	▪ Malvino A. P. Electronic Principles, (2019) McGraw-Hill Publishing House, New Delhi. Edition: 7 ▪ Ryder J. D. Electronic fundamentals and applications, (1970) Prentice Hall, 4th Edition, ISBN-10: 0132513552; ▪ Mehta V. K. Principles of Electronics, S. Chand Publications, New Delhi, ISBN9788121924504 4 ▪ Allen Mottershead. Electronic Devices and Circuits, (1973) Good year Publishing Company, ISBN- 0608161306 ▪ Malvino and Leach. Digital Principles and Applications,(1993) McGraw-Hill Publication. ISBN- 9339203410 ▪ Jain R. P. Modern Digital Electronics,(2010) Tata McGraw-Hill Pvt. Ltd., New Delhi, ISBN- 97800706691 ▪ Millman J. and Halkias C.C. (1991). Integrated Electronics, Tata Mc-Graw Hill. ▪ Salivahanan S. and Suresh Kumar N. (2012). Electronic devices and circuits, Tata Mc- Graw Hill. ▪ Rashid M.H. (2011). Microelectronic Circuits, 2nd Edn, Cengage Learning. ▪ Sedra A.S., Smith K.C., Chandorkar A.N. (2014). Microelectronic circuits, 6th Edn., Oxford University Press,ISBN 978–0–19–933913. ▪ Anand Kumar A. (2009). Fundamentals of Digital Circuits, 2nd Edition, PHI Learning Pvt. Ltd, ISBN: 9788120336797,	

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-DSC-233: Practical on Thermodynamics & Electronics

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To understand basics of heat and thermal energy. ▪ To understand and verify the laws of thermodynamics. ▪ To give hands on training on basic experiments of thermodynamics. ▪ To give hands on using mechanical kits and observe thermodynamics processes as well kinetics of gases.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand and verify the practical aspects of thermodynamics. ▪ Verification of thermal and thermodynamics laws. ▪ Understand nature of molecules and energy in gases. ▪ Use the learnt concepts to solve daily upcoming issues related to thermodynamics.	
Sr. No.	**Contents**	**Hours**
1	To determine the coefficient of thermal conductivity of a bad conductor by Lee's method and Charlton's disc method.	**4**
2	To determine thermal conductivity of rubber by tubing method.	**4**
3	To demonstrate and understand working of 2-stroke and 4-stroke engines.	**4**
4	Calibration of thermocouple for Temperature measurement.	**4**
5	To determine characteristics of thermistor and to find an unknown temperature by using thermistor.	**4**
6	To demonstrate and understand working of the thermal and steam engine.	**4**
7	To determine the specific heat of water/metal.	**4**
8	To verify Stefan's fourth power law using bulb.	**4**
9	Specific heat by Newton's law of cooling	**4**
10	To verify Clausius-Clapeyron equation	**4**
11	To study the characteristics of Light Emitting Diode (LED).	**4**
12	To study the I–V characteristic of a p–n junction diode.	**4**
13	To determine fill factor and efficiency of solar cell.	**4**
14	Comparison of luminous intensities of two light sources by using photo voltaic cell.	**4**
15	Study of logic gates (AND, OR and NOT) using diodes and transistors.	**4**
16	Verification of De Morgan's Theorems (using ICs).	**4**
17	Experimental verification of NAND gate as a universal building block.	**4**
18	Study of full wave rectifier with capacitor filter and to calculate its ripple factor	**4**
19	Study of zener diode as a voltage regulator	**4**
20	To study half wave rectifier.	**4**
21	To study full wave rectifier.	**4**
Study Resources	▪ Dr. Dinesh V Kala (2020), Physics Practical Manual for UG & PG, InSc International Publisher ▪ Flint B.L.&Worsnop H.T. (1971). Advanced Practical Physics for students, Asia Publishing House. New Delhi	

	▪ Michael Nelson and Jon M. Ogborn. Advanced level Physics Practical, 4th Edition, reprinted 1985, Heinemann Educational Publishers. ▪ InduPrakash and Ramakrishna (2011). A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi. ▪ Khandelwal D.P. (1985). A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication. New Delhi. ▪ Flint B.L.&Worsnop H.T. (1971). Advanced Practical Physics for students, Asia Publishing House. New Delhi ▪ Michael Nelson and Jon M. Ogborn. Advanced level Physics Practical, 4th Edition, reprinted 1985, Heinemann Educational Publishers ▪ InduPrakash and Ramakrishna (2011). A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi. ▪ Khandelwal D.P. (1985). A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication. New Delhi	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-SEC-231-Basic Instrumentation Skills

Total Hours: 30 **Credits: 2**

Course objectives	▪ To expose the students to various aspects of instruments and their usage through hands-on mode. ▪ To provide them an understanding of basics of measurement and electrical quantity measuring instruments. ▪ To understand the basics of Cathode Ray Oscilloscope. ▪ To provide them an understanding of Signal Generators and Digital Instruments	
Course outcomes	After successful completion of this course, students are expected to: ▪ Understand the necessary working knowledge on accuracy, precision, resolution, range and errors/uncertainty in measurements. ▪ Explanation of the specifications of CRO and its uses. ▪ Understand the electric & electronics instruments. ▪ Understand the necessary working of digital instruments.	
Unit	**Contents**	**Hours**
Unit I	**Basics of Measurements:** ▪ Definitions of accuracy, precision, sensitivity, resolution, range, etc. ▪ Errors in measurements, Impedance matching and loading. Electrical quantity measuring instruments: ▪ Classification of instruments- Deflection and Null type, manually operated and automatic type, Analog and Digital types, Self-generating and power-operated types, Contacting and Non-contacting types.	**08**
Unit II	**Signal Generators and Analysis Instruments** ▪ Block diagram, explanation and specifications of low frequency signal generators, pulse generator, and function generator. Brief idea for testing, specifications. ▪ Block diagram of basic Cathode Ray Oscilloscope (CRO), Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only (no mathematical treatment), brief discussion on screen, Time base operation, Front panel controls. Specifications of a CRO and their significance, Use of CRO for the measurement of voltage (dc and ac), frequency, time period and phase. Introduction of Dual trace CRO.	**10**
Unit III	**Digital Instruments** ▪ Principle and working of digital meters. Comparison of analog and digital instruments. ▪ Characteristics of a digital meter. ▪ Block diagram and Working principle of digital voltmeter (Ramp type only). Block diagram, working and uses of a digital multimeter.	**06**
Unit IV	**Measurement Applications** ▪ **Signal Generators:** Pulse, audio-video, digital pattern generator, radar, WiFi and cellular communication ▪ **CRO:** measure voltage, current, frequency, comparing phase and frequency of signal, study of Lissajous figures ▪ **Digital meters:** troubleshooting in electrical circuits, accurate readings, real time monitoring	**06**
Study References	▪ V. K. Mehta, (2020) 12th Edition, Principles of Electronics, S. Chand Publications, New Delhi. ▪ B.L. Thereja, (2005) Basic Electronics (Solid State), Publisher: S. Chand and Company, New Delhi. ▪ R K Rajput (2007) Electrical measurements and measuring instruments S. Chand and Co. New Delhi. ▪ A.P. Malvino and D. P. Leach. (2011) Digital Principles and Applications, Tata McGraw-Hill Publishing Company Limited, New Delhi. ▪ Albert D. Helfrick, Willam D. Cooper, Modern Electronic Instruments and Measurement techniques, Prentice Hall India Pvt. Ltd, New Delhi. ASIN: B00BG743IG, ISBN-10: 8120307526, ISBN-13: 978-8120307520 ▪ A. K. Sawhney (2005) A course in Electrical and Electronic Measurements and Instruments: DhanpatRai and Co. ▪ R P Jain (2009) 4th Edition, Digital electronics, McGraw Hill Education. ▪ B. Grob (2024) Basic Electronics, Publisher: McGraw Hill Book Co. New York. ▪ H.S. Kalsi (2019) Electronic Instrumentation, Tata McGraw-Hill Publishing Company Limited, New Delhi. ▪ Venugopal (2011) Digital Circuits and systems, Tata McGraw Hill.	

