

Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.



NAAC- 'A+' Grade

CIRCULAR NO.SU/ Sci./College/NEP-2020/73/2025

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies/ Ad-hoc Boards/Committee and recommended by the Dean, Faculty of Science & Technology, the Academic Council at its meeting held on 09 May 2025 has been accepted **the following B.Sc. Course Structure & Curriculum** under the Faculty of Science & Technology as per National Education Policy - 2020 run at the Affiliated Colleges of Dr. Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1	B.SC. PHYSICS	III RD AND IV TH SEMESTER
2	B.SC. ELECTRONICS	III RD AND IV TH SEMESTER
3	B.SC. MATHEMATICS	III RD AND IV TH SEMESTER
4	B.SC. INDUSTRIAL CHEMISTRY	III RD AND IV TH SEMESTER
5	B.SC. AGROCHEMICAL AND FERTILIZE	III RD AND IV TH SEMESTER
6	B.SC. HORTICULTURE	III RD AND IV TH SEMESTER
7	B.SC. BIOCHEMISTRY	III RD AND IV TH SEMESTER
8	B.SC. BOTANY	III RD AND IV TH SEMESTER
9	B.SC. ZOOLOGY	III RD AND IV TH SEMESTER
10	B.SC. BIOTECHNOLOGY	III RD AND IV TH SEMESTER
11	B.SC. MICROBIOLOGY	III RD AND IV TH SEMESTER
12	B.SC. DIARY SCIENCE AND TECHNOLOGY	III RD AND IV TH SEMESTER
13	B.SC. STATISTICS	III RD AND IV TH SEMESTER
14	B.SC. COMPUTER SCIENCE	III RD AND IV TH SEMESTER
15	B.SC. GEOLOGY	III RD AND IV TH SEMESTER
16	B.SC. CHEMISTRY	III RD AND IV TH SEMESTER
17	B.SC. ANALYTICAL CHEMISTRY	III RD AND IV TH SEMESTER
18	B.SC. POLYMER CHEMISTRY	III RD AND IV TH SEMESTER
19	B.SC. ENVIRONMENTAL SCIENCE	III RD AND IV TH SEMESTER
20.	B.SC. FISHERIES SCIENCE	III RD AND IV TH SEMESTER

21.	B.SC. HOME SCIENCE	III RD AND IV TH SEMESTER
22.	B.SC. DATA SCIENCE	III RD AND IV TH SEMESTER
23.	B.SC. INFORMATION TECHNOLOGY	III RD AND IV TH SEMESTER
24.	B.SC. NETWORKING AND MULTIMEDIA	III RD AND IV TH SEMESTER
25.	B.SC. AUTOMOBILE TECHNOLOGY	III RD AND IV TH SEMESTER
26.	B.SC. FORENSIC SCIENCE	III RD AND IV TH SEMESTER
27.	B.SC. FORENSIC SCIENCE & CYBER SECURITY	III RD AND IV TH SEMESTER
28.	B.SC. NON-CONVENTIONAL & CONVENTIONAL ENERGY	III RD AND IV TH SEMESTER
29.	B.SC. CLINICAL LABORATORY SCIENCE	III RD AND IV TH SEMESTER
30.	BACHELOR OF COMPUTER APPLICATION	III RD AND IV TH SEMESTER

This is effective from the Academic Year 2025-26 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrapati Sambhajinagar
-431 004.

Ref.No. SU/Sci./2025/ 827-29
Date:- 26/05/2025

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*Deputy Registrar,
Syllabus Section.*

Copy forwarded and necessary action to :-

- 1] **The Principal of all Affiliated Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,
- 2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

- 1] The Director, Board of Examinations & Evaluation, Dr. Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY
CHHATRAPATI SAMBHAJI NAGAR – 431004**



FACULTY OF SCIENCE AND TECHNOLOGY

B.Sc. Degree Programme

(Three Year / Four Years (Honors) / Four Years (Honors with Research))

Course Structure and Curriculum

(Revised)

(AS PER NEP-2020)

Syllabus of

(Non Conventional & Conventional Energy)

B. Sc. Second Year

Semester – III and IV

Effective from 2025-26

**DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY
CHHATRAPATI SAMBHAJI NAGAR – 431004**

PREFACE

As we stand on the threshold of a new era in education, the dawn of the National Education Policy 2020 illuminates our path toward a holistic, inclusive, and progressive educational landscape. The Bachelor of Science (B. Sc.) curriculum outlined herein reflects the ethos and aspirations of this transformative policy, aiming to equip learners with the knowledge, skills, and values necessary to thrive in the dynamic world of the 21st century.

At its core, the National Education Policy 2020 envisions an educational framework that is learner-centric, multidisciplinary, and geared towards fostering creativity, critical thinking, and innovation. It emphasizes the integration of knowledge across disciplines, breaking down traditional silos to encourage holistic understanding and application of concepts. The Bachelor of Science (B. Sc.) curriculum embodies these principles by offering a diverse array of courses spanning various scientific domains, while also incorporating interdisciplinary studies to nurture well-rounded graduates capable of addressing complex challenges with agility and insight.

Furthermore, the curriculum is designed to promote experiential learning, research, and hands-on exploration, recognizing the importance of practical engagement in deepening understanding and cultivating real-world skills. Through laboratory work, field experiences, internships, and project-based learning opportunities, students will have the chance to apply theoretical knowledge in practical settings, develop problem-solving abilities, and cultivate a spirit of inquiry and discovery.

Integral to the National Education Policy 2020 is the commitment to inclusivity, equity, and access to quality education for all. The Bachelor of Science (B. Sc.) curriculum reflects this commitment by embracing diversity in perspectives, backgrounds, and experiences, and by fostering an inclusive learning environment where every student feels valued, supported, and empowered to succeed.

Moreover, the curriculum emphasizes the cultivation of ethical values, social responsibility, and global citizenship, instilling in students a sense of accountability towards society and the environment. By integrating courses on ethics, sustainability, and social sciences, the Bachelor of Science (B. Sc.) program aims to produce graduates who are not only proficient in their respective fields but also compassionate, ethical leaders committed to making a positive impact on the world.

As we embark on this journey of educational transformation guided by the National Education Policy 2020, the Bachelor of Science (B. Sc.) curriculum stands as a testament to our collective vision of a more equitable, inclusive, and enlightened society. It is our hope that through rigorous academics, innovative pedagogy, and unwavering dedication to excellence, we can inspire the next generation of scientists, scholars, and change-makers to realize their full potential and contribute meaningfully to the advancement of knowledge and the betterment of humanity.

