**Dr.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD**

## CIRCULAR NO.SU/B.Sc./CBC&GS /08/2023

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted the **following syllabi of Bachelor of Science with Practical Pattern of Question Paper under the scheme of Choice Based Credit & Grading System** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

| Sr.No. | Courses | Semester |
|---|---|---|
| 1. | **B.Sc.Electronics (Optional)** | **IIIrd & IVth semester** |
| 2. | **B.Sc. Instrumentation Practice (Optional)** | **IIIrd & IVth semester** |
| 3. | **B.Sc.Non Conventional and Conventional Energy (Degree)** | **IIIrd & IVth semester** |

This is effective from the Academic Year 2023-24 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,
Aurangabad-431 004.
REF.NO.SU/2023/ 4017-25
Date:-04.07.2023.

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Deputy Registrar,
Academic Section

**Copy forwarded with compliments to :-**

1] **The Principal of all concerned 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.BAMU,A'bad.**

2] The Section Officer,[B.Sc.Unit] Examination Branch,Dr.BAMU,A'bad.
3] The Programmer [Computer Unit-1] Examinations, Dr.BAMU,A'bad.
4] The Programmer [Computer Unit-2] Examinations, Dr.BAMU,A'bad.
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7] The Record Keeper, Dr.BAMU,A'bad.

# Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

**Choice Based Credit System (CBCS) Curriculum**
**For**
**Faculty of Science and Technology**
**Course Structure and Scheme of Examination**

## B.Sc. Non Conventional and Conventional Energy
## Second Year Undergraduate Degree Program

### Semester III

| | Course Code | Course Title | Total periods (Teaching periods/week) | Credits | Scheme of Examination | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Max Marks | CIA | UA | Min Marks |
| Optional I ( DSC-1A) Core Courses | NCCE-301-T | Solar Photovoltaic Energy Conversion –I | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-302-T | Bio-Energy | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-309-P | Practical Based on NCCE-301-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| | NCCE-310-P | Practical Based on NCCE-302-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| Optional II ( DSC-2A) Core Courses | NCCE-303-T | Mathematical Methods in Physics | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-304-T | Electronics | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-311-P | Practical Based on NCCE-304-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| | NCCE-312-P | Practical Based on NCCE-305-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| Optional III ( DSC-3A) Core Courses | NCCE-305-T | Physical Chemistry | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-306-T | Organic Chemistry | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-313-P | Practical Based on NCCE-306-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| | NCCE-314-P | Practical Based on NCCE-303 -T & NCCE-308-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| Skill Enhancement Course | SEC - 315 | Any one skill to be chosen out of two<br>SEC – 1(A) Medical Physics<br>SEC – 1(B) Study of Robotics | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| Ability Enhancement compulsory courses (AECC-1) | NCCE-307-T | Marathi or Hindi | 45(5/week) | 3 | 50 | 10 | 40 | 20 |
| | NCCE-308-T | Communication skills -III | 45(4/week) | 3 | 50 | 10 | 40 | 20 |
| | | | 675 | 29 | 750 | 150 | 600 | |

**Total Credits for Semester III : 29 ( Theory : 20 ; Laboratory : 9)**

## Semester IV

| | Course Code | Course Title | Total periods (Teaching periods/week) | Credits | Scheme of Examination | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Max Marks | CIA | UA | Min Marks |
| ptional I DSC-1B) ore ourses | NCCE-401-T | Solar Photovoltaic Energy Conversion – 2 | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-402-T | Bio Gas Technology | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-409-P | Practical Based on NCCE-401-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| | NCCE-409-P | Practical Based on NCCE-402-T& NCCE-408-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| ptional II DSC-2B) ore ourses | NCCE-403-T | Oscillations, Waves and Sound | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-404-T | Optics | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-410-P | Practical Based on NCCE-403-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| | NCCE-411-P | Practical Based on NCCE-404 | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| otional III DSC-3B) ore urses | NCCE-405-T | Inorganic Chemistry | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-406-T | Analytical Chemistry | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| | NCCE-411-P | Practical Based on NCCE-405-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| | NCCE-411-P | Practical Based on NCCE-406-T | 45(3/week) | 1.5 | 50 | 10 | 40 | 20 |
| ill hanceme urse | SEC - 415 | Any one skill to be chosen out of two<br>SEC – 1(A) Study of Robotics<br>SEC - 1(B) Mechatronics | 45(3/week) | 2 | 50 | 10 | 40 | 20 |
| ility hanceme | NCCE-407-T | Marathi or Hindi | 45(5/week) | 3 | 50 | 10 | 40 | 20 |
| npulsory urses ECC-2) | NCCE-408-T | Communication skills -IV | 45(4/week) | 3 | 50 | 10 | 40 | 20 |
| n-Credit urse ditional dits | XXX-412 | Environmental Studies | 45(3/week) | 2 * | 50 | 10 | 40 | 20 |
| | | | 675 | 29 | 750 | 150 | 600 | |

**Total Credits for Semester IV : 29 ( Theory : 20 ; Laboratory : 9)**

B.Sc.

(Non Conventional& Conventional Energy)

Semester III

**Course:**B.Sc.(NCCE.) III Sem. **Max. Marks:**50

**Paper Title: Solar Photovoltaic Energy Conversion– IPaper No. :** NCCE-301-T

| Chapter | Details | No. of Lectures |
|---|---|---|
| | **SOLAR PHOTOVOLTAIC ENERGY CONVERSION – I** | |
| 1. | **PLACE OF PV IN WORLD ENERGY SCENARIO**<br>1.1 World Energy Requirement<br>1.2 Need for sustainable Energy Sources<br>1.2.1 Limited Fossil Fuels<br>1.2.2 Environmental Impact of Fossil Fuels<br>1.2.3 Energy Security and Potential for Conflicts<br>1.3 Sustainable Sun's Energy<br>1.3.1 Sun's Energy : Advantages<br>1.3.2 Sun's Energy : Conversion Challenges<br>1.3.3 Other Energy Alternatives<br>1.4 Current Status of Renewable Energy Sources<br>1.4.1 Wind Energy Technology<br>1.4.2 Solar Thermal Technologies<br>1.4.3 Biomass Energy Technologies | 09 |
| 2. | **AN INTRODUCTION TO SOLAR CELLS**<br>2.1 Why P-*N* Junction Diode?<br>2.1.1 Space Charge Region<br>2.1.2 Energy Band Diagram of P-N Junction<br>2.1.3 P-N Junction Potential<br>2.1.4 Width of Depletion Region<br>2.1.5 Carrier Movements and Current Densities<br>2.1.6 Carrier Concentration Profile<br>2.2 P-*N* Junction in Non-equilibrium Condition<br>2.2.1 P-*N* Junction I-V Relation: A Qualitative Analysis<br>2.2.2 P-*N* Junction I-V Relation: A Quantitative Analysis<br>2.3 P-*N* Junction under Illumination: Solar Cell<br>2.3.1 Generation of Photo voltage<br>2.3.2 Light Generated Current<br>2.3.3 I-V Equation of Solar Cells<br>2.3.4 Solar Cell Characteristics | 09 |