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-CEP-231: Community Engagement Program

Total Hours: 60 **Credits: 2**

Course Objectives

- To engage students in activities that promote emotional, social, and intellectual growth, fostering a well-rounded approach to personal and academic development.
- To provide hands-on experiences that complement classroom learning, enabling students to apply their knowledge insocioeconomic problems of real-world.
- To instil a sense of responsibility towards the community by encouraging students to actively participate in social and environmental initiatives, appreciate rural culture, lifestyle, and wisdom.

Course Outcomes

After completing this course, students will be able to

- Understand rural and/or urban culture, ethos, and socioeconomic realities.
- Develop a sense of empathy with the local community while appreciating the significant contributions of local communities to society and the economy.
- Learn to value the local community wisdom and identify opportunities for contributing to the community's socioeconomic improvements.

Activities

- Conduct workshops and interactive sessions on emotional intelligence and social skills.
- Organize debates, discussions, and intellectual challenges that stimulate critical thinking and socioeconomic problem-solving using concern subject.
- Organize field visits where students can work on real-world problems, such as environmental conservation, rural and/or urban planning, or community health.
- Organize internships or service-learning opportunities with local businesses, NGOs, or government agencies.
- Facilitate project-based learning activities that require students to use their academic knowledge to develop solutions to community issues.
- Engage students in community service activities that address local social and environmental issues.
- Organize cultural exchange programs or field trips to rural areas to foster an appreciation of rural culture and wisdom.
- Facilitate collaborative projects involving students, educators, and community members to develop solutions for local challenges, promoting teamwork and collective problem-solving.
- Conduct educational sessions on the status of various agricultural and development programs and the challenges faced by vulnerable households, ensuring inclusivity and accessibility for all students.

S. No.	Module Title	Module Content	Assignment submission	Teaching/ Learning Methodology
1	**Appreciation of Rural Society**	Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages', rural infrastructure.	Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village.	– Classroom discussions – Field visit – Assignment
2	**Understanding rural and local economy and livelihood**	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets, migrant labour.	Describe your analysis of the rural house hold economy, its challenges and possible pathways to address. Circular economy and migration patterns.	– Field visit – Group discussions in class – Assignment

3	**Rural and local Institutions**	Traditional rural and community organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), Nagarpalikas and municipalities, local civil society, local administration.	How effectively are Panchayati Raj and Urban Local Bodies (ULBs) institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual).	– Classroom – Field visit – Group presentation of assignment
4	**Rural and National Development Programmes**	History of rural development and current national programmes in India: SarvaShikshaAbhiyan, BetiBachao, BetiPadhao, Ayushman Bharat, Swachh Bharat, PM AwaasYojana, Skill India, Gram Panchayat Decentralised Planning, National Rural Livelihood Mission (NRLM), Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA), SHRAM, Jal Jeevan Mission, Scheme of Fund for Regeneration of Traditional Industries (SFURTI), AtmaNirbhar Bharat, etc.	Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving the implementation of the programme for the poor. Special focus on the urban informal sector and migrant households.	– Classroom – Each student selects one program for field visit – Written assignment

Note: The modules are suggestive in nature and students can opt any oneactivities for community engagement program and field project based on topic appropriate to their regional community context.

Some additional suggestive themes for field-based / community engagement activities are listed below:

- Management curriculum may include aspects of micro-financing in a rural context;
- Chemistry syllabus can have a component of conducting water and soil analysis in surrounding field areas;
- Political science syllabus could include a mapping of local rural governance institutions and their functioning.
- Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living
- Understanding panchayats and constitutional mandate of local governance
- Panchayat administration, Gram Sabha, Mahila Sabha, Gram Panchayat Development Plan (GPDP), local planning of basic services.
- Micro-finance, SHGs, system of savings and credit for local business, linkages to banks, financial inclusion.
- Rural – entrepreneurship, opportunities for small business in local communities, access to financial and technical inputs to new entrepreneurs.
- Renewable energy, access to household and community level solar and bio-mass systems for sustainable energy use.
- Participatory Monitoring and evaluation of socio-economic development programmes, and cost-benefit analysis of project proposals.
- Migrant workers' livelihood security and social services.

- Hygiene and sanitation, improving health and personal behaviours, locally manageable decentralised systems and awareness against stubble burning.
- Water conservation, traditional practices of storage and harvesting, new systems of distribution and maintenance.
- Women's empowerment, gender inequality at home, community and public spaces, safety of girls and women, access to skills, credit and work opportunities.
- Child security, safety and good parenting, nutrition and health, learning and training for child care.
- Rural Marketing, market research, designing opportunities for rural artisans and crafts, and new products based on demand assessment.
- Community Based Research in Rural Settings, undertaking research that values local knowledge, systematises local practices and tools for replication and scale-up.
- Peri-urban development of informal settlements, mapping and enumeration, design of local solutions.