Course Structure

Course and credit distribution structure as per NEP-2020
Illustrative Credit distribution for three/four year Honours with Research Degree Programme with
multiple entry and exit options
B.Sc. Second Year (III Semester) Subject: NCCE

Course Type	Course Code	Examination Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
				Theory	Practical	Theory	Practical	
Major (Core) Mandatory DSC	NCCE/DSC-5/T/200	SAC12072003T	Solar Photo Voltaic Energy -I	2		2		2+2+2+2 = 08
	NCCE/DSC-6/T/201	SAC12072013T	Bio Gas Technology	2		2		
	NCCE/DSC-7/P/226	SAC12072003P	Practical based on SUB/DSC/T/200		4		2	
	NCCE/DSC-8/P/227	SAC12072013P	Practical based on SUB/DSC/T/201		4		2	
Minor (Choose any two from pool of courses) It is from different discipline of the same faculty	NCCE/Mn-1/T/200	SCC12072003T	To be chosen from other discipline	2		2		2+2 = 04
	NCCE/Mn-2/T/201	SCC12072013T	To be chosen from other discipline	2		2		
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) It should be chosen compulsorily from the faculty other than that of Major	NCCE/GE/OE-1/T/200	SDC12072003T	To be chosen from other faculty	2		2		02
VSC(Vocational Skill Courses) (Choose any one from SUB/VSC/T/ 200 and SUB/VSC/T/ 201) and corresponding Practicals	NCCE/VSC-1/T/200	SEC12072003T	Electrical Vehicle Technology	1		1		1+1 =02
	NCCE/VSC-2/T/201	SEC12072013T	Drone Technology	1		1		
	NCCE/VSC-3/P/226	SEC12072003P	Practicals based on SUB/VSC/T/ 200		2		1	
	NCCE/VSC-4/P/227	SEC12072013P	Practical's based on SUB/VSC/T/ 201		2		1	
AEC, VEC, IKS	SUB/AEC/T/200		English (Common for all the faculty)	2		2		2 + 2 = 04
	SUB/VEC/T/201		Environmental Studies	2		2		
OJT/ FP/CEP/CC/RP	SUB/CC/P/226		Cultural Activity / NSS,NCC (Common for all the faculty)		4		2	02
				15	14	15	07	22

Minor Courses for other Discipline

SUB/Mn/T/ 200: This is a 2-credit theory course designed for other discipline (**Green Chemistry**)

SUB/Mn/T/ 201: This is a 2-credit theory course designed for other discipline (**Digital Electronics**)

Generic /Open Elective Courses for other faculty

SUB/GE/OE/T/200: This is a 2-credit theory course designed for other faculty (**Maths for Competitive Success**)

Course Structure

Course and credit distribution structure as per NEP-2020
Illustrative Credit distribution for three/four year Honours with Research Degree Programme with multiple entry and exit options
B.Sc. Second Year (IV Semester) Subject: NCCE

Course Type	Course Code	Examination Code	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
				Theory	Practical	Theory	Practical	
Major (Core) Mandatory DSC	NCCE/DSC-9/T/250	SAC12072504T	Solar Photo Voltaic Energy -II	2		2		2+2+2+2 = 08
	NCCE/DSC-10/T/ 251	SAC12072514T	Semi-Conductor Technology	2		2		
	NCCE/DSC-11/P/ 276	SAC12072504P	Practical based on SUB/DSC/T/250		4		2	
	NCCE/DSC-12/P/ 277	SAC12072514P	Practical based on SUB/DSC/T/ 251		4		2	
Minor (Choose any two from pool of courses) It is from different discipline of the same faculty	NCCE/Mn-3/T/250	SCC12072504T	To be chosen from other discipline	2		2		2+2 = 04
	NCCE/Mn-4/T/251	SCC12072514T	To be chosen from other discipline	2		2		
Generic / Open Elective (GE/OE) (Choose any one from pool of courses) It should be chosen compulsorily from the faculty other than that of Major	NCCE/GE/OE-2/T/250	SDC12072504T	To be chosen from other faculty	2		2		02
SEC(Skill Enhancement Courses)(Choose any one from SUB/SEC/T/250and SUB/SEC/T/ 251) and corresponding Practicals	NCCE/SEC-1/T/250	SEC12072504T	Green Energy	1		1		1+1 =02
	NCCE/SEC-2/T/ 251	SEC12072514T	Energy Management	1		1		
	NCCE/SEC-3/P/276	SEC12072504P	Practical's based on SUB/SEC/T/250		2		1	
	NCCE/SEC-4/P/277	SEC12072514P	Practical's based on SUB/SEC/T/ 251		2		1	
AEC, VEC, IKS	SUB/AEC/T/250		Modern Indian Language (MIL-2) (Choose any one from pool of language courses)	2		2		02
OJT/ FP/CEP/CC/RP	SUB/FP/P/276		Field Project		4		2	2+2= 04
	SUB/CC/P/277		(Fine/ Applied/ Visual/ Performing Arts) (Common for all the faculty)		4		2	
				13	18	13	09	22

Exit Option: Award of UG Diploma in major and minor with 88 credits and an additional 4 credits NSQF course (related to major / minor) / Internship during summer vacation OR Continue with Major and Minor

Minor Courses for other Discipline

SUB/Mn/1/ 250: This is a 2-credit theory course designed for other discipline (Thin Film Technology)

SUB/Mn/T/ 251: This is a 2-credit theory course to be designed for other discipline (Medical Physics)

Generic /Open Elective Courses for other faculty

SUB/GE/OE/T/250: This is a 2-credit theory course to be designed for other faculty (Environmental Remediation)

Detailed Illustration of Courses included in 3rd and 4th semester:

Detailed Illustration of Courses included in 3rd and 4th semester:

1) Major (Core) subject is mandatory.

SUB/DSC/T/200: This is a 2-credit theory course corresponding to Major (core) subject

SUB/DSC/T/201: This is a 2-credit theory course corresponding to Major (core) subject

SUB/DSC/P/226: This is a 2-credit practical course based on SUB/DSC/T/200

SUB/DSC/P/227: This is a 2-credit practical course based on SUB/DSC/T/201

SUB/DSC/T/250: This is a 2-credit theory course corresponding to Major (core) subject

SUB/DSC/T/251: This is a 2-credit theory course corresponding to Major (core) subject

SUB/DSC/P/276: This is a 2-credit practical course based on SUB/DSC/T/250

SUB/DSC/P/277: This is a 2-credit practical course based on SUB/DSC/T/251

2) Minor: It is from different discipline of the same faculty

SUB/Mn/T/200: This is a 2-credit theory from different discipline of the same faculty

SUB/Mn/T/201: This is a 2-credit theory from different discipline of the same faculty

SUB/Mn/T/250: This is a 2-credit theory from different discipline of the same faculty

SUB/Mn/T/251: This is a 2-credit theory from different discipline of the same faculty

3) Generic / Open Elective (GE/OE): (Needs to be chosen (any one) from pool of courses available at respective college). **These courses should be chosen compulsorily from faculty other than that of Major.**

SUB/GE/OE/T/200: This is a 2-credit theory course should be chosen compulsorily from faculty other than that of Major.

SUB/GE/OE/T/250: This is a 2-credit theory course should be chosen compulsorily from faculty other than that of Major.

4) VSC (Vocational Skill Courses): Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.

SUB/VSC/T/200: This is a 1 credit theory course-based Hands-on Training corresponding to Major (core) subject.

SUB/VSC/T/201: This is a 1 credit theory course-based Hands-on Training corresponding to Major (core) subject.

SUB/VSC/P/226: This is a 1 credit practical course based on SUB/VSC/T/200

SUB/VSC/P/227: This is a 1 credit practical course based on SUB/VSC/T/201

- 5) **SEC** (Skill Enhancement Courses): Choose any one from pool of courses. These courses should be based on Hands on Training corresponding to Major (core) subject.

SUB/SEC/T/250: This is a 1 credit theory course to enhance the technical skills of the students in specific area.

SUB/SEC/T/251: This is a 1 credit theory course to enhance the technical skills of the students in specific area.

SUB/SEC/P/276: This is a 1 credit practical course based on **SUB/SEC/T/250**

SUB/SEC/P/277: This is a 1 credit practical course based on **SUB/SEC/T/251**

- 6) **AEC** (Ability Enhancement courses): The focus of these courses should be based on linguistic and communication skills.

SUB/AEC/T/200: English

This is a 2-credit theory course based on linguistic proficiency.

SUB/AEC/T/250: Modern Indian Language MIL-2 (Hindi/ Marathi/ Pali & Buddhism/ Sanskrit/ Urdu)

This is a 2-credit theory course based on linguistic proficiency. Students will have to choose one of the above-mentioned languages.