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|---|---|---|
| 3. | **SOLAR CELL CHARACTERSTICS**<br>3.1 I-V Characteristics?<br>3.2 Effect of variation of Inolation and Temperature<br>3.3 Energy Losses and Efficiency.<br>3.4 Maximizing the Performance<br>3.5 Cell Size<br>3.6 Energy payback Period (EPP) | 09 |
| 4. | **SOLAR CELL CLASSIFICATINON**<br>4.1.1 On the Basis of Thickness of Active Material<br>4.1.2 On the Basis of Junction Structure.<br>4.1.3 On the Basis of Type of Active Material<br>4.1.4 Single Crystal (or Mono Crystalline) Silicon Cell.<br>4.1.5 Production of Monocrystalline Silicon Cell.<br>4.1.6 Multicrystalline Silicon Solar Cell.<br>4.1.7 AmorphousSilicon (a-Si) Solar Cell.<br>**SOLAR CELL TECHNOOGIES**<br>4.1.8 Water based Si Solar Cell Technologies<br>4.1.9 Thin Film Amorphous Si Technologies<br>4.1.10 Thin Flim Cadmium Telluride (CdTe) and Copper Indium (Gallium) Selenide (CIGS) Technologies.<br>4.1.11 Thin Film Crystalline Si Cell Technologies<br>4.1.12 Emerging Solar Cell Technologies. | 09 |
| 5. | **SOLAR CELL, MODULE, AND ARRAY CONTRUCTION**<br>5.1 Solar Cell<br>5.2 Solar PV Module<br>5.3 Solar PV Panel<br>5.4 Maximizing the Solar PV output and load Matching<br>5.5 Maximum Power Point Tracker | 09 |

**TEXT-BOOKS:**


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


**REFERENCE**


1. S. P. Sukhatme and J.K. Nayak, Solar Energy – Principles of Thermal Collection and Storage, Tata McGraw-Hill, New Delhi.
2. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, Prentice-Hall.

3. Solar Energy, Fundamentals and Applications, Garg, Prakash, Tata McGraw Hill.
4. J.A. Duffie and W.A. Beckmann, Solar Engineering of Thermal Processes, John Wiley, London, 1991.
5. Antonio Luque, Steven Hegedus; Handbook of Photovoltaic Science and Engineering; John Wiley and Sons, 2002.
6. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
7. Jean Claude Sabonnadiere, NouredineHadjsaid, "Smart Grids", Wiley Balackwell.
8. Kreith F. and Kreider J.F., „Principles of Solar Engineering", McGrawhill Book Co.
9. H.A. Kiehne (ed), Battery Technology Handbook; Marcel and Dekker, New York, 1989.
10. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011.

**Course::**B.Sc.(NCCE.) III Sem.**Max. Marks:**50
**Paper Title: Bio-Energy – I Paper No. :** NCCE-302

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **BIO-ENERGY – I** | |
| 1 | **Energy from Biomass -I**<br>1.1. Introduction<br>1.2. Biomass Conversion Technologies<br>1.3. Photosynthesis<br>1.4. Biogas Generation<br>1.5. Factors Affecting Bio-digestion or Generation of Gas<br>1.6. Classification of Biogas Plants<br>1.7. Advantages and Disadvantages of Floating Drum Plant Advantages<br>1.8. Advantages and Disadvantages of Fixed Dome Type Plant. | 09 |
| 2 | **Energy from Biomass –II**<br>2.1 Types of Biogas Plants<br>2.2 Constructional Details of some Main Digesters<br>2.3 Bio-gas from Plant Wastes<br>2.4 Community Biogas Plants<br>2.5 Materials Used for Bio-gas Generation<br>2.6 Selection of Site for a Biogas Generation | 09 |
| 3 | **Energy from Biomass –III**<br>3.1 Digester Design Considerations<br>3.2 Methods for Maintaining Biogas Production<br>3.3 Problem Related to Bio-gas Plants<br>3.4 Starting a Biogas Plant<br>3.5 Filling a Digester for Starting<br>3.6 Fuel Properties of Bio-gas<br>3.7 Utilization of Biogas. | 09 |
| 4 | **Energy from Biomass –IV**<br>4.1 Biomass as a Sources of Energy<br>4.1.1 Introduction<br>4.1.2 Energy Plantation<br>4.1.3 Advantages of Energy Plantation<br>4.1.4 Plants Proposed for Energy Plantation<br>4.2 Methods for Maintaining Biogas Production<br>4.3 Thermal Gasification of Biomass<br>4.3.1 Introduction<br>4.3.2 Classification of Biomass Gasifies | 09 |

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| | 4.3.3 Chemistry of the Gasification Process<br>4.3.4 Application of the Gasifier.<br>4.3.5 Problems in Development of Gasifiers.<br>4.4 Advantages and Disadvantages of Bio-logical Conversion of Solar Energy<br>4.5 Paralysis (destructive distillation) | |
| 5 | **BIOMASS ENERGY FROM PHOTO SYNTHESIS**<br>5.1 Introduction<br>5.2 Photosynthesis: A key process for life on Earth<br>5.3 Tropic level photosynthesis<br>5.4 Relation of Photosynthesis to Other plan processes<br>5.5 Photosynthesis at the cellular and molecular level<br>5.6 Energy farming: Biomass Production for energy. | 09 |

**Text Book**


1. Non-Conventional Energy Sources, **G. D. Ray, KhannaPublications.**
2. Non-Conventional Energy Resources, **B.H. Khan, The McGraw Hill Publications**
3. "Renewable Energy Resources" by John Tidwell and Tony Weir, 2nd edition, Fspon& Co.