Assessment:

- Readings from related literature including e-content and reflections from field visits should be maintained by each student in the form of Field Diary (20 Marks)
- Submission of assignments based on modules assignment submission (details mentioned above) (20 Marks)
- Oral/ Group discussion/ Presentation (10 Marks)

S.Y. B.Sc. Physics (Minor)
Semester-III
PHY-MIN-231: Modern Physics

Total Hours: 30 **Credits: 2**

Course Objectives	▪ This course covers certain conceptual courses of physics by virtue of which the students will be able to understand some concepts of Quantum Mechanics, Atomic Physics and Nuclear Physics. ▪ It also imparts the basic principles of Quantum mechanics, Schrodinger equation and its applications ▪ To introduce students to the fundamentals of atomic physics and nuclear physics. ▪ To introduce them to the basic Laser principles and Properties.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand and explain the differences between classical and quantum mechanics. ▪ Understand properties of the nucleus and other sub-atomic particles. ▪ Understand structure of atoms and the origin of the observed spectra. ▪ Understand the construction and working of different Laser used and makes a comparison between them.	
Unit	**Contents**	**Hours**
Unit I	**Radiation and its nature** ▪ Black body Radiation ▪ Planck's quantum hypothesis. ▪ Photoelectric effect and Compton scattering - light as a collection of photons. ▪ Davisson-Germer experiment. ▪ De Broglie wavelength and matter waves. ▪ Wave-particle duality. ▪ Wave description of particles by wave packets. ▪ Heisenberg uncertainty principle with illustration.	**08**
Unit II	**The Structure of the Atoms** ▪ Alpha-particle Scattering and Rutherford's Nuclear Model of Atom ▪ Atomic Spectra ▪ Bohr Model of the Hydrogen Atom ▪ Energy level diagram of hydrogen atom. ▪ The correspondence principle ▪ Frank and Hertz Experiments ▪ Failure of Bohr Model	**07**
Unit III	**Nuclei and its properties** ▪ Atomic Masses and Composition of Nucleus ▪ Size of the Nucleus ▪ Discovery of Neutron ▪ Classification of nucleus ▪ Mass defect and Binding Energy ▪ Nuclear Force and its properties ▪ Radioactivity (Definition, Types of Radiation and its Properties, Half-life	**08**

	and Mean life) ▪ Nuclear Energy (Nuclear Fission and Nuclear fusion)	
Unit IV	**Modern Industry Applications** ▪ Nuclear Reactors ▪ Isotope Tracing ▪ Carbon Dating ▪ Diagnostic Imaging –PET **and** SPECT ▪ Cancer Treatment	**07**
Study Resources	▪ Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill. ▪ Refresher course in B. Sc Physics Vol I and Vol III, C. L. Arora, 2010, S. Chand Publishers. ▪ Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill ▪ Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education. ▪ Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill ▪ Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan ▪ Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning. ▪ Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2ndEdn, Tata McGraw-Hill Publishing Co. Ltd. ▪ Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co. ▪ Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.	

S.Y. B.Sc. Physics (Minor)
Semester-III
PHY-MIN-232: Mathematical Tools in Physics

Total Hours: 30 **Credits: 2**

Course objectives	▪ To impart knowledge of various physical, mathematical, and statistical quantities and its basic operations. ▪ To provide the knowledge and methodology necessary for solving problems in Physics. ▪ The course also involves the related experiments based on the theory. ▪ To understand the applications of dimensional analysis, errors in measurements, vectors and statistics in various fields.	
Course outcomes	After successful completion of this course, students are expected to ▪ Apply the concept of use of knowledge of physical, mathematical, and statistical quantities in real life problems. ▪ Help to understand types of error and method of finding error. ▪ Understanding of the course will create scientific temperament. ▪ Know the applications of dimensional analysis, errors in measurements, vectors and statistics in various fields.	
Unit	**Contents**	**Hours**
Unit I	**Physical quantities and its dimensional analysis:** ▪ Units, Conditions for standard unit, System of units, ▪ Fundamental quantities and its dimensions, Derived quantities and its dimensions, Supplementary quantities ▪ Dimensions and dimensional analysis. ▪ Applications of dimensional analysis: To check the correctness of equations, conversion of units, Derivation of new Formula, Identifying the nature of Physical quantities. ▪ Limitations of dimensional analysis.	**08**
Unit II	**Errors in Measurements:** ▪ Systematic errors, Random errors, Estimation of errors, ▪ Combination of errors- errors in sum difference, product, division and powers. ▪ Determination of errors in instruments such as VernierCalliper, Micro meter screw gauge and Spherometer, Significant figures and Rules for determining significant figures. ▪ Applications: Scientific research and Experimentation, Engineering and Manufacturing, Financial and Statistical analysis, GPS and Navigation System.	**07**
Unit III	**Scalar and Vectors:** ▪ Definition and examples of scalar and vector quantities, Types of vectors, Vector Operations, Resolution of vectors, Multiplication of vectors- scalar product, Triangle law of Vector addition, ▪ Law of Parallelogram of Vectors, Vector product expressed as determinant, volume of parallelogram, ▪ Scalar triple product,vector triple product and its geometrical interpretation, Volume of tetrahedron. ▪ Application: Vectors in physics, engineering and structural analysis, computer graphics and animation.	**08**
Unit IV	**Statistical Techniques:** ▪ Statistics, Frequency Distribution, Graphical Representation- Histogram, Frequency Polygon, Frequency curve, Cumulative Frequency curve, Bar chart and Pie diagrams. ▪ Exclusive and Inclusive Class intervals, Arithmetic averages or Mean, Median, Mode. ▪ Geometric mean, Harmonic mean, standard deviation (definition and formula),	**07**

	Variance (definition and formula). ▪ Applications: Statistical techniques in health care, business and economics, environmental science, government and public policy, sports and research and developments.	
Study References	▪ Mathematical Physics, H. K. Das, Seventh Revised Edition 2014, S. Chand Publishers. ▪ Concept of Physics, Vol I, H. C. Varma, BharatiBhawan Publisher. ▪ Basic Physics, Roshan Kr. Sinha, Foundation Publishing House. ▪ Basic Physics, D. T. Gaikwad, S. Padmakar, S. R. Rane and V. Morankar, 2011, S. Chand Publisher. ▪ Mathematical Physics, B. S. Rajput, 1997, PragatiPrakashan.	