- 7) **VEC:** Environmental Studies

SUB/VEC/T/201: Environmental Studies

This is 2-credit theory course based on Environmental Studies.

- 8) **FP-1: Field Project:**

SUB/FP/P/276: This is a 2-creditcourse, should be corresponding to Major (core) subject

- 9) **CC** (Curricular Courses): The courses such as Health and wellness, Yoga education, Sports and Fitness, Cultural activities, NSS/NCC, Performing Arts.

SUB/CC/P/226: Cultural Activity / NSS, NCC

This is a 2-credit practical course based on Co-curricular activities. It will be common for all the faculty

SUB/CC/P/277: Fine/ Applied/ Visual/ Performing Arts

This is a 2-credit practical course based on Co-curricular activities. It will be common for all the faculty

CURRICULUM

B. Sc. (NCCE) Second Year

Third Semester

Major (DSC-5): SOLAR PHOTOVOLTAIC ENERGY – I

Course Code: NCCE/DSC-5/T/200

Examination Code: SAC12072003T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Explain the fundamental principles of the Solar Cell and its characteristics classification.
- Describe experimental techniques and their significance.
- Explore applications of PV solar devices.
- Solve numerical and conceptual problems in solar cells.

Course Outcomes: *On successful completion of this course students will be able to:*

- Able to explain the factors influencing solar cells, explain the experimental setup and apply it for applications
- Understand the fundamentals of PN junction diode, solar cell systems, their characteristics and diversified applications including industry.
- Use this knowledge for applications of solar cell in specific fields of their interest

Unit – I: PLACE OF PV IN WORLD ENERGY SCENARIO

[10 L]

World Energy Requirement, Need for sustainable Energy Sources, Limited Fossil Fuels, Environmental Impact of Fossil Fuels, Energy Security and Potential for Conflicts, Sustainable Sun's Energy, Sun's Energy : Advantages, Sun's Energy : Conversion Challenges, Other Energy Alternatives, Current Status of Renewable Energy Sources, Wind Energy Technology, Solar Thermal Technologies, Biomass Energy Technologies

Unit – II: AN INTRODUCTION TO SOLAR CELLS

[10L]

Why P-N Junction Diode? Space Charge Region, Energy Band Diagram of P-N Junction, P-N Junction Potential, Width of Depletion Region, Carrier Movements and Current Densities, Carrier Concentration Profile, P-N Junction in Non-equilibrium Condition, P-N Junction I-V Relation: A Qualitative Analysis, P-N Junction I-V Relation: A Quantitative Analysis, P-N Junction under Illumination: Solar Cell, Generation of Photo voltage, Light Generated Current, I-V Equation of Solar Cells, Solar Cell Characteristics

Unit – III: SOLAR CELL CHARACTERISTICS AND CLASSIFICATION

[10L]

I-V Characteristics?, Effect of variation of Irradiation and Temperature, Energy Losses and Efficiency., Maximizing the Performance, Cell Size, Energy payback Period (EPP), On the Basis of Thickness of Active Material, On the Basis of Junction Structure., On the Basis of Type of Active Material, Single Crystal (or Mono Crystalline) Silicon Cell. Production of Mono crystalline Silicon Cell. Multi crystalline Silicon Solar Cell. Amorphous Silicon (a-Si) Solar Cell.

Learning Resources:

1. Non-Conventional Energy Resources, B. H. Khan, The McGraw Hill Publications.
2. Non-Conventional Energy Sources, G.D. Ray, Khanna Publications.
3. Solar Photo Voltaics: Fundamental, Technologies and Applications, C.S. Solanki, Prentice Hall of India, 2011.

Major (DSC-6): Bio-gas Technology

Course Code: NCCE/DSC-6/T/201

Examination Code: SAC12072013T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Biogas technology can not only provide fuel, but is also important for comprehensive utilization of biomass forestry, animal husbandry, fishery, agricultural economy, protecting the environment, realizing agricultural recycling, as well as improving the sanitary conditions, in rural areas.
- Improve the properties of the soil through the high-quality organic fertilizer.
- Reduce the pollution in villages by reducing the bio-waste and agricultural waste and organic garbage.

Course Outcomes: *On successful completion of this course students will be able to:*

- Biogas is a renewable energy source that can replace fossil fuels, which are carbon-intensive. Biogas can reduce methane and black carbon emissions.
- Biogas can provide a reliable, local source of energy for cooking, lighting, and electricity.
- Biogas can help improve global health by reducing the need to burn wood, dung, or fossil fuels for household energy.
- Biogas can improve resource efficiency by turning organic waste into higher-value products.

Unit – I: An Overview of Biogas Technology

[10L]

Introduction., Historical Background of Bio-methanation, An Overview Of Bio-methanation in India, Basic of anaerobic fermentation, Actors affecting Biogas Yield, Commonly Used Feed Materials for Bio-methanation, Properties and Characteristics of Biogas. Potential of Biogas Plant Sludge as Enriched Fertilizer., Biomethanation as an aid for Environment Improvement., Applications of Biogas., Community Versus Family Size Plants., Integrated Farming System., Concluding Remarks.

Unit – II: Properties of Biogas and Methods for Purification

[10L]

Introduction, Important Properties, Safety Aspects for Handling Bio-gas, Removal of Carbon-Dioxide from Biogas, Removal of Hydrogen Sulphide from Biogas, Microbiological Methods of Purification, Concluding Remarks

Unit – III: Biogas Plant Designs and Generation from Wastes

[10L]

Introduction, Movable Drum Type Plants, Fixed Dome Type Plants, An Overview of Select Plant Designs in World. Biogas Generation from Bagasse, Biogas Generation from Pressmud, Biogas Production from Canteen Wastes., Biogas Production from Distillery Wastes., Biogas Production from Textile Mill Wastes., Biogas Production form Confectionery Wastes., Biogas Production form Fruit and Vegetable Wastes.

Learning Resources:

1. Bio-gas System, Principal and Application. K M Mittal
2. Non-Conventional Energy Sources. G.D. Ray, Khanna Publications.
3. Non-Conventional Energy Resources, B.H. Khan, Tata Mc-Graw Hill Publications.
4. Handbook on Biogas and Its Applications e- book By NIIR Board of Consultants & Engineers,

Major (DSC-7): Practicals Based on DSC-5

Course Code: NCCE/DSC-7/P/226

Examination Code: SAC12072003P

Total Contact Hours: 60

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Introduces to the concepts of converting sunlight to electricity with photovoltaic cells.
- Study the characteristics of different types of photovoltaic cells.
- Students can learn about the uses of PV systems.
- Calculate the amount of solar energy on Earth at a given time and location.

Course Outcomes: *On successful completion of this course students will be able to:*

- Explain the basic physics behind the photovoltaic effect
- Describe the different components of a solar PV system and their functions
- Analyze the economic viability of a solar PV project
- Identify the environmental benefits of solar power

1. Construction the Photovoltaic Energy system for light source changes (wear goggles)
2. Performing the activity for Light
3. Construction the Photovoltaic Energy system for Temperature
4. Performing the activity for effects of distance from light source
5. Performing effects of Tilt angle on cell current
6. Performing effects of Shading on cell current PV Cells in series.

Major (DSC-8): Practicals Based on DSC-6

Course Code: NCCE/DSC-8/P/227

Examination Code: SAC12072013T

Total Contact Hours: 60

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- understanding the potential of biogas as a renewable energy source, gaining knowledge about different biogas plant designs and operations,
- Identify the different types of microorganisms involved in biogas production.
- Understand the factors affecting biogas yield (temperature, pH, substrate composition)
- To ensure relevant knowledge acquisition and skill development in biogas technology.