**References**


1. Khandelwal, K.C., Mahdi, S.S., Biogas Technology – A Practical Handbook, Tata McGraw-Hill, 1986.
2. R. C. Mahaeswari, Bio Energy for Rural Energisation, Concepts Publication, 1997.
3. Tom, B. Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981
4. Best Practises Manual for Biomass Briquetting, I R E D A, 1997.
5. S. Eriksson and M. Prior, The briquetting of Agricultural wastes for fuel, FAO Energy and Environment paper, 1990.
6. "Energy conversion systems" by Rakosh das Begamudre, New age international publishers, New Delhi - 2000.
7. Parker, Colin & Roberts, Energy from Waste – An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
8. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Printice Hall, 2000.
9. ManojDatta, Waste Disposal in engineered Landfills, Narosa Publishing House, 1997
10. Rich, Gerald et. al., Hazardous Waste Management Technology, Podvan Publishers, 1987
11. Bhide AD., Sundaresan BB., Solid Waste Management in Developing Countries, INSDOC New Delhi, 1983.
12. Mathur, A.N., and Rathore, N.S., "Renewable Energy and Environment" – Proceedings of the National Solar Energy, Himanshu Publications, Udaipur
13. Rao and Parulekar B.B., (19)


**Websites**

1 http://www.bio-energy.at

2 http://www.abchansen.dk.

3 www.soest.hawaii.edu/csf

4 http://www.bical.net

5 http://www.volund.dk

6 http://www.iswa.org

**Course::**B.Sc.(NCCE.) III Sem. **Max. Marks :**50

**Paper Title:** Mathematical Methods In Physics **Paper No. :**NCCE-303

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **MATHEMATICAL METHODS IN PHYSICS** | |
| 1. | **ComComplex Numbers**<br>1.1. Introduction to complex numbers.<br>1.2. Algebra of complex numbers<br>1.3. Argand diagram, algebra of complex numbers using Argand diagram<br>1.4. Rectangular, polar and exponential forms of complex numbers.<br>1.5. De-Moivre's Theorem (statement only)<br>1.6. Trigonometric, hyperbolic and exponential functions.<br>1.7. Powers, roots and log of complex numbers.<br>1.8. Applications of complex numbers to determine velocity and acceleration in curved motion<br>1.9. Problems | 09 |
| 2. | **Vector Algebra**<br>2.1 Introduction to scalars, vectors: dot product and cross product.<br>2.3 Scalar triple product and its geometrical interpretation.<br>2.4 Vector triple product and its proof.<br>2.5 Problems. | 09 |
| 3. | **Vector Analysis**<br>3.1 Differentiation of vectors with respect to scalar<br>3.2 Scalar and vector fields<br>3.3 Vector differential operator<br>3.4 Gradient of scalar field and its physical significance.<br>3.5 Divergence of scalar field and its physical significance<br>3.6 Curl of vector field and its physical significance<br>3.7 Vector integrals: line, surface and volume integral with their examples<br>3.8 Statements of Gauss-Divergence theorem and Stoke"s theorem<br>3.9 Vector identities<br>a. $\nabla x \nabla \phi = 0$<br>b. $\nabla.(\nabla x\ V) = 0$<br>c. $\nabla.(\nabla \phi) = \nabla 2\phi$<br>d. $\nabla.(\phi A) = \nabla\phi.\ A + \phi\ (\nabla.A)$<br>e. $\nabla X\ (\phi\ A) = \phi(\nabla X\ A) + (\nabla\phi)\ X\ A$<br>f. $\nabla.(A\ X\ B) = B.\ (\nabla X\ A) - A.(\nabla X\ B)$<br>3.10 Problems | 09 |
| 4. | **Partial Differentiation**<br>4.1 Definition of partial differentiation<br>4.2 Successive differentiation<br>4.3 Total differentiation<br>4.4 Exact differential<br>4.5 Chain rule<br>4.6 Theorems of differentiation<br>4.7 Change of variables from Cartesian to polar co-ordinates. | 09 |

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| | 4.8 Implicit and explicit functions<br>4.9 Conditions for maxima and minima (without proof)<br>4.10 Problems | |
| 5 | **Differential Equation**<br>5.1 Frequently occurring partial differential equations (Cartesian coordinates)<br>5.2 Degree, order, linearity and homogeneity of differential equation.<br>5.3 Singular points (x = 0, x = x0) of differential equation<br>5.4 Problems | **09** |

**Text Books:**

1. Mathematical Physics by B. D. Gupta
2. Mathematical Physics by Rajput and Gupta

**Reference Books:**

1. Methods of Mathematical Physics by Laud, Takwale and Gambhir
2. Mathematical Methods in Physical Science by Mary and Boas
3. Vector analysis by Spiegel and Murrey
4. Mathematical Methods for Physicists by Arfken and Weber, 5th Edition, Academic Press.

**Course : :** B.Sc.(NCCE.) III Sem. **Max. Marks :**50
**Paper Title: ELECTRONICS** **Paper No. :**NCCE-304

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **ELECTRONICS** | |
| 1. | **Basic Electronic Components and power supply**<br>1.1. Definitions of resistance, capacitance and inductance<br>1.2. Equations defining resistance, capacitance and inductance<br>1.3. Concept of reactance and impedance<br>1.4. Transformers: Centre tapped, Step-up, Step-down, Various energy losses in transformer.<br>1.5. Half wave, Full wave and Bridge rectifier, ripple factor, capacitor filter<br>1.6. Difference between regulated and unregulated power supply<br>1.7. Definition of Line and Load regulation<br>1.8. Series and Shunt regulators- Block diagram and circuit of regulated power supply using discrete components, Simple current limiting circuit<br>1.9. Problems | 10 |
| 2. | **Network Theorems**<br>2.1 Kirchhoff's laws (revision)<br>2.2 Voltage and current divider circuits<br>2.3 Thevenin's theorem<br>2.4 Norton's theorem<br>2.5 Super-position theorem<br>2.6 Maximum power transfer theorem (All theorems 2.3 to without proof)<br>2.7 Problems | 7 |
| 3. | **Semiconductor Devices**<br>3.1 Revision of bipolar junction transistor, types, symbols and basic action.<br>3.2 Configurations (Common Base, Common Emitter & Common Collector)<br>3.3 Definition of alpha, beta and their relations.<br>3.4 Input, output and transfer characteristics of CE and CB configurations.<br>3.5 Biasing methods<br>3.6 AC and DC load lines, Operating point (Q point)<br>3.7 Transistor as a switch, Transistor as an amplifier (only concept)<br>3.8 Frequency response of CE transistor amplifier.<br>3.9 Uni-junction transistor: principle, construction and operation<br>3.10 Problems | 10 |