S.Y. B.Sc. Physics (Minor)
Semester-III
PHY-MIN-233: Practical on Modern and Mathematical tools in Physics

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To provide practical knowledge in quantum physics, atomic physics, nuclear physics and lasers. ▪ To understand the Practical on quantum physics, atomic physics, nuclear physics and lasers. ▪ To develop an ability to handle various instruments like GM tube, laser, photoelectric cell, Frank Hertz experiment, etc. ▪ To develop the experimental skills of students.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand the concept of quantum physics, atomic physics, nuclear physics and lasers practically. ▪ Know about the instruments like GM tube, laser, photoelectric cell, Frank Hertz experiment, etc. ▪ Able to handle the various instruments in Laboratory. ▪ Adequate knowledge of the instruments.	
Sr. No.	**Contents**	**Hours**
1	Estimation of absolute error, relative error and percentage error from given data.	**4**
2	Measurements of length (or diameter or thickness) using vernier caliper, micrometer screw guageandtravellingmicrocope of given objects.	**4**
3	To determine radius of curvature of given spherical surface by sphero meter.	**4**
4	To determine the mean, mode and median of the given data	**4**
5	To determine the Karl Pearson's Coefficient of Skewness from the given data.	**4**
6	Determine the dimensions of given physical quantities.	**4**
7	To check the correctness of given physical equations.	**4**
8	To determine the gradient, divergence and curl of given equations.	**4**
9	To determine the diameter of wire by diffraction method using He-Ne laser.	**4**
10	To determine the wavelength of laser source using diffraction of single slit.	**4**
11	To determine the wavelength of laser source using diffraction of double slits.	**4**
12	To determine the value of Plank's constant using photocell.	**4**
13	To study the characteristics of GM tube.	**4**
14	To determine linear absorption coefficient and mass absorption coefficient of Al by GM tube.	**4**
15	To determine the Planck's constant using LEDs of at least 4 different colors.	**4**
16	To determine the thickness of engraved scale by diffraction using laser.	

Study Resources	▪ Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House. ▪ Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers. ▪ A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Edn, 2011,Kitab Mahal ▪ Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers ▪ A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11thEdn, 2011,Kitab Mahal ▪ Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House. ▪ Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers ▪ A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi. ▪ A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication. ▪ College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi) 11. Practical Physics: Gupta and Kumar (PragatiPrakashanMeerat) ▪ Advanced Level Practical Physics: J. M.Nelkon, J.M.Ogloom (EIBS) ▪ FlintB.L., and WorsnopH.T. (1971), Advanced Practical Physics for students, Asia Publishing House. ▪ Das H. K. (2014), Mathematical Physics, Seventh Revised Edition, S. Chand Publishers. ▪ Michael Nelson and OgbornJon M. (1985), Advanced level Physics Practical, 4thEdition, reprinted, Heinemann Educational Publishers.	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Physics (Open Elective)
Semester-III
PHY-OE-231: Battery Technologies

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To understand the different types of energy storage system. ▪ To study about the battery characteristic & parameters. ▪ To know the concepts of battery management system and design the battery pack. ▪ To study about the battery testing, disposal and recycling.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Learn about the different types of energy storage system. ▪ know about the battery characteristic & parameters. ▪ Learn the concepts of battery management system and design the battery pack. ▪ Know about the battery testing, disposal and recycling.	
Unit	**Contents**	**Hours**
Unit I	**Introduction to Batteries:** ▪ Overview of batteries: history, importance, and applications. ▪ Basic components of batteries: electrodes, electrolytes, and separators. ▪ Types of batteries: primary and secondary batteries. ▪ Energy storage metrics: voltage, capacity, and energy density. ▪ Electrode materials: properties and selection criteria.	**7**
Unit II	**Performance &Maintainanceof Batteries:** ▪ Oxidation-reduction reactions and electron transfer (Basic Concept) ▪ Electrolyte solutions: types and role in battery performance ▪ Charging and discharging processes, Internal resistance and impedance, Cycle life and degradation mechanisms ▪ Battery Maintainance, Management of Electrolytic batteries	**8**
Unit III	**Advanced Battery Technologies:** ▪ Emerging battery technologies: lithium-ion, solid-state, and beyond. ▪ Safety considerations: overheating and short-circuiting. ▪ Environmental impact and sustainability: recycling and eco-friendly alternatives.	**7**
Unit IV	**Applications of Batteries in different fields**: ▪ Primary Batteries: consumer electronics, medical devices, emergency and backup systems, portable devices ▪ Secondary Batteries: consumer electronics, electric vehicles (EVs), renewable energy storage, power tools, ▪ healthcare devices, tele-communications, emergency and backup lighting, grid energy storage, ▪ Military and aerospace applications, drones and remote-controlled vehicles, ▪ Consumer and commercial appliances, transportation and rail systems.	**8**
Study Resources	▪ Armand, M., & Tarascon, J. M. (Eds.). (2008). Building Better Batteries. Springer. DOI: 10.1007/978-0-387-34445-4 ▪ Goodenough, J. B., & Park, K. S. (2013). The Li-ion Rechargeable Battery: A Perspective. Springer. DOI: 10.1021/ja310466u ▪ Bruce, P. G., Freunberger, S. A., Hardwick, L. J., & Tarascon, J. M. (Eds.). (2012). Li-O2 and Li-S Batteries with High Energy Storage. Springer. DOI: 10.1038/nmat3223 ▪ Whittingham, M. S. (2012). History, Evolution, and Future Status of Energy Storage. Proceedings of the IEEE. DOI: 10.1109/JPROC.2011.2168369 ▪ Manthiram, A., Yu, X., & Wang, S. (Eds.). (2017). Lithium Battery Chemistries Enabled by Solid-State Electrolytes. Springer.	