Course Outcomes: *On successful completion of this course students will be able to:*

- The participants will learn about basic, types of waste materials, design of different digester, installation, operating procedures, systematic maintenance practices, & trouble shooting etc.
- Biogas is an environmentally-friendly, renewable energy source produced by the breakdown of organic matter such as food scraps and animal waste.
- Biogas could help slow climate change, improve global health, reduce agricultural losses, increase energy access, and improve people's lives and businesses

1. Bio gas is used as a fuel for cooking food and other domestic uses.
2. Fixed dome digester
3. Fixed dome plant design
4. Basic function of a fixed-dome biogas plant
5. Floating drum digester
6. Floating drum digester (Indian model)
7. Bag digester
8. Plug flow digester
9. Plug flow digester
10. Plug flow digester model
11. Anaerobic filter
12. Upflow anaerobic sludge blanket –UASB plants

Note: Students should perform at least six experiments

Minor-1: Green Chemistry
Course Code: NCCE/Mn-1/T/ 200
Examination Code: SCC12072003T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- With the environmental concern and shrinking resources procuring mammoth proportions,
- it has become imperative to conceive safer alternative materials and technology that would ensure the human sustenance.
- This course intends to take the students through the newer, environment friendly products and procedures and incite them to take a more holistic view of different chemical processes.

Course Outcomes: *On successful completion of this course students will be able to:*

1. Understand the importance of Green Chemistry and Green Synthesis.
2. Engage in Microwave assisted organic synthesis.
3. Demonstrate skills using the alternative green solvents in synthesis.
4. Demonstrate and explain enzymatic catalysis.
5. Analyze alternative sources of energy and carry out green synthesis.
6. Carry out the chemical method of nonmaterial synthesis.

Unit –I: Introduction to Green Chemistry

[10L]

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/Obstacles in the pursuit of the goals of Green Chemistry. Definition and concepts: green chemistry; sustainable consumption of resources; individual community level participation such as small-scale composting pits for biodegradable waste.

Unit – II: Principles of Green Chemistry and Designing a Chemical synthesis.

[10L]

Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles: Prevention of Waste/byproducts: maximum incorporation of the materials used in the process into the final products (Atom Economy)

Unit – III: Cleaner Production

[10L]

The Cleaner Production Concept, Why Cleaner Production. Difference with End of Pipe Concept. Cleaner Production and Sustainable Development. Implementation of Cleaner Production. Change of Raw Material. Technology Change. Good Operating Practice. Product Change. On Site Reuse and Recycling. Who Is Responsible For Cleaner Production. Government Rules.

Learning Resources:

1. Anastas P.T., Warner, J.Green Chemistry and Practice; Oxford University Press: London, 1998.
2. Mukesh Doble, Anil Kumar Kruthiventi, in Green Chemistry and Engineering.2007
3. VK.Ahluwalia & M.R. Kidwai : New Trends in Green Chemistry Anamalaya Publishers 2005
4. P.T. Anastes &J.K. Warner: Oxford Green Chemistry Theory and Practical University Press(1998)
5. A.S.Mallack: Introduction to Green Chemistry, Marcel Deckkar (2001).
6. M.C. Cann &M.E. Connely: Real-World case in Green Chemistry, American Chemical Society, Washington (2000).
7. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical (2002).

Minor-2: Digital Electronics
Course Code: NCCE/Mn-2/T/ 201
Examination Code: SCC12072013T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the basics of digital electronics and its applications in scientific fields.
- Develop proficiency in designing and interpreting simple digital circuits.
- Relate digital systems to real-world scientific experiments.
- Gain foundational knowledge to explore advanced digital systems in the future.

Course Outcomes: *On successful completion of this course students will be able to:*

- Describe and explain the fundamentals of digital electronics.
- Perform number system conversions and basic logic operations.
- Design and simulate simple combinational and sequential logic circuits.
- Recognize the importance of digital systems in scientific research and experiments.

Unit – I: Number System:

[10L]

Binary, decimal, octal, and hexadecimal number system; Number system conversions, Arithmetic operations on binary number system: Addition, Subtraction Multiplication and division, problems

Unit –II: Logic Gates:

[10L]

Basic concepts of logic gates, All basic logic gates (AND, OR, NOT) Algebraic form, graphical symbols truth tables and physical circuit with switches, Implementation of NOT gate using all basic gates, Universal gates (NAND, NOR), Implementation of gates using universal gates

Unit –III: Boolean Algebra:

[10L]

Concept of Boolean Algebra, Boolean Laws: Commutative Law, Associative Law, Distributive Law, Associative law, Identity Laws, Null Law, Complement Law, De Morgan's law, SOP and POS form of Boolean expression, simplification of Boolean Expression

Learning Resources

- 1) Digital Fundamentals: by Thomas L. Floyd
- 2) Digital Principles and Applications: by Donald P. Leach, Albert Paul Malvino, and Goutam Saha
- 3) Digital Electronics: Principles and Applications, by Roger L. Tokheim
- 4) Modern Digital Electronics: by R.P. Jain
- 5) Digital Electronics: by S. Salivahanan
- 6) Digital Electronics: Principles and Integrated Circuits” by Anil K. Maini's

GE/OE-1: Maths for Competitive Success

Course Code: NCCE/GE/OE-1/T/200

Examination Code: SDC12072003T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- To improve arithmetical abilities
- To understand number systems
- To develop analytical and critical thinking skills
- To improve logical reasoning
- To enable students to solve problems quickly and effectively with applying appropriate techniques and strategies for competitive examinations

Course Outcomes: *On successful completion of this course students will be able to:*

- Understand and apply fundamental mathematical concepts essential for various competitive exams
- Apply logical reasoning, analytical thinking, and problem solving techniques to tackle quantitative aptitude questions efficiently
- Improve calculation speed and accuracy
- Apply problem solving strategies and computational skills to solve problems
- Demonstrate a strong foundation in mathematical concepts

Unit - I: Number System,

[10 L]

H.C.F. and L.C.M. of Numbers, Simplification, Square Roots and Cube Roots, Average, Problems on Ages, Percentage, Profit and Loss

Unit - II: Ratio and Proportion,

[10 L]

Pipes and Cisterns, Time and Work, Time and Distance, Boats and Streams, Problems on Trains, Simple Interest, Compound Interest, Area

Unit - III: Volume and Surface Areas,

[10 L]

Races and Games of Skill, Calendar, Clocks, Stocks and Shares, True Discount, Height and Distance

Learning Resources:

1. Dr. R. S. Aggarwal, "Quantitative Aptitude", S. Chand, 2024
2. Er. Deepak Agarwal and Mr. D. P. Gupta, "Rapid Quantitative Aptitude", Disha Publication, 2019.
3. Arun Sharma, "Teach Yourself Quantitative Aptitude", McGraw Hill Education, 2017

Scope:

Chapter-1, 2, 4, 5, 6, 8, 11, 12, 13, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 32, 34 [Text Book 1]

VSC-1: Electrical Vehicle Technology

Course Code: NCCE/VSC-1/T/ 200

Examination Code: SEC12072003T

Total Contact Hours: 15

Credit: 01

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- To provide fundamental knowledge of electric vehicle systems, components, and principles of operation.
- To develop an understanding of energy storage, battery technologies, and charging infrastructure.
- To equip students with hands-on experience in basic diagnostics, assembly, and testing of EV components.

Course Outcomes: *On successful completion of this course students will be able to:*

- Demonstrate a clear understanding of electric vehicle technology and its role in sustainable mobility.
- Apply knowledge of battery systems, energy management, and charging techniques in practical scenarios.
- Perform basic diagnostics, assembly, and maintenance of electric vehicles.