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| 4. | **Operational Amplifiers and Oscillators**<br>4.1 Operational amplifier: IC 741- Block diagram, Characteristics: ideal and practical<br>4.2 Concept of virtual ground<br>4.3 Inverting and non-inverting operational amplifiers with concept of gain.<br>4.4 Operational amplifier as an adder and substractor<br>4.5 Oscillators: concept of positive and negative feedback<br>4.6 Barkhausein criteria for an oscillator<br>4.7 Phase shift oscillator and Wien bridge oscillator (Derivation for frequency and feedback factor for both oscillators expected)<br>4.8 Problems | **10** |
| 6. | **Digital Electronics**<br>1.1. Number systems: Binary, Binary coded decimal (BCD), Octal, Hexadecimal<br>1.2. Addition and subtraction of binary numbers and binary fractions using one's and two's complement.<br>1.3. Basic logic gates: OR, AND, NOT, Derived gates: NOR, NAND, EXOR, EXNOR with symbols and truth tables<br>1.4. Boolean Algebra, Boolean Equations<br>1.5. De Morgan's theorems and its verification<br>1.6. Problems | **10** |

**Text Books**


1. Principles of Electronics, V. K. Mehta, S. Chand Publication New Delhi..
2. Op Amp and Linear integrated circuits, RamakantGaikwad, Prentice Hall of India Pub.
3. Digital Principles and Applications, Malvino and Leech Tata Mc-Graw Hills Pub.


**Reference Books**


4. Electronics Principles, Malvino, 7th Edition TaTaMc-Graw Hills..
5. Integrated Circuts, Botkar, Khanna Publications, New Delhi

**Course :**B.Sc.(NCCE.)IIISem. **Max.Marks :**50
**Paper Title:PhysicalChemistry** **Paper No.:**NCCE-305

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **PHYSICAL CHEMISTRY** | |
| 1 | **Thermodynamics:-**<br>1.1. Recapitulation of entropy, Thermodynamics of mixing, Entropy change or mixing of idealgases<br>1.2. Third law of thermodynamics, Statement, Limitation, Importance of third law, evaluation of absolute entropies, use of absoluteentropies | 07 |
| 2 | **Free energy and equilibrium:-**<br>2.1 Introduction, Helmholtz free energy, variation of Helmholtz free energywith volume and temperature, Helmholtz free energy change for chemicalreaction.<br>2.2 Gibb's free energy, Variation of Gibb's free energy with pressure and temperature, Gibb's free energy change for chemicalreaction.<br>2.3 Gibbs– Helmholtz equation, properties and significance of Gibbsfree energy change, free energy change for ideal gas, Standard free energy change, VantHoffsreactionisotherm.<br>2.4 The thermodynamic equilibrium constant, Relation between Kp and Kcfor gaseous reactions, Variation of equilibrium constant with temperature, Criteria of chemical equilibrium, physical equilibria, Clapeyronequation and Clausius– Clapeyronequation, Applications of ClapeyronandClausius–Clapeyronequation, numerical.<br>2.5 Le chatelier– Braun principle, Applicationof Le chatelier– Braun principle to the formation of ammonia andphosgene. | 13 |
| 3 | **Colligative properties of solutions:-**<br>3.1 Introduction, Solution, electrolytes and non-electrolytes, Meaning of term colligative property, lowering of vapourpressure of solvent in solution, elevation of B.P. of solvent insolution.<br>3.2 Landbergersmethod, freezing point depression, Beckmannsmethod, Osmosis and Osmotic pressure, Berkeley and Hertleymethod, Modern osmometer, application of colligative properties to determinemolecularweight of non-electrolyte, abnormal molecularweight.<br>3.3 Relation between VantHoff"s factor and degree of dissociation of electrolyte by Colligative property,Numericals. | 09 |
| 4 | **Solutions of liquids in liquids:-**<br>4.1 Types of solution, Ideal solution, Rault"slaw, Ideal dilute solution, Henr"slaw,<br>3.1 Application of Henryslaw, Vapourpressure –composition diagram of ideal and non idealsolution.<br>3.2 Temperature – compositiondiagram ofmiscible binary solution, Distillation from temperature – compositiondiagram.<br>3.3 Azeotropes, partially miscible liquid, immiscible liquids, distillationimmiscible liquids, determination of molecular weight by steam distillation, Numericals. | 11 |

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| 5 | **Distribution Law**<br>5.1 Nernst distribution law, Statement and thermodynamic proof for Nernst distributionlaw,<br>5.2 Association and dissociation of solute in solvent, application of distributionlaw,Numericals. | 5 |

**Reference books:**


1. Principles of Physical Chemistry by S. H. Maron and C. Prutton4thedition
2. Physical Chemistry by W. J. Moore 5thedition
3. Physical Chemistry by P. W. Atkin4thedition
4. Physical Chemistry by D.Alberty