SEMESTER-IV

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-DSC-241:Waves and Oscillations

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To impart knowledge of basic concepts of Waves and Oscillations. ▪ To study different basic parameters and types of waves. ▪ To provide the information and methodology necessary for solving problems of waves and acoustics. ▪ To understand actual phenomena of forced and damping oscillations.	
Course Outcomes	After successful completion of this course, students are expected to ▪ Apply the concept of Waves and Oscillation to real life problems with proper interpretation of wave equations. ▪ Understandscientific impotance for damping and resosnance of waves. ▪ Developan approach towards application of sound& knowledge of acoustics. ▪ .Apply& observe Dopplers effect in routine life with its prime importance.	
Unit	**Contents**	**Hours**
Unit I	**Basics of SHM and Wave motion** ▪ Different types of equilibria (stable, unstable, and neutral equilibrium), Definition of linear and angular S.H.M., ▪ Differential equation of S.H.M. and its solution (exponential form),Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (analytical method), ▪ Lissajous's figures ▪ Wave Motion General: Transverse waves on a string. ▪ Travelling and standing waves on a string. ▪ Normal Modes of a string. ▪ Plane waves, Spherical waves, Basic concept of Wave intensity,	**08**
Unit II	**Damped oscillation, Forced oscillations and Resonance** ▪ Differential equation of a damped oscillator and its solutions ▪ Logarithmic decrement; relaxation time, quality factor ▪ Idea of forced oscillations, Differential equation of forced oscillations and its solution, Amplitude of forced oscillations, ▪ circuit Resonance and its types-Mechanical resonance (Barton's pendulum), Acoustic resonance (resonance tube), Electrical resonance (LCR circuit) and Optical resonance (sodium vapour lamp), Amplitude resonance, ▪ Application to series L-C-R. Application of Resonance (Brief on Radio, TV, signal processing, communication, etc.)	**08**
Unit III	**Sound and Light Waves** ▪ Sound intensity, Loudness, Pitch, Quality and timber, ▪ Acoustic intensity level measurement, Acoustic pressure and its measurement. ▪ Reverberation and time of reverberation. ▪ Classification of sound frequencies,Piezoelectric effect, ▪ Generation of ultrasonic waves by piezoelectric oscillator (using transistor), ▪ Application of ultrasonic waves ;-X-ray, MRI imaging, Ultrasonic: cleaning, surgery & therapy pulmonology,	**08**
Unit IV	**Doppler effect in sound and Light** ▪ Expression for apparent frequency (no derivation), ▪ Discussion of different cases when source, observer and medium are in relativemotion, ▪ Asymmetric nature of Doppler effect in sound, ▪ Doppler effect in light, Symmetric nature of Doppler effect in light, ▪ Applications of Doppler effect in sound, light, SONAR & GPS	**06**

Study References	▪ Pain H J (2013). The Physics of Vibrations and Waves, 7th edition, Wiley ELBS. ▪ Ghosh R K (1975). The mathematics of waves and vibrations, Macmillan co. pvt ltd, New Dehi. ▪ Khandelwal D.P. (1976) Oscillations and Waves, Himalaya Pub. House, Bombay. ▪ Ghosh M., (2016) A text book of Sound, S. Chand & Co.5th edition, ISBN 9385676156. ▪ Brijlal and Subramaniyam. Waves and oscillations, Vikas Publishing House, ISBN 9780706985436. ▪ Chaudhari R. N. Waves and Oscillations, New Age International (Pvt.) Ltd. New Delhi, 2nd edition, ISBN 13- 978812242842. ▪ Taggarase A. P., Jivan Sheshan. Conceptual Physics, Himalaya Publishing. ▪ Bajaj N. K. (1988), The Physics of Waves and Oscillations, Tata McGraw Hill. ISBN–0074516108, 9780074516102. ▪ Agarwal B. S.. Oscillations and Waves, KedarNath, Ram Nath Publishers ISBN–1234567146749. ▪ Mee and Heinmann. (1967) Sound, London Edition 2nd Edition.	

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-DSC-242: Optics

Total Hours: 30 **Credits: 2**

Course Objectives	▪ To impart knowledge of basic concepts in Optics. ▪ To describe the principles of interference and its applications ▪ To study phenomenon of diffraction. ▪ To study phenomenon of polarization and its applications	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Apply the optics using different geometrical shapes. ▪ Understand the idea of various kinds of polarization of light wave and their detection. ▪ Clear the idea of spatial and temporal coherence for the formation of interference fringes. ▪ Describe the operation of optical devices including, polarisers, retarders and interferometers.	
Unit	**Contents**	**Hours**
Unit I	**Geometrical Optics:** ▪ The nature of light, Review of some concepts in optics, ▪ Images produced by lenses ▪ Deviation produced by thin lenses ▪ equivalent focal length of two thin lenses separated by a distance and when in contact. ▪ Power of lens, Spherical aberration in lens, chromatic aberration, reduction of spherical aberration, Achromatism.	**07**
Unit II	**Interference** ▪ Principal of superposition ▪ concept of interference of light and intensity distribution ▪ expression for fringe width, youngs double slit experiment, ▪ Fresnel biprism and Lioyds mirror. ▪ Stoke's treatment, ▪ Newton's ring experiment	**07**
Unit III	**Diffraction** ▪ Definition and concept of diffraction ▪ Types of diffraction Fresnel's diffraction, Derivation of radius of HPZ, Diffraction at single slit, ▪ Fraunhoffer's Diffraction, Diffraction through Single slit,double slit, multiple slit and grating	**08**
Unit IV	**Polarization:** ▪ Experiment to determine transverse nature of light. ▪ Polarization: polarized and unpolarized light, types of polarization, basic phenomenon of polarization: 1) polarization by reflection 2) polarization by refraction 3) polarization by scattering, Brewster's law, ▪ Malus law, Huygen's explanation of double refraction in uniaxial crystal, Nicol prism, ▪ Optical Activity, optical rotation, specific rotation, Polarimeter.	**08**

Study Resources	▪ Hetch E., GanesanA.R.. Optics, fourth edition, Pearson education, ▪ Subhramanyam N., Brijlal, Avadhanulu M. N..A Text book of Optics, S. Chand publication. ▪ Ghatak A. K. Physical Optics, McMillan, New Delhi. ▪ Jenkins F. A., White H. E. Fundamentals of Optics, McGraw- Hill international Edition. 10 ▪ E. Hetch, A.R. Ganesan. 2008 Optics, fourth edition, Pearson education, 4th edition, ISBN 10- 8131718077 , ISBN 13 - 9788131718070 ▪ Subhramanyam N., Brijlal, Avadhanulu M. N. A Text book of Optics, S. Chand publication. ISBN - 9788121926119 ▪ Ghatak A. K. Physical Optics, McMillan, New Delhi. ISBN - 9781259004346 ▪ Jenkins F. A., White H. E. 1957Fundamentals of Optics, McGraw- Hill international Edition. ▪ Mathur D. S. 1999 Principles of optics, Gopal Press, Kanpur, 7TH edition	

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-DSC-243: Practical on Waves, Oscillation and Optics