Unit – I: Introduction to Electric Vehicle Technology

[5 L]

Overview of Electric Vehicles (EVs): Definition, types, and advantages, Comparison of EVs with internal combustion engine (ICE) vehicles, Environmental and economic benefits of EVs, Career opportunities in the EV sector.

Unit – II: EV Components and Systems

[5 L]

Basic EV Architecture: Powertrain, motor, and controller, Battery Technology: Types, working principles, capacity, and energy density, Charging Systems: Types of chargers, charging standards, and infrastructure, Regenerative Braking Systems.

Unit – III: Emerging Trends and Challenges in EV Technology

[5 L]

Smart Features in EVs: Connectivity, IoT, and autonomous capabilities, Challenges: Range anxiety, battery recycling, and infrastructure limitations, Future Trends: Advances in battery technology, hydrogen fuel cells, and hybrid EVs, Government initiatives and policies for EV adoption in India.

Learning Resources:

1. Modern Electric Hybrid Electric & Fuel Cell Vehicles, by Stefano Longo Mehrdad Ehsani, Yimin Gao, TAYLOR & FRANCIS EXCLUSIVE(OTHERS); Third edition (2019)
2. Electric and Hybrid Vehicles, by A. K. Babu, Khanna Publishing (2022)
3. Electric and Hybrid Electric Vehicles, by James D. Halderman, Curt Ward, Pearson Education India,
4. Fundamentals of Hybrid and Electric Vehicles, by Prof. K.C.Jain, Dr.AmitR.Patil, Dr. Arvind J. Bhosale, Dr. S.S. Raghuvanshi, Khanna Publishers New Delhi; First Edition (2024)

VSC-2: Drone Technology
Course Code: NCCE/VSC-2/T/ 201
Examination Code: SEC12072013T

Total Contact Hours: 15

Credit 01

Marks 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- To provide foundational knowledge about Drones, their components, and working principles.
- To explore the applications of Drones in different businesses, commerce, and industries, such as Agriculture, Logistics and Healthcare.
- To equip students with practical skills in operating Drones using Mobile Phone applications.

Course Outcomes: *On successful completion of this course students will be able to:*

- Understand the basic principles, components, and navigation systems of Drones.
- Identify various applications of Drones in businesses, commerce, and industries like Agriculture and Logistics.
- Recognize the legal, safety, and ethical guidelines for responsible Drone operation.

Unit – I: Introduction to Drone Technology

[5 L]

History and Evolution of Drones, Types of Drones: Fixed-wing, Multi-rotor, and Hybrid, Components of a Drone: Frame, Propellers, Motors, Batteries, and Flight Controllers, Basics of Drone Navigation and Communication Systems.

Unit – II: Applications of Drone Technology

[5 L]

Drones in Creative Arts: Aerial photography, videography, and creative projects, Drones in Commerce: Logistics, inventory management, and marketing campaigns, Other Applications: Disaster Management, Agriculture, and Real Estate, healthcare (e.g., medical supply delivery), environmental monitoring.

Unit – III: Legal and Ethical Considerations

[5 L]

Drone Regulations and Permissions: Regulations of DGCA India-2021 (e.g., no-fly zones, altitude limits), FAA of USA (e.g., drone registration, Part 107 certification), and the importance of maintaining flight logs for compliance. Safety Measures in Drone Operations: Drone Safety and Risk Management. Ethical Issues in Drone Usage: Privacy, Security, and Environmental Concerns.

Learning Resources:

1. "Drone Technology for Beginners – Learn, Build, Fly Drones", by Dharna Nar and Dr. Radhika Kotecha, Published by Drone School India and Ane Books Pvt LTd (2024)
2. "Basics of Unmanned Aerial Vehicles: Time to Start Working on Drone Technology" by Garvit Pandya, Notion Press Chennai, (2021)
3. "Fundamentals of Drone Technology", by I.V.S. Yeswanth, V.S. Sridhar, Authors Click Publishing (2024)
4. Directorate General of Civil Aviation (DGCA), India, The Drone Rules, 2021,
5. The Federal Aviation Administration (FAA) USA, (Drone Pilot Training Guide)

Students are encouraged to refer to the official documentation of the listed tools and stay updated with emerging drone technologies and applications.

VSC-3: Practicals Based on VSC-1 EV
Course Code: NCCE/VSC-3/P/ 226
Examination Code: SEC12072003P

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- To provide fundamental knowledge of electric vehicle systems, components, and principles of operation.
- To develop an understanding of energy storage, battery technologies, and charging infrastructure.
- To equip students with hands-on experience in basic diagnostics, assembly, and testing of EV components.

Course Outcomes: *On successful completion of this course students will be able to:*

- Demonstrate a clear understanding of electric vehicle technology and its role in sustainable mobility.
- Apply knowledge of battery systems, energy management, and charging techniques in practical scenarios.
- Perform basic diagnostics, assembly, and maintenance of electric vehicles.

01. Basic EV Component identification and functionality.

Identifying key EV components: Battery, motor, controller, inverter, etc., Understanding the functionality of each component.

02. Battery Management and Safety

Basics of lithium-ion battery handling and safety precautions, Simple experiments on battery charging and discharging cycles.

03. Assembly of a Simple Electric Drive System

Connecting a basic motor and controller circuit for a small EV model, Testing and troubleshooting assembly issues.

04. EV Charging Station Setup and Operation

Demonstrating the working of an EV charging station, Practical exposure to plug-in charging systems and safety protocols.

05. Basic EV Diagnostics and Maintenance

Using diagnostic tools to identify issues in EV systems, performing routine maintenance tasks like checking battery health and motor performance.

06.- Using diagnostic tools to identify issues in EV systems, performing routine maintenance tasks like checking battery health and motor performance.

VSC-4: Practicals Based on VSC-2 Drone Technology

Course Code: NCCE/VSC-4/P/227

Examination Code: SEC12072013P

Total Contact Hours:30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Understand the fundamental concepts of Drone technology and its applications in various industries.
- Gain knowledge of legal and ethical considerations related to Drone usage.
- Develop basic technical proficiency in operating Drones using Mobile Phone devices.

Course Outcomes: *On successful completion of this course students will be able to:*

- Demonstrate the ability to operate Drones using Android-based applications.
- Apply Drone technology for tasks such as aerial photography, videography, and route planning.
- Analyze and utilize data collected through drones for real-world applications in businesses, commerce, and industries.

01. Basic Drone Operation

Tools: Free Android-based drone control apps (e.g., Drone Harmony, FreeFlight Mini, etc.).

Activity: Learn to pair and control a drone, including basic flight maneuvers, troubleshooting, common connection problems.

02. Aerial Photography and Videography

Tools: Open-source drone camera apps (e.g., Open Drone Map, Drone Harmony, etc.).

Activity: Capture aerial photos and videos for artistic or commercial use.

03. Drone Navigation and Route Planning

Tools: Free mission planning apps like Google Earth or Q Ground Control, etc.

Activity: Create and execute a pre-planned flight route using GPS

04. Data Collection and Analysis

Tools: Free Android-based mapping apps such as 'Drone Deploy,' 'Pix4Dcapture,' or similar apps, along with mobile-friendly GIS tools like 'Mappt' or 'SW Maps, etc.

Activity: Use Android Mobile Phone apps to capture drone imagery, generate and visualize 2D/3D maps, perform analysis, (e.g., area measurements, elevation profiling, heatmaps), and interpret insights for agriculture, urban planning, or environmental monitoring

05. Simulated Drone Flight Training

Tools: Free simulation mobile apps such as 'Quadcopter FX Simulator,' 'Crazyflie Simulator,' 'FPV Free rider Free Version,' or other similar apps.