**Course : :** B.Sc.(NCCE.)IIISem. **Max.Marks:**50

**Paper Title:ORGANIC CHEMISTRY** **Paper No.:**NCCE-306

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **ORGANIC CHEMISTRY** | |
| 1 | **Stereoisomerism : (Three dimensional aspects of sp3 hybridized carbon):-**<br>1.1. Introduction – optical isomerism, chirality and optical activity. Three dimensional representation of chiral centre, enantiomers, Absolute configuration, R/S system and D/LNomenclature.<br>1.2. Optical isomer with two chiral centers (AA and AB type) Erythro, threo, meso, diastereromers.<br>1.3. Stereoisomerism in cycloalkanes- Baeyer''sstraintheory, Heats of combustion and relative stability of cycloalkanes, factors affecting the stability of conformation, conformations of cyclohexane, Equatorial and axial bonds in cyclohexane. Monosubstitutedcyclohexanes.<br>1.4. Stability of – Cl, Br, I, –OH, –CH3, –C(CH3)3 substituted cyclohexanes. | 11 |
| 2 | **Chemistry of Aldehydes and Ketones:-**<br>2.1 Structure of carbonylgroups.<br>2.2 Nomenclature of Aldehyde andketones<br>2.3 Physical properties of aldehydes andketones<br>2.4 Preparations of aldehydes from primary alcohol, methyl benzenes, acid chlorides, phenols<br>2.5 Preparation of ketones from – secondary alcohols, FriedelCraft acylation,nitriles<br>2.6 Reaction of aldehydes and ketones – (i) Oxidation (ii) reduction –catalytic reduction, metal hydrides – LiAlH4, NaBH4. Clemmenson''sreduction,Wolfkishner, Thioketal reduction, (iii) Addition of cyanides (iv) Addition of derivatives of ammonia (v) Addition of alcohols (vi) Cannizzaroreaction (vii) Addition or Grignard reagent (viii) Aldolcondensation (ix) Perkins reaction (x) haloformreactions g) Analysis of aldehyde andketones | 11 |
| 3 | **Chemistry of Natural and Unnatural carboxylic acids and their derivatives:-**<br>3.1 Introduction – Natural and unnatural carboxylic acid withexample<br>3.2 Structure of simple carboxylicacid<br>3.3 Classification<br>3.4 Nomenclature<br>3.5 Physicalproperties<br>3.6 Preparation of carboxylic acid from – primary alcohol, oxidation of alkyl benzenes, carboxylation of Grignard reagent, hydrolysis of nitriles, Kolbe'sreaction<br>3.7 Reaction of carboxylic acids, acidity, salt formation, conversion into acid chlorides, esters, amides, acidanhydrides<br>3.8 Hell-VolhardZelinskyreaction (halogenation of aliphaticacids). | 7 |

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|---|---|---|
| 4 | **Aliphatic and Aromatic amines:-**<br>4.1 Structure<br>4.2 Classification<br>4.3 Nomenclature<br>4.4 Physical Properties – salt ofamine<br>4.5 Preparation of amine from – reduction of nitro compounds, reductive amination, reduction of nitriles, Hoffmann degradation ofamides<br>4.6 Reactions of amines - basicity, salt formation, alkylation, conversion into amides, ring substitution in aromatic amines, Hoffmann elimination, reactions with nitrous acid<br>4.7 Diazonimumsalts– preparation and reactions h) Sandmeyerreaction<br>4.8 Replacement of nuclear H by – I & - oH<br>4.9 Analysis ofamines. | 7 |
| 5 | **Chemistry of Homocyclic and Heterocyclic compounds:-**<br>5.1 Naphthalene and Anthracene. Numbering of carbon atoms, nomenclature of derivatives, preparation and reactions of naphthalene andanthracene.<br>5.2 Heterocyclic compounds – Definition, classification, nomenclature of heterocyclic compounds.<br>5.3 Five membered heterocyclic compounds - furan,pyrrole,Thiophene, nomenclature, preparation dorm 1, 4-diketones, reactions sulphonation, F.C. Acylation,Diazocoupling, Riemer – Tiemann reaction,catalytichydrogenations.<br>5.4 Sixmembered heterocyclic compounds, Pyridine, structure, preparationfrompicoline, acetylene, acrolein, reactions nitration, sulphonation, bromination, catalytichydrogenation. | 9 |

**Reference Books:**


1. Organic Chemistry - 6h Ed. Morrison and Boyd Prentice Hall of India PvtLtd, New Delhi - 2001.
2. Outline of Biochemistry 5h Ed., Conn, Sumpf, BrueningandRoy DoiJohnwiley1987.
3. SterochemistrybyEliel

## B.Sc. Non Conventional and Conventional Energy
## Semester III
## Skill Enhancement Course

Note :
Any one skill enhancement course to be chosen out of two either 'SEC-1(A): Medical Physics,' Or 'SEC-1(B):Renewable Energy ,'

**Course : :** B.Sc.(NCCE.)IIISem.
**Paper Title: SEC-1(A) Medical Physics**

**Max.Marks:**50
**Paper No.:**NCCE-315

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | | |
| 1 | **X-Ray Generators**<br>Discovery – Production – Properties of x-ray - X-ray spectrum : Characteristics and continuous spectra – Design ogf hot cathode X-ray tube – Basic Requirements of medical diagnostics, therapeutic and cooling of X-ray tubes – Rotating anode tubes – Hooded anode tubes –Rating of tubes – standerd exposure charts,<br>Limitations on loading safety devices in X-ray tubes – Insulation and cooling of X-ray tubes – Design requirements for X-ray equipment, Faults Detection in X-ray equipments such as pilting of anode, filament evaporation etc., -Types of X-ray units (Fixed radiography, CT, Interventional radiology, C-Arm, Mammography, Bone Mineral Densitometer, dental X-ray units etc.,). Fitration in the X-ray machines. | 13 |
| 2 | **Radioactivity.**<br>Radioactivity – General properties of alpha, beta and gamma rays – Laws of radioactivity – half life and Avearge Life – Lawsof successive transformations –Natural radioactive series – Radioactive equilibrium – Alpha ray spectra – Beta ray spectra –Gamma emission – Electron capture – Internal conversion – nuclear isomerism – Artificial radioactivity. | 11 |
| 3 | **Computed Tomography, MRI and Ultrasound Imaging.**<br>**Computed Tomography (CT):**<br>Principle, CT imaging system, image reconstruction and processing, acquisition and image quality.<br>**Magnetic resonance Imaging (MRI):**<br>NMR Principle, techniques involved MR image acquisition reconstruction, safety and applications of MRI in radiotherapy for treatment planning<br>**Ultrasound imaging (US):**<br>Construction and Working of a tranducer, B- mode signal processing, modern imaging methods,image artifacts – US Imaging in radioactivity for treatment planning. | 11 |

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| 4 | **Medical testing equipment.**<br>Construction, working of the medical testing equipment: Thermometer, Optical thermometer, Infrared thermometer, Reflax hammer, radiography, Weighing machine, Glucometer, ECG machine, Stethoscope, X-ray machine, CT scan, PET machine, MRI, Influsion pump, medical laser, Ultrasound machine. | **10** |

**Reference Books:**


1. F. M. Khan, The Physics of Radiation therapy, 3rd edition, Lippincott Williams & Wikins, Philadelphia, 2003
2. Radiation Physics in Radiology, Oliver R., BlackwellScience Ltd; 1st Edition (1966).
3. Radiation Physics foe 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).