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To give hands on training on Waves and oscillations experiments. ▪ To study resonance using different methods. ▪ To verify different phenomenon in sound and light wave experiments using Doppler effect. ▪ To study types of damping in the waves motion.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand and verify the practical aspects of waves and oscillation. ▪ Calculate different coefficients/constants with damping or resonance. ▪ Comprehend the relation between theory and practical observations of Lissajous figures. ▪ Measure actual velocity of sound using experimental kits.	
Sr. No.	**Contents**	**Hours**
1	To understand the applications of CRO by measuring voltage, frequency and phase of a of different waveforms using CRO.	**4**
2	To study Lissajous Figures and demonstration of Lissajous figures by using C.R.O.	**4**
3	Study of acoustic resonance by using bottle as a resonator.	**4**
4	To study Log decrement.	**4**
5	Study of resonance using Kater's pendulum.	**4**
6	To calculate Damping coefficient.	**4**
7	To study the Doppler effect in sound/light waves.	**4**
8	To study the arrangement andalingnment of Spectroscope by Schutsters method	**4**
9	To determine the Resolving Power of a Prism.	**4**
10	To determine wavelength of sodium light using Newton's Rings.	**4**
11	To determine wavelength of Sodium light using plane diffracBtion Grating	**4**
12	To determine Velocity of sound by phase shift method	**4**
13	Study of acoustic resonance by using resonance tube.	**4**
14	Study of Oscillations under Bifilar suspension.	**4**
15	Determination of specific rotation α of optically active substance using Polarimeter.	**4**
16	To determine wavelength of spectrum of Mercury light using plane diffraction Grating	**4**
17	To measure the intensity using photo sensor and laser in diffraction patterns of single and double slits.	**4**
18	To determine the Dispersive Power of a Prism.	**4**
19	To determine the Dispersive Power of a Plane Diffraction Grating.	**4**
20	To measure the intensity using photo sensor and laser in diffraction patterns of single and double slits.	**4**

Study Resources	▪ Flint B.L. &Worsnop H.T. (1971). Advanced Practical Physics forstudents, Asia Publishing House. 2 nd edition ▪ Michael Nelson and Jon M. Ogborn. Advanced level Physics Practical, 4th Edition, reprinted 1985, Heinemann Educational Publishers ▪ InduPrakash and Ramakrishna (2011) A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi. ▪ Arora C. L. B.Sc. Practical Physics, S. Chand Publishing Co. Ltd., New Delhi, ISBN – 9788121909099 ▪ Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House. ▪ Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd. ▪ Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press. ▪ A Text Book of Practical Physics, Vol I and II, Prakash and Ramakrishna, 11/e, 2011, KitabMahal. ▪ An Introduction to Error Analysis: The study of uncertainties in Physical Measurements, J. R. Taylor, 1997, University Science Books List of experiments. ▪ Flint B.L. &Worsnop H.T. (1971). Advanced Practical Physics for students, Asia Publishing House. 2 nd edition. ▪ Michael Nelson and Jon M. Ogborn. Advanced level Physics Practical, 4th Edition, reprinted 1985, Heinemann Educational Publishers. ▪ InduPrakash and Ramakrishna (2011) A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi.	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-SEC-241: Electrical Circuits and Network Skills

Total Hours: 30 **Credits: 2**

Course objectives	▪ To understand the basic electricity principles and electrical circuits. ▪ To empower students with basic knowledge of generators , transformers and electric motors. ▪ To impart the basic concepts in electrical protection such as relay, Fuses. ▪ To provide the knowledge about basic in electrical wiring.	
Courseoutcomes	After successful completion of this course, students are expected to: ▪ To understand the basic concepts of electrical circuits ▪ To repair the basic electric fault in circuit. ▪ To calculate the monthly bill of any load. ▪ To understand the basic concepts of electrical protection and electrical wiring.	
Unit	**Contents**	**Hours**
UnitI	**Basic Electricity Principles**: ▪ Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. **Understanding Electrical Circuits**: ▪ Resistor, Inductor and Capacitor (R,L and C) and their combination. Rules to analyze DC sourced electrical circuits (KCL, KVL) ▪ Current and voltage drop across the DC circuit elements, Diode, Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components AC source. Power factor.	**09**
UnitII	**Electrical Protection**: ▪ Relays, Fuses and disconnect switches. ▪ Circuit breakers, Overload devices, ▪ Ground-fault protection, Grounding and isolating, Phase reversal, Surge protection.	**06**
Unit III	**Electrical Wiring**: ▪ Different types of conductors and cables. Basics of wiring-Star and delta connection. ▪ Voltage drop and losses across cables and conductors, Instruments to measure current, voltage, power in DC and AC circuits, Electrical Insulation, Solid and Stranded Cable,Conduit,Cable trays, ▪ Splices: Wirenuts, Crimps, Terminal blocks, Split bolts, and Solder, Preparation of extension board.	**08**
Unit IV	**Generators**: ▪ Types of DC Power sources. Principle of AC/DC generators, Construction and working of DC generator and its types. **Electric Motors**: ▪ AC and DC electrical motors, Single-phase AC & DC motors (Basic design), Speed &Power of AC motor, Structure of AC motor, Interfacing DC or AC sources to control heaters & motors.	**07**
Study References	▪ Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi. ▪ Basic Electronics (Solid State): B.L. Thereja, Publisher: S. Chand and Company, New Delhi. ▪ Electrical measurements and measuring instruments: R K Rajput, S.	

	Chand and Co. New Delhi. ▪ Digital Principles and Applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill Publishing Company Limited, New Delhi. ▪ Modern Electronic Instruments and Measurement techniques: Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi. ▪ A course in Electrical and Electronic Measurements and Instruments: A. K. Sawhney, DhanpatRai and Sons. ▪ Basic Electronics: B. Grob, Publisher: McGraw Hill Book Co. New York, ▪ Electronic Instrumentation: H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New	

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-SEC-242: Practical on Electrical Circuits and Network Skills