Activity: Practice virtual drone flights, including take-off, navigation, and landing; simulate complex routes like obstacle avoidance and GPS paths; handle emergencies like signal loss or low battery; and use analytics to track and enhance flying precision and efficiency.

CURRICULUM
B. Sc. (NCCE) Second Year
Fourth Semester

Major (DSC-9): Solar Photovoltaic Energy-II

Course Code: NCCE/DSC-9/T/250

Examination Code: SAC12072504T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Explain the basic principles of photovoltaic (PV) technology, solar radiation, and energy conversion efficiency.
- Describe Photovoltaic System Components
- Study the basic structure of a solar cell (p-n junction), the factors affecting efficiency
- Understand the Design and Composition of PV Modules.
- Analyze Factors Affecting PV Module Performance
- Understand the Principles of Electrochemical Cells.
- Explain the Working Principles of Batteries and analyze factors affecting battery Performance and Efficiency

Course Outcomes: *On successful completion of this course students will be able to:*

- Understand the concepts of Solar Photo Voltaic Cells.
- Recognize and explain the function of key components in a PV system, including solar modules, inverters, charge controllers, and batteries.
- Differentiate between various PV module technologies, such as monocrystalline, polycrystalline, and thin-film, in terms of efficiency, cost, and applications.
- Explain how batteries function as electrochemical cells, including charge and discharge processes, electrode reactions, and efficiency factors.

Unit – I: Solar Photovoltaic

[10 L]

Introduction, Fundamentals of Photovoltaic Conversion, Semiconductor Materials, Photon Energy, Electron-hole Concentration and Fermi Level, A p-n Junction, Light Absorption in a Semiconductor, Solar Cell Materials, Efficiency of Solar Cells, Silicon Solar Cell, Purification of Silicon, Methods of Growing Crystal, Silicon Wafer to Solar Cell Fabrication, Module Design, Polycrystalline Silicon Cell, Amorphous Silicon Cell

Unit – II: Solar Photovoltaic Modules, Design and Structure

[10 L]

Solar PV Modules From Solar Cells, Series and Parallel Connection of Cell, Mismatch in Cell/Module, Mismatch in Series Connection, Hot Spots in module, Bypass Diode, Number of Solar Cell in a Module, Wattage of Modules, Fabrication of PV Module, PV Module of Power Output, I-V Equation of PV Modules, Rating of PV Modules, I-V and Power Curve of Module, Effect of Solar Irradiation, Effect of Temperature

Unit – III: Basic of Electrochemical Cell

[10 L]

Introduction to Batteries, Element of an Electrochemical Cell, Operation of an Electrochemical Cell, Theoretical Cell Voltage and Capacity, Losses in the Cell, Battery Classification, Cell to Battery, Battery Parameter, Factors affecting Battery Performance, Battery Voltage Level, Battery Discharge Current, Battery Temperature during discharge, Choice of a battery, Battery Charging and discharging Method, Battery for PV System, Lead acid Batteries, Nickel-Cadmium (Ni-Cd) Batteries, Comparison of Batteries

Learning Resources:

1. Solar Energy, Fundamentals and Applications, Garg, Prakash, Tata Mc-Graw Hill.
2. C.S. Solanki, Solar Photo-voltaics: Fundamental, Technologies and Applications, Prentice Hall of India, 2011.
3. - Non-Conventional Energy Resources, B. H. Khan, Tata Mc Graw Hill Publications.
- 4.-Non- Conventional Energy Sources, G.D. Ray, Khanna Publications.

Major (DSC-10): Semi-Conductor Technology

Course Code: NCCE/DSC-10/T/251

Examination Code: SAC12072514T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Explain the function and characteristics of essential electronic components such as resistors, capacitors, diodes, transistors, and inductors in electrical circuits.
- Understand Power Supply Principles and Types.
- Explain and use key electrical network theorems such as Kirchhoff's Laws, Thevenin's Theorem, Norton's Theorem, and Superposition Theorem to analyze electrical circuits.
- Analyze the Characteristics and Applications of Semiconductor Devices

Course Outcomes: *On successful completion of this course students will be able to:*

- Describe the function, characteristics, and applications of essential electronic components such as resistors, capacitors, diodes, transistors, and inductors.
- Assess voltage, current, and power distribution in complex electrical networks by applying appropriate network theorems for efficient circuit analysis.
- Explain the Working Principles of Semiconductor Devices
- Evaluate the behaviour of transistors in rectifier, amplifier, and switching circuits, and its electronic applications.

Unit – I: Basic Electronic Components and power supply

[10 L]

Definitions of resistance, capacitance and inductance, Equations defining resistance, capacitance and inductance, Concept of reactance and impedance; Transformers: Centre tapped, Step-up, Step-down, Various energy losses in transformer., Half wave, Full wave and Bridge rectifier, ripple factor, capacitor filter, Difference between regulated and unregulated power supply, Definition of Line and Load regulation, Series and Shunt regulators- Block diagram and circuit of regulated power supply using discrete components, Simple current limiting circuit, Problems

Unit – II: Network Theorems

[10 L]

Kirchhoff's laws (revision), Voltage and current divider circuits, Thevenin's theorem, Norton's theorem, Super-position theorem, Maximum power transfer theorem, Problems

Unit – III: Semiconductor Devices

[10 L]

Revision of bipolar junction transistor, types, symbols and basic action, Configurations (Common Base, Common Emitter & Common Collector), Definition of alpha, beta and their relations., Input, output and transfer characteristics of CE and CB configurations., Biasing methods, AC and DC load lines, Operating point (Q point), Transistor as a switch, Transistor as an amplifier (only concept), Frequency response of CE transistor amplifier., Uni-junction transistor: principle, construction and operation, Problems

Learning Resources:

1. Principles of Electronics, V. K. Mehta, S. Chand Publication New Delhi..
2. Modern Physics R. Murugesan and Er. Kiruthiga Sivaprasath
3. Electronics Principles, Malvino, 7th Edition TaTa Mc-Graw Hills.

Major (DSC-11): Practicals based on DSC-09

Course Code: NCCE/DSC-11/P/276

Examination Code: SAC12072504P

Total Contact Hours: 60

Credit: 02

Marks 50: (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- The primary objective of a solar cell is to convert sunlight directly into electricity through the photovoltaic effect
- To maximize the amount of sunlight captured and transformed into electrical energy, achieving a high percentage conversion rate.
- To develop manufacturing processes that produce solar cells at a low cost to make solar power more accessible.
- To design solar cells that can withstand environmental conditions and operate reliably for extended periods.

Course Outcomes: *On successful completion of this course students will be able to:*

- Solar energy technologies and power plants do not produce air pollution or greenhouse gases when operating.
- Solar energy can be a clean, cost-effective, and sustainable energy source.
- Solar cells have no moving parts, easy to construct, require little maintenance.
- Solar cells derive their energy from solar radiation which is a renewable source of energy and also inexhaustible.

1. Experiment on VI Characteristics and Efficiency of 1 kWp Solar PV system
2. Experiment on Shadowing effect and diode based solution in 1 kWp Solar PV System
3. Study of Solar Photovoltaic Fencing
4. Study of Solar Cookers
5. Study of Solar Water Heater
6. Study of Solar Dryer
7. Study of Solar Water Pumping System.
8. Study of Solar Lighting System
9. Study of Solar Photovoltaic System
10. Study of Solar Distillation System

Note: Students should perform at least SIX experiments

Major (DSC-12): Practicals based on DSC-10

Course Code: PHY/DSC-12/P/277

Examination Code: SAC12072514P

Total Contact Hours: 60

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- To develop practical skills in basic and conceptual Electronics.
- To develop students to learn measuring skills in practical.
- To familiarize students with fundamental experimental techniques related to Zener diode, Solar Cell and thermistor
- To prepare students for advanced laboratory work and increase the curiosity.