**Course : :** B.Sc.(NCCE.)IIISem. **Max.Marks:**50

**Paper Title: SEC-1(B) Renewable Energy** **Paper No.:**NCCE-315

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | | |
| 1 | Introduction to Energy sources<br>Energy sources and their availability, non-conventional sources, advantages of renewable energy sources, prospects of renewable energy sources.<br>Sun as asource of energy: Solar energy collectors – flat plate collectors and concentrating collectors, solar energy, storage system – mechanical, electrical, chemical and electro-magnetic, solar pond, applications of solar energy – solar water heating, solar distillation, solar cooking. | 13 |
| 2 | Wind and Geothermal Energy<br>Wind Energy: Introduction, principle of wind energy conversion, advantages and disadvantages of wind mills, Applications of wind energy.<br>Geothermal energy: Introduction – Estmates of Geothermal Power – Nature of geothermalfields – Geothermal resources – Hydrothermal (convective) Resources Geo pressured resources. | 11 |
| 3 | Bio Energy<br>Energy from biomass – Sources of biomass – Different species – Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification and combination BiogasPlants – Properties and characteristics of biogas. | 7 |
| 4 | Ocean Energy:<br>Introduction, Principle of ocean thermal enrgy conversion (OTEC), Tidal power generation, Tidal energy technologies, Energy from waves, Wave energy conversion, Wave energy technologies, advantages and disadvantages. | |

**Reference Books:**

1. Non-Conventional Energy Resources By B. H. Khan, Tata McGraw Hill Pub., 2009
2. Solar Energy, fundamental and Applications, Garg, Prakash, Tata McGraw Hill
3. Solar energy – M P Agarwal – S Chand and Co. Ltd
4. Solar energy – Suhas P Sukhatme Tata McGraw – Hill Publishing Company Ltd
5. Non- conventional energy sources – G. D. rai – Khanna Publications, New Delhi.

# B. Sc.

## (Non Conventional& Conventional Energy)

## Semester IV

**Course :**B.Sc (NCCE) IV Se m. **Max.Marks**: 50
**Paper Title** :Solar Photovoltaic Energy Conversion-II **Paper No.** : NCCE-401

| Sr.No. | Details | No. Of Lectures |
|---|---|---|
| | **Solar Photovoltaic Energy Conversion-II** | |
| 1 | **Solar Photovoltaic I**<br>1.1Introduction<br>1.2 Fundaments of Photovoltaic Conversion<br>1.2.1 Semiconductor Materials<br>1.2.2 Photon Energy<br>1.2.3 Electron-hole Concentration and Fermi Level<br>1.2.4 A p-n Junction<br>1.2.5 Light Absorption in a Semiconductor<br>1.2.6 Solar Cell Materials<br>1.3 Efficiency of Solar Cells<br>1.4 Silicon Solar Cell<br>1.4.1 Purification of Silicon<br>1.4.2 Methods of Growing Crystal<br>1.4.3 Silicon Wafer to Solar Cell Fabrication<br>1.4.4 Module Design<br>1.4.5 Polycrystalline Silicon Cell<br>1.4.6 Amorphous Silicon Cell | 9 |
| 2 | **Solar Photovoltaic Modules**<br>2.1 Solar PV Modules From Solar Cells<br>2.1.1 Series and Parallel Connection of Cell<br>2.1.2 Mismatch in Cell/Module<br>2.2 Mismatch in Series Connection<br>2.2.1 Hot Sopts in module<br>2.2.2 Bypass Diode | 9 |
| 3 | **Design and Structure of PV Modules**<br>3.1.1 Number of Solar Cell in a Module<br>3.1.2 Wattage of Modules<br>3.1.3 Fabrication of PV Module<br>3.2 PV Module of Power Output<br>3.2.1 I-V Equation of PV Modules<br>3.2.2 Rating of PV Modules<br>3.2.3 I-V and Power Curve of Module<br>3.2.4 Effect of Solar Irradiation<br>3.2.5 Effect of Temperature | 9 |
| 4 | **Balance of Solar PV System**<br>4.1 Basic of Electrochemical Cell<br>4.1.1 Introduction to Batteries<br>4.1.2Element of an Electrochemical Cell<br>4.1.3 Operation of an Electrochemical Cell<br>4.1.4Theoretical Cell Voltage and Capacity | 9 |

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| | 4.1.5Losses in the Cell<br>4.1.6Battery Classification<br>4.1.7Cell to Battery<br>4.1.8Battery Parameter<br>4.2 Factors affecting Battery Performance<br>4.2.1 Battery Voltage Level<br>4.2.2Battery Discharge Current<br>4.2.3 Battery Temperature during discharge<br>4.2.4 Choice of a battery<br>4.2.5 Battery Charging and discharging Method<br>4.3 Battery for PV System<br>4.3.1 Lead acid Batteries<br>4.3.2Nickel-Cadmium (Ni-Cd) Batteries<br>4.3.3 Comparison of Batteries | |
| 5 | Solar PV Applications<br>5.1 Industrial Application<br>5.2 Social Application<br>5.3 Consumer Application<br>5.4 Solar Water Heating ( or Hot Water Supply System)<br>5.5 Solar Distillation<br>5.6 Solar Pumping | 9 |

**TEXT-BOOKS:**

1. Solar Energy, Fundamentals and Applications, Garg, Prakash, Tata McGrawHill.
2. C.S. Solanki, Solar Photovoltaics: Fundamental, Technologies and Applications, Prentice Hall ofIndia, 2011.

**REFERENCES:**


1. Non-Conventional Energy Resources, B. H. Khan, TheMcGraw HillPublications.
2. Non-Conventional Energy Sources, G.D. Ray, KhannaPublications.
3. S. P. Sukhatme and J.K. Nayak, Solar Energy – Principles of Thermal Collection and Storage, Tata McGraw-Hill, NewDelhi.
4. Gilbert M. Masters, Renewable and Efficient Electric Power Systems,Prentice-Hall
5. J.A. Duffieand W.A. Beckmann, Solar Engineering of Thermal Processes, John Wiley, London,1991.
6. Antonio Luque, Steven Hegedus; Handbook of Photovoltaic Science and Engineering; John Wileyand Sons,2002.
7. ClarkW.Gellings,"The Smart Grid: Enabling Energy Efficiency and Demand Response", CRCPress.
8. Jean Claude Sabonnadiere, NouredineHadjsaid, "Smart Grids", WileyBalackwell.