Total Hours: 60 **Credits: 2**

Course Objectives	▪ Toprovidepracticalknowledgeinresistor, capacitor etc. ▪ To understand thePracticalonseries and parallel circuits. ▪ To develop an ability to handle various instruments like switch, ammeter, voltmeter etc. ▪ Todevelop theexperimental skillsof students.	
Course Outcomes	After successful completion of this course, students are expected to: ▪ Understand and practice the skills while doing physics practical. ▪ Correlate their physics theory concepts through practical. ▪ Enlighten subject theoretical background doing hand-on Practical. ▪ Expertise of designing & handling electrical circuits.	
Sr. No.	**Contents**	**Hours**
1	To study Digital multimeter.	**4**
2	To identify and test electrical components like capacitor, inductor and diode.	**4**
3	To study the various types of resistors and find the value of givenfixed resistors by using color codes.	**4**
4	To measure the voltage and current using a digital multimeter, voltmeter, and ammeter in a closed circuit.	**4**
5	To verify Ohm's law through experimental data.	**4**
6	To verify series and parallel circuits with resistors.	**4**
7	To verify current division and voltage division in series and parallel circuits.	**4**
8	To verify Kirchhoff's current law (KCL) through a series-parallel circuit.	**4**
9	To verify Kirchhoff's voltage law (KVL) through a series-parallel circuit.	**4**
10	To Measure the energy and power consumed by a resistor in a circuit using ammeter and voltmeter.	**4**
11	To make an extension board with at least three switches, a plug, a fuse, and an indicator.	**4**
12	To determine the series and parallel combination of capacitance of capacitor.	**4**
13	To study the characteristics of a diode.	**4**
14	Demonstration of AC and DC generator.	**4**
15	Measurement of electrical wire gauges.	**4**
Study Resources	▪ Worsnop, B. L., & Flint, H. T. (1927), Advanced practical physics for students. Methuen. ▪ Nelson, M. and Ogborn Jon M.(1985), Advanced level Physics Practical, 4thEdition, reprinted, Heinemann Educational Publishers. ▪ Prakash, I and Ramakrishna, (2011). A Text Book of PracticalPhysics,11thEdition, KitabMahal,NewDelhi. ▪ Rajopadhye, V. Y., Purohit, V.L., and Deshpande, A.S., A text Book of Experimental Physics, Continental Prakashan, Poona-30 ▪ Shukla, R. K., Srivastava, A. (2006). Practical Physics, New Age International	

	▪ Singh, S.P. (1976). Advance Practical Physics, Pragati Prakashan ▪ Gupta and Kumar (2017). Practical Physics, Pragati Prakashan, Meerut ▪ Tayal, D. C., University Practical Physics, Himalaya Publishing House	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-FP-241: Field Project

Total Hours: 60 **Credits: 2**

Course Objectives

- To provide students with practical exposure in rural and urbansocioeconomic context.
- To develop students abilities to apply subject knowledge to address real world problems
- To foster critical thinking and innovative approaches to solve socioeconomic issues.

Course Outcomes

After completing this course, students will be able to

- Participateactively in filed projects that benefit local communities and promote sustainable development practices.
- Analyse the socio economic data using appropriate methods showcasing improved problem-solving skills, technical proficiency.
- Demonstrate the ability to apply theoretical knowledge to real-world situations effectively and exhibit communication skills.

Course structure

The course is divided in to four probable phases

I] Orientation and preparation

- Introduce to the course, objectives and expectation
- Overview of socioeconomic development issues in rural and urban context
- Training on working methodology and data collection techniques
- Review existing literature related to topic to understand the background and context.

II] Workplanand Field visit

- Visit the potential sites to get a sense of the environment and logistical requirements.
- Create a detailed project plan outlining the steps, timeline, resources needed, and roles of team members.
- Obtain necessary approvals (Ethical/ local authorities/organizations/communities)
- Gather materials and resources (recording devices, cameras, notebooks and supplies)
- Conduct Preliminary Survey, choose appropriate methods for data collection and analysis (e.g., surveys, interviews, observations).

III] Data collection and analysis

- Pilot test to identify issues with data collection.
- Collect data systematically, ensuring consistency and accuracy.
- Keep detailed records of all data (field notes, recordings, photographs etc)
- Organize and analyse the data (manual/ software)

IV] Interpretation and Reporting

- Interpret your findings in the context to objectives.
- Write and submit a comprehensive report detailing your methodology, findings, analysis, and conclusions. (Include visuals - charts, graphs, and photographs).
- Prepare a presentation to share findings with peers/ instructors/ community.

Assessment

- Field work participation, field note book, team work etc. (10 Marks)
- Data Collection and Analysis (15 Marks)
- Field project report (15 Marks)
- Presentation of Findings(10 Marks)

S.Y. B.Sc. Physics (Minor)
Semester-IV
PHY-MIN-241: Semiconductor Devices

Total Hours: 30 **Credits: 2**

Course Objectives	• To understand the fundamentals of basics semiconductor physics • To understand the formation of diode using semiconductors • To understand the basic concepts of rectifiers and transistors. • To provide problem solving experience and learning of concepts through it in Semiconductor Physics, in both the classroom and the laboratory learning environment.	
Course Outcomes	After successful completion of this course, students are expected to: • Understand fundamentals of energy band theory in semiconducting materials. • Understand the basic of Intrinsic and Extrinsic Semiconductors. • Understand the concepts diodes, rectifiers and transistors and their applications in real life . • Analyze and apply the elementary understanding of the measurement techniques for semiconductor.	
Unit	**Contents**	**Hours**
Unit I	**Theory of semiconductors:** • Conductors, insulator and semiconductors. • Types of semiconductors: Intrinsic and extrinsic semiconductors. • Band structure of semiconductors. • Carrier concentration in intrinsic and extrinsic semiconductors. • Electrical conductivity and conduction mechanism in semiconductors. • Fermi level in intrinsic and extrinsic semiconductors and its dependence on temperature and carrier concentration. • Carrier generation – recombination, mobility, drift-diffusion current. • Hall effect (Definition).	**08**
Unit II	**Semiconductor Diodes:** • PN junction diode and Barrier Formation in PN Junction Diode. • Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. • PN junction and its characteristics. • Static and Dynamic Resistance. • Principle, Construction, Working and Characteristics of (1) LEDs (2) Photodiode (3) Solar Cell (P-N Junction), (4) Zener Diode (5) Schottky diode	**08**
Unit III	**Rectifiers and Power Supplies** • Introduction to Rectifiers • Types: Half-wave & Full-Wave Rectifiers (Centre-tapped and Bridge Rectifiers) • Calculation of Ripple Factor and Rectification Efficiency • Basic idea about capacitor filter • D.C. power Supply (unregulated and regulated) • Zener diode as a voltage regulator	**07**
Unit IV	**Bipolar junction transistor** • Bipolar Junction transistors: n-p-n and p-n-p Transistors. • Characteristics of CB, CE and CC configurations. • Active, Cutoff, and Saturation Regions. • Current gains α and β and Relations between α and β.	**07**

	• Load Line analysis of Transistors. • DC Load line and Q point. • Transistor as an Amplifer	
Study Resources	• Electronic Principles – A. P. Malvino, McGraw-Hill Publishing House • Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition • Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi • Electronic Devices and Circuits – Allen Mottershead, Good year Publishing Company • Digital Principles and Applications – Malvino and Leach, McGraw-Hill Publication. • Modern Digital Electronics – R. P. Jain, Tata McGraw-Hill Pvt. Ltd., New Delhi • Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. • Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill. • Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning. • Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press. • Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.	