Course Outcomes: *On successful completion of this course students will be able to:*

- Understand the theoretical principles of basic practical Electronics
- Develop awareness of minimizing errors.
- Handle carefully various practical instruments.
- Correlate theoretical concepts with the help of experiments.

1. Half wave Rectifier
2. Full wave Rectifier
3. Characteristics of Photoconductive and Photo –emissive cells
4. Energy Band gap of a semiconductor by using thermistor
5. Bridge Rectifier
6. Characteristics of Zener diode.
7. Characteristics of Diode
8. Characteristics of Solar Cell
9. Effect of Light Intensity on Solar Cell Performance
10. Series and Parallel Connection of Solar Cells
11. Spectral Response and Quantum Efficiency of Solar Cells
12. Temperature Dependence of Solar Cell Efficiency

Note: Students should perform at least six experiments

Minor - 3: Thin Film Technology

Course Code: NCCE/Mn-3/T/250

Examination Code: SCC12072504T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Acquire the knowledge of thin film preparation by various techniques.
- Analyse the behaviour of the thin films by different characterization methods
- Apply the knowledge to develop a device

Course Outcomes: *On successful completion of this course students will be able to:*

- Acquire adequate knowledge of thin film preparation and characterization.
- Develop various thin film based devices

Unit – I: Vacuum Technology

[10 L]

Basics of Vacuum – Principles of different vacuum pumps: Rotary, Roots, Diffusion, Turbomolecular, and Cryogenic pumps; Measurement of vacuum – Concept of Capacitance Manometer, Pirani and Penning gauges – Vacuum Systems & Applications.

Unit – II: Methods of Thin Film Preparation

[10 L]

Physical Vapor Deposition (PVD) Techniques: Evaporation: Thermal evaporation, Electron beam evaporation, Laser ablation, and Cathode arc deposition. Sputtering: DC sputtering, RF Sputtering, and Ion beam sputtering, Chemical Vapor Deposition (CVD) Techniques: Conventional CVD and Spin coating

Unit – III: Characterization of Thin Film Properties

[10 L]

Film thickness measurement: Quartz crystal thickness monitor and Stylus Profiler methods. Surface morphology and topography by SEM and AFM; Film structure by X-ray diffraction; Electrical characterization by Four Probe, **Thin Film Devices:** Transistors (TFT), Sensors and Solar cells, *Thin film* Coatings: Diamond-like carbon (DLC) coating

Learning Resources:

1. Vacuum Technology by A. Roth
2. Thin Film Phenomenon by K.L. Chopra, McGraw-Hill
3. Materials Science of Thin Films by Milton Ohring
4. Thin-Film Deposition: Principles and Practice by Donald Smith

Minor - 4: Medical Physics
Course Code: NCCE/Mn-4/T/251
Examination Code: SCC12072514T

Total Contact Hours:30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- To learn the construction of X-ray generator.
- Explain different types of radiation, their sources/properties.
- The basic principles and working of CT, MRI and Ultrasound Imaging.
- Able to provide adequate knowledge about medical testing equipment.
- Able to transfer knowledge and skills to students as well as younger professionals.

Course Outcomes: *On successful completion of this course students will be able to:*

- Understand the principles, applications, and usage of various medical equipment including thermometers, glucometers, ECG machines, X ray machines for diagnostic purposes in healthcare settings
- Compenrehencing the principles, and components Computed Tomography (CT) Systems, including image reconstruction, acquisition techniques, and factors influencing image quality.
- Develop a comprehensive understanding and proficiency in various image acquisition techniques, advanced imaging methods, safety protocols, and their applications in planning radiotherapy treatments.

Unit – I: Medical Equipments:

[5 L]

Thermometer, Optical thermometer, Thermal gun, LASER gun, Infrared thermometer, Reflex hammer, radiography, Weighing machine, Glucometer, Oximeter, ECG machine, Stethoscope, X-Ray machine

Unit – II: Computed Tomography (CT):

[5 L]

Principle, CT imaging system, image, reconstruction and processing, acquisition and image quality.

Unit – III: Magnetic Resonance Imaging (MRI):

[5 L]

Introduction, to MRI, techniques involved MR image acquisition and reconstruction, safety and applications of MRI in radiotherapy for treatment planning, Ultrasound imaging (US):

Construction and working of a transducer, B-mode signal processing, modern imaging methods, Ultrasound imaging in radiotherapy for treatment.

Learning Resources:

1. F. M. Khan, The Physics of Radiation therapy, 3rd Edition, Lippincott Williams & Wikins, Philadelphia, 2003
2. Radiation Physics in Radiology, Oliver R., Blackwell Science Ltd; 1st Edition (1966).
3. Radiation Physics for Medical Physicists, E. B. Podgarsak, Springer Verlag, 1st Edition (1996).
4. The essential physics of medical imaging, Bushberg, S.T., Seibert, J.A, Leidholt, E.M. & Boone, J.M., Baltimore: Williams & Wilkins 1st Edition (1990).

GE/OE-2: Environmental Remediation

Course Code: NCCE/GE/OE-2/T/250

Examination Code: SDC12072504T

Total Contact Hours: 30

Credit: 02

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

- Identify various pollutants and their impact on ecosystems.
- Explore physical, chemical and Biological remediation methods.
- Examine case studies of successful environmental clean-up projects.

Course Outcomes: *On successful completion of this course students will be able to:*

- Explain the fundamental concepts and significance of environmental remediation.
- Identify various pollutants and select appropriate remediation techniques.
- Evaluate the effectiveness of remediation strategies through case studies.

Unit- I Introduction to Environmental Remediation

[10 L]

Basics of Environmental Pollution, Types of pollution: Air, Water, Soil, and Noise, Major pollutants and their sources, Effects of pollution on human health and ecosystems

Concept of Environmental Remediation, Definition and importance of remediation, Natural vs. engineered remediation processes, Principles of site assessment and monitoring Environmental laws and policies in India (EPA, Water Act, Air Act), Global agreements (Paris Agreement)

Unit- II Remediation Technologies

[10 L]

Physical and Chemical Remediation Methods: Filtration, adsorption, sedimentation, Chemical oxidation and reduction, Solidification and stabilization of contaminants

Biological Remediation Techniques, Bioremediation: Microbial degradation of pollutants, Phytoremediation: Role of plants in pollutant removal, Mycoremediation: Fungal applications in detoxification, Innovative and Emerging Technologies: Use of nanotechnology in remediation

Unit-III Applications, Challenges, and Case Studies

[10 L]

Real-World Applications of Remediation, Groundwater and soil remediation projects, Oil spill cleanup techniques, Heavy metal removal from industrial waste

Challenges and Future Prospects, Limitations of current remediation method, Cost-effectiveness and sustainability concerns, Case Studies: Successful remediation projects in India and worldwide, Industrial pollution control efforts.