**Course :**B.Sc (NCCE) IV Se m. **Max.Marks** : 50

**Paper Title** : Biogas Technology - II **Paper No.** : NCCE-402

| Sr.No. | Details | No.Of Lectures |
|---|---|---|
| | **Biogas Technology** | |
| 1 | **An Overview Of Biogas Technology**<br>1.1 Introduction.<br>1.2 Historical Background of Bio-methanation.<br>1.3 An Overview Of Bio-methanation in India.<br>1.4 Basic of anaerobic fermentation.<br>1.6Actors affecting Biogas Yield.<br>1.7Commonly Used Feed Materials for Bio-methanation.<br>1.8Properties and Characteristics of Biogas.<br>1.9Potential of Biogas Plant Sludge as Enriched Fertilizer.<br>1.10Biomethanation as an aid for Environment Improvement.<br>1.11Applications of Biogas.<br>1.12Community Versus Family Size Plants.<br>1.13Integrated Farming System.<br>1.14Concluding Remarks. | 9 |
| 2 | **Properties of Biogas And Methods For Its Purification**<br>2.1 Introduction<br>2.2 Important Properties<br>2.3 Safety Aspects for Handling Bio-gas<br>2.4 Removal of Carbon-Dioxide from Biogas.<br>2.5 Removal of Hydrogen Sulphide from Biogas.<br>2.6 Microbiological Methods of Purification.<br>2.7 Concluding Remarks | 9 |
| 3 | **A Compendium Of Biogas Plant Designs**<br>3.1 4.1 Introduction<br>3.2 Movable Drum Type Plants<br>3.3 Fixed Dome Type Plants<br>3.4 4.5 An Overview of Select Plant Designs in World | 9 |
| 4 | **Biogas Generation From Industrial Wastes**<br>4.1 Introduction.<br>4.2 Biogas Generation From Bagasse<br>4.3 Biogas Generation from Pressmud.<br>4.4 Biogas Production From Canteen Wastes.<br>4.5 Biogas Production from Distillery Wastes.<br>4.6 Biogas Production from Textile Mill Wastes.<br>4.7 Biogas Production form Confectionery Wastes.<br>4.8 Biogas Production form Fruit and Vegetable Wastes. | 9 |
| 5 | **Applications And Usage Of Biogas**<br>5.1 Introduction<br>5.2 Biogas as a Cooking Fuel and Some Common Indian Burner Designs<br>5.3 Burner Designs Commonly Used In China<br>5.4 Use of Biogas as a Lighting Fuel.<br>5.5 Utilization of Biogas for Pumping Water and Miscellaneous other<br>5.6 Application. | 9 |

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| | 5.7 Biogas as a Vehicle Fuel<br>5.8 Applications of Biogas for Power Generation<br>5.9 fuel Cell Linked Biogas Systems. | |

**Book:**


1. Bio-gas System, Principal and Application. K M Mittal
2. Non-Conventional Energy Sources. G.D. Ray, KhannaPublications.
3. Non-Conventional Energy Resources, B.H. Khan, TheMcGraw Hill Publications.


**REFERENCES:**


1. Vimal, O.P. and TyagiP.D. 1985. Fuel wood from waste land. Agricolepublishing Academy, New Delhi.
2. Glass, D.L. and EmertM. 1985. Fuels from Biomassswaste Ann Arbor Science publishing Inc. Michigan.
3. TilmanD.A. Progress in Biomass Conversion Vol. I to V., Academic Press,London.
4. KjellstormN. 1980. Producer Gas – Local ElectricityGenerationfrom wood and agricultural residues. FAOPublication.
5. Kaupp A. 1984. Gasification of Rice Hulls - Theory and Practice. Publication of GATE,Gmbh,Germany.

**Course:** B.Sc.(NCCE.) IV Sem. **Max. Marks:** 50

**Paper Title: OSCILLATIONS, WAVES AND SOUND** **Paper No. :** NCCE-403

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **OSCILLATIONS, WAVES AND SOUND** | |
| 1. | **Undamped Free Oscillations**<br>1.1 Different types of equilibria (stable, unstable, and neutral equilibrium)<br>1.2 Potential well and periodic oscillations, Approximation of a general potential well V(x) to a parabola for small oscillations<br>1.3 Definition of linear and angular S.H.M.<br>1.4 Differential equation of S.H.M. and its solution (exponential form)<br>1.5 Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (analytical method)<br>1.6 Lissajous's figures and its uses, Applications (mechanical, electrical and optical)<br>Problems | 9 |
| 2. | **Damped Oscillations**<br>2.1 Introduction<br>2.2 Differential equationof damped harmonic oscillator and its solution, discussion of different cases.<br>2.3 Logarithmic decrement<br>2.4 Energy equation of damped oscillations<br>2.5 Power dissipation<br>2.6 Quality factor<br>2.7 Application: LCR series circuit<br>Problems | 9 |
| 3. | **Forced Oscillations**<br>3.1 Forced oscillation with one degree of freedom<br>3.2 Differential equation of forced oscillation and its solution (transient and steady state) Amplitude of forced oscillation<br>3.3 Resonance and its examples: mechanical (Barton's pendulum), optical (sodium vapor lamp), electrical (LCR Circuit)<br>3.4 Velocity and Amplitude resonance<br>3.5 Sharpness of resonance<br>3.6 Energy of forced oscillations<br>3.7 Power dissipation<br>3.8 Quality factor and Bandwidth<br>3.9 Application of forced oscillations (LCR circuit)<br>3.10 Equation of coupled oscillations, electrically coupled oscillations<br>Problems | 9 |

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| 4. | **Wave Motion**<br>1.1 Differential equations of wave motion in continuous media<br>1.2 Equations for longitudinal waves and it's solution (one dimension only)<br>1.3 Equation for transverse waves and its solution (one dimension only)<br>1.4 Energy density and intensity of a wave<br>1.5 Discussion of seismic waves<br>Problems | 9 |
| 5. | **Doppler Effect and Sound.**<br>5.1 Explanation of Doppler effect in sound<br>5.2 Expression for apparent frequency in different cases.<br>5.3 Asymmetric nature of Doppler effect in sound<br>5.4 Definition of sound intensity, loudness, pitch, quality and timber<br>5.5 Acoustic intensity level measurement<br>5.6 Acoustic pressure and it"s measurement<br>5.7 Reverberation time and Reverberation of a hall<br>5.8 Sabine"s formula (without derivation)<br>Problems | 9 |