S.Y. B.Sc. Physics (Minor)
Semester-IV
PHY-MIN-242: Practical on Semiconductor Devices

Total Hours: 60 **Credits: 2**

Course Objectives	▪ To understand concept of semiconductor. ▪ To understand the forward and reverse characteristics of different diodes. ▪ To understand the characteristics and various factors of rectifiers and transistors. ▪ To develop the experimental skills of students.	
Course Outcomes	After successful completion of this course, students are expected to: • Apply the concept of use of knowledge of semiconductors to real life problems. • Understand the characteristics and various factors of diodes, rectifiers and transistors practically. • Able to handle the different components of semiconductors in Laboratory. • Understanding of the course will create scientific temperament.	
Sr. No.	**Contents**	**Hours**
1	Identification of electronic components and their specification (diodes, transistors),	**4**
2	Forward Biased characteristics of P-N Junction Diodes.	**4**
3	To Study of half wave rectifier with capacitor filter and to calculate its ripple factor.	**4**
4	To plot V-I Characteristics of Zener Diode.	**4**
5	To study Zener diode as a voltage regulators.	**4**
6	To study the characteristics of Light Emitting Diode (LED).	**4**
7	To determine fill factor and efficiency of solar cell.	**4**
8	To determine band gap of semiconductor (Si/ Ge)	**4**
9	To study resistivity of semiconductor material using Four Probe Method	**4**
10	Reverse Biased characteristics of P-N Junction Diodes.	**4**
11	To Study of bridge full wave rectifier with capacitor filter and to calculate its ripple factor.	**4**
12	To Study of center tap full wave rectifier with capacitor filter and to calculate its ripple factor.	**4**
13	To study the characteristics of BJT	**4**
14	Study of D.C. power Supply (unregulated and regulated)	**4**
15	Study of a Single Stage CE amplifier.	**4**
Study Resources	• Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House. • Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers • A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi. • A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication. • College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi) 11. Practical Physics: Gupta and Kumar (PragatiPrakashanMeerat)	

***Mandatory to perform any 12 practical from above.**

S.Y. B.Sc. Physics (Open Elective)
Semester-IV
PHY-OE-241: Solar Cell Technologies

Total Hours: 30 **Credits: 2**

Course Objectives	• This syllabus is design to provide basic knowledge of solar radiation. • It gives students detail information of energy generation from solar cell. • To understand different types of solar cell. • It may help students application of solar energy for different purposes.	
Course Outcomes	After successful completion of this course, students are expected to: • Get familiar with basic of solar radiation and its measurement. • Learn about working principle of of solar cells, I-V characteristics,efficiency and power output of solar cell. • Learn about different types of solar cell. • Understand the grid connections with solar plants and may help in further studies for solar panel installation.	
Unit	**Contents**	**Hours**
Unit I	**Solar Radiation** ▪ Issues concerning the use of the conventional energy sources, ▪ Renewable energy and its role in energy supply spectral energy distribution of solar radiation, ▪ Depletion of solar radiation - Absorption, scattering, atmospheric attenuation, ▪ Measurement of solar radiation, Solar radiation geometry, Calculation of angle of incidence, ▪ Calculation of total solar radiation on horizontal and tilted surfaces. Angles for tracking surfaces.	**07**
Unit II	**Solar Cell and its Types** ▪ Solar radiation to electrical energy conversion, ▪ basic structure of a solar cell, Current-voltage characteristics, equivalent circuit, efficiency, power curve, maximum power point ▪ Classification of solar cells- mono, poly-crystalline, amorphous silicon, cadmium telluride, copper indium gallium di selenide cells. ▪ Optical, ohmic and recombination losses in solar cells, measures for improving efficiency.	**08**
Unit III	**Grid Systems and Maintanence** ▪ Module, panel and array, series and parallel connection of solar cells, I-V characteristics of a PV module, ▪ Block diagram of grid system, installation and types of grid system ▪ Effect of irradiation and temperature on performance of PV panel ▪ Routine Maintenance Procedures, Cleaning Solar Panels, Troubleshooting and Diagnostics, Safety and Performance Monitoring.	**07**
Unit IV	**Application of Solar cell technologies** ▪ Residential Energy Generation(Solar Panels for Homes, Solar Roof Tiles), Commercial and Industrial Energy Generation (Solar Farms, Building-Integrated Photovoltaics), Portable Power Backup Devices, Off-Grid Energy Solutions (Remote Area Power supply, Solar-Powered Water Pumps), Electric Vehicles, Agricultural Applications (Solar Irrigation Systems, Greenhouses, Solar-Powered Lighting), Solar Thermal Systems, Military and Defense	**08**

	Applications(Solar-Powered Drones, Remote Base Power). ▪ Career Opportunities:Roles in solar installation, Maintenance and service technician roles, Solar project management and consultancy.	
Study Resources	▪ Andrews, J., & Jelley, N. (2010). Energy science. Oxford University Press. ▪ De Vos, A. (2008). Thermodynamics of solar energy conversion. Wiley-VCH. ▪ Duffie, J. A., & Beckman, W. A. (2006). Solar engineering of thermal processes (3rd ed.). Wiley. ▪ Foster, R., Ghassemi, M., & Cota, A. (2010). Solar energy. CRC Press. ▪ Garg, H. P., & Prakash, J. (2005). Solar energy: Fundamentals and applications. Tata McGraw-Hill. ▪ Goswami, Y. D., Kreith, F., & Kreider, J. F. (2003). Principles of solar engineering (2nd ed.). Taylor & Francis. ▪ Kalogirou, S. (2009). Solar energy engineering: Processes and systems. Elsevier. ▪ Petela, R. (2010). Engineering thermodynamics of thermal radiation for solar power. McGraw-Hill Co. ▪ Vogel, W., & Kalb, H. (2010). Large-scale solar thermal power technology. Wiley-VCH.	