Learning Resources:

1. Environmental Pollution and Remediation Techniques" by Elliot Franco, Edition: 1st Edition (2021)
2. Environmental Pollution and Remediation" edited by Ram Prasad, Edition: 1st Edition (2020)
3. Environmental Pollution and Public Health: Case Studies on Air, Water and Soil from an Interdisciplinary Perspective" edited by Ronnie Frazer-Williams, Mary B. Ogundiran, and Emmanuel I. Unuabonah, Edition: 1st Edition (2024)
4. Handbook of Complex Environmental Remediation Problems" edited by Jay H. Lehr and Jack Keeley, Edition: 1st Edition (2002)
5. Fundamentals of Site Remediation" by John Pichtel, Edition: 3rd Edition (2019)

SEC-1: Green Energy
Course Code: NCCE/SEC-1/T/250
Examination Code: SEC12072504T

Total Contact Hours:15

Credit: 01

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

1. Understand the fundamental principles of green energy and its importance in sustainability.
2. Understand the behavioural aspects of energy conservation.
3. Analyze the environmental and economic impact of green energy solution.
4. Aware about the causes that harmful for the environment.
5. Learn energy storage systems, technologies, and applications.
6. Comprehend grid management principles, infrastructure, and operations.
7. Understand energy policy framework, instruments, and impact.
8. Comprehend energy economics, including demand, supply, pricing, and subsidies.

Course Outcomes: *On successful completion of this course students will be able to:*

1. Explain the concept of green energy.
2. Asses the environmental and ecosystem impacts
3. Learn about energy storage.
4. Analyses the life cycle of renewable energy systems.
5. Acquire skills to design and implement energy management systems.

Unit – I: Basic Concept of Green Energy

[5 L]

Introduction to Green Energy, concept, nature, scope, importance, demand, types, approach to ecosystem, environmental impact. Challenges like pollution, global warming and cut carbon emission.

Unit – II: Application of Green Energy

[5 L]

Rechargeable Batteries, super-capacitor, Hydrogen storage, Combination of multiple renewable sources. Energy storage roadmap for India.

Unit – III: Energy Storage Devices

[5 L]

Eco friendly building, Green vehicles and transport system. Green Farming, Green future. Green energy in modern life. Use of renewable and alternative energy sources.

Learning Resources:

1. Renewable Energy & Green Technology. Anjan Kumar Sahoo, Dr. S.P. Nanda. Notion Press.
2. Fundamental and Applications of Green Energy Systems. Dr. G. Mahendran, Dr.. Jinnah Sheik Mohmed M, Dr. S. Nagarajan, Sr. Santosh Kumar Sahu. Scientific International Publishing House.
3. GREEN WORLD GREEN ENERGY. M. K. Ghosh Ray
4. Green Energy Jasmine Ting. Scholastic Inc.
5. Green Transportation Priynaka Lamichhane. Scholastic Inc.
6. Green Farming. Daniel Johnson, Samantha Johnson, Scholastic Inc.
7. Applications of Green Power and Green Energy in Modern Life. Dr. Dharmasa, Dr Jayalakshmi. Notion Press
8. Renewable Energy Generation. Rajiv Jindal & Ashish Garg.
9. Renewable Energy and Green Technology. A. A. Deogirikar, A. G. Mohod, Shri Rajlaxmi Prakashan.
10. Energy Storage System Roadmap for India: 2019-2032

SEC-2: Energy Management
Course Code: NCCE/SEC-2/T/251
Examination Code: SEC12072514T

Total Contact Hours: 15

Credit 01

Marks 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

1. Understand the definition, importance, and objectives of energy management.
2. Understand the sources, production, and utilization of conventional and non-conventional energy sources.
3. Understand the behavioral aspects of energy conservation.
4. Understand building energy management design, operation, and maintenance.
5. Understand energy storage systems, technologies, and applications.
6. Comprehend grid management principles, infrastructure, and operations.
7. Understand energy policy framework, instruments, and impact.
8. Comprehend energy economics, including demand, supply, pricing, and subsidies.

Course Outcomes: *On successful completion of this course students will be able to:*

1. Learn the fundamentals and importance of energy management.
2. Learn about energy storage and grid management.
3. Learn about energy policy, economics, and environment.
4. Acquire skills to conduct energy audits and improve energy efficiency.
5. Acquire skills to design and implement energy management systems.

Unit – I: Introduction to Energy Management

[5L]

Energy scenario: global and national perspective, Energy management: definition, importance, and objectives, Energy policy and regulations, Conventional Energy Sources- Production, utilization, and marketing. Non-conventional energy sources- Production, utilization, and marketing

Unit – II: Energy Efficiency and Conservation

[5 L]

Energy auditing: principles, procedures, and tools Energy conservation: behavioral aspects, policy measures, Building energy management: design, operation, and maintenance

Energy Storage and Grid Management, Energy storage systems: types, technologies, and applications, Grid management: principles, infrastructure, and operations

Unit – III: Energy Policy, Economics, and Environment

[5 L]

Energy policy: framework, instruments, and impact, Energy economics: demand, supply, pricing, and subsidies, Environmental impact: air, water, land, and climate change

Sustainable development: energy access, energy poverty

Learning Resources:

1. Energy Policy and Economics by David M. Kammen and Daniel M. Lashof
2. Energy Storage: A New Approach by Ralph Zito
3. Smart Energy Systems: From Design to Implementation by Henrik Lund
4. Energy Management Systems: ISO 50001 by ISO (International Organization for Standardization)
5. Energy Management Handbook by Wayne C. Turner and Steve Doty (8th edition)
6. Energy Management: Principles and Practice by G. T. Tamhane and A. V. Shenoy (2nd edition)

SEC-3: Practicals Based on SEC-1 Green Energy

Course Code: NCCE/SEC-3/P/276

Examination Code: SEC12072504P

Total Contact Hours: 15

Credit: 01

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

1. Understand green energy concepts.
2. Knowledge of renewable energy sources.
3. Understand the energy efficiency and conservation.
4. Understanding emerging technologies in storage system.
5. Explore community based renewable energy solutions.

Course Outcomes: *On successful completion of this course students will be able to:*

1. To develop knowledge base and understanding of green energy.
2. Understanding appreciate need for energy conservation and control measures.
3. Apply knowledge to evaluate performance of thermal energy.
4. Carryout assessment and suggest to promote use of green energy.

1. Case study on green energy initiatives.
2. Compare the temperature of surrounding near home and factory.
3. Measure voltage drop after charging and discharging.
4. Explore the benefits of green energy.
5. Analyze the social impacts of conventional energy sources.
6. Enlist the applications of green energy.
7. Compare the electricity bill of same consumption without green energy use.
8. Survey of green building.
9. Survey of green vehicles.

Note: Students should perform at least six experiments

SEC-4: Practicals Based on SEC-2

Course Code: NCCE/SEC-4/P/277

Examination Code: SEC12072514P

Total Contact Hours: 15

Credit: 01

Marks: 50 (CA=20, ESE 30)

Learning Objectives: *By the end of this course, students will be able to:*

1. Understand the importance of energy management and its relevance to real-world scenarios.
2. Develop skills in analyzing energy policies and regulations.
3. Understand the sources, production, and utilization of conventional and non-conventional energy sources.
4. Analyze the environmental impacts of conventional energy sources.
5. Understand energy policy framework, instruments, and impact.

Course Outcomes: *On successful completion of this course students will be able to:*

1. Learn fundamental concepts of energy management and its applications.
2. Learn the sources, production, and utilization of conventional and non-conventional energy sources.
3. Learn the emerging trends and technologies in energy management.
4. Learn the skills in energy auditing, energy-efficient technologies, and energy conservation

1. Prepare a case study to understand the importance of energy management.
2. Analyze energy policies and regulations.
3. Analyze the sources, production, and utilization of solar energy.
4. Analyze the sources, production, and utilization of solar energy.
5. Analyze the economic and social impacts of conventional energy sources
6. Study the environmental impacts of conventional energy sources.
7. Study the environmental impacts of non-conventional energy sources
8. Study the principles, procedures, and tools of energy auditing.
9. Analyze energy policy framework, instruments, and impact.

Note: Students should perform at least six experiments