**OSCILLATIONS, WAVES AND SOUND**

**Text Book**

1. Waves and Distillations,Khanna, Bedi,
2. Text book of sound, Subramanyam and Brijlal, VikasPrakashan
3. Text book of Sound,Khanna, Bedi,

**Reference Books:**

1. Waves and Oscillations, Stephenson.
2. The physics of waves and oscillations, N. K. Bajaj, Tata McGraw- Hill, Publishing co. ltd.
3. Fundamentals of vibration and waves, S. P. Puri, Tata McGraw- Hill, Publishing co. ltd.
4. Waves and Oscillations, R. N. Chaudhari, New age international (p) ltd.

**Course:** B.Sc. (NCCE.) IV Sem. **Max. Marks:** 50

**Paper Title: OPTICS** **Paper No. :** NCCE-404

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **OPTICS** | |
| 1 | **Geometrical Optics**<br>1.1. Introduction to development of Optics<br>1.2. Lenses: thin and thick lenses<br>1.3. Lens equation<br>1.4. Lens maker's formula<br>1.5. Cardinal points of an optical system<br>1.6. Combination of two thin lenses (equivalent lenses) (including derivation for focal length and cardinal points).<br>1.7. Problems | 09 |
| 2. | **Lens Aberrations**<br>2.1 Introduction<br>2.2 Types of aberrations: monochromatic and chromatic aberration<br>2.3 Types of monochromatic aberration and their reduction<br>2.4 Spherical aberration<br>2.5 Coma<br>2.6 Astigmatism<br>2.7 Curvature of field<br>2.8 Distortion<br>2.9 Types of chromatic aberration: Achromatism (lenses in contact and separated by finite distance)<br>2.10 Problems | 09 |
| 3. | **Optical Instruments**<br>3.1 Simple microscope and Compound microscope<br>3.2 Telescopes, Reflection and transmission type of telescope<br>3.3 Eyepieces: Huygens's eyepiece, Ramsden's eyepiece, Gauss's eyepiece<br>3.4 Constant deviation spectrometer<br>3.5 Problems | 09 |
| 4. | **Interference and Diffraction**<br>4.1 Classification of interference of thin films, Interference by division of amplitude<br>4.2 Interference by wedge shaped film: Interference due to reflected light and transmitted light.<br>4.3 Fringes of equal inclination, equal thickness, equal chromatic order (FECO fringes), colors of thin films, Newton's Ring<br>4.4 Interferometry: Michelson's interferometer and Fabry-Perot interferometer | 09 |

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| 5 | **Polarization**<br>5.1 Introduction to polarization<br>5.2 Types of polarization- plane, circular, elliptical<br>5.3 Polarization by reflection of light<br>5.4 Brewster's law<br>5.5 Law of Malus<br>5.6 Polarisation by double refracting uni-axial crystals<br>5.7 Linear polarizer (Polaroid)<br>5.8 Fabrication of linear polarizer by Nicol prism<br>5.9 Problems | 09 |

**Text Book:**

1. A Text book of Optics, N.Subhramanyam, Brijlal, M. N. Avadhanulu, S. Chand publication.

**Reference Books:**

1. Optics, fourth edition, Pearson education, E. Hetch, A. R. Genesan
2. Introduction to Optics, Third Edition, F.L. Pedrotti, Pearson Education
3. Physical Optics by A.K.Ghatak, McMillan, New Delhi
4. Fundamental of Optics, F.A.Jenkins, H.E.White, McGraw-Hill international Edition.
5. Principles of optics, D.S. Mathur, Gopal Press, Kanpur
6. Optics and Atomic physics, D.P.Khandhelwal, Himalaya Publication Bombay.
7. Fundamentals of optics- Francies A Jenking, Harvey E.White, Tata McGraw Hill

**Course:** B.Sc. (NCCE.)IVSem. **Max. Marks:**50

**Paper Title:INORGANICCHEMISTRY** **Paper No. :**NCCE-405

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **INORGANIC CHEMISTRY** | |
| 1 | **General Principles of Metallurgy:-**<br>1.1. Introduction occurrence of metals, ores and minerals, types of ores, operations involved in metallurgy, crushing, connentaion, various methods of concentration such as hand picking, gravity separation, magneticseparation.<br>1.2. Froth flotation, Calcinations,Roastingetc. Reduction, variousmethodsof reduction such as smelting, Aluminothermicprocess and electrolytic reduction, Refining of metals, various methods of refining such as poling, liquation, electrolytic and vapourphaserefining. | 9 |
| 2 | **Metallurgy of Iron and Steel (Pyrometallurgy)**<br>2.1 Occurrence, concentration, calcination, smelting physio-chemicalprinciples, reactions in the blast furnace, wroughtiron.<br>2.2 Manufacture of steel by Bessemer and L.D. process, its composition and<br>**Metallurgy of Aluminium (Electrometallurgy)**<br>2.3 Occurrence, physiochemical principles, Extraction ofAluminium<br>2.4 Purification of bauxite by Bayer's process, Electrolysis of alumina, application of aluminum and itsalloys. | 10 |
| 3 | **Chemistry of p-block Elements (III A to VII A groups):-**<br>3.1 Position of elements in the periodic table, electronic configuration of elements, Reasoning of anomalous behavior of first member of each group. Trends in the properties of the elements with respect to following points- size of atoms and ions, ionization potential, electron negativity, oxidation state, reactivity.<br>3.2 Bonding and shapes of following molecules – B2H6, PCl5, Al2 Br6, CO2, SF6, H2SO4, Allotropes of carbon diamond, graphite andfullerene. | 10 |
| 4 | **Chemistry of d-block elements:-**<br>5.1 Position of d-block in periodic table, trends in properties of these elements w.r.t.<br>(a) size of atoms &ions<br>(b) reactivity<br>(c) catalytic activity<br>(d)oxidationstate<br>(e) complex formation ability<br>(f) colour<br>(g) magnetic properties<br>(h) Non- Stoichiometry<br>(i) density, melting &boilingpoints. | 7 |

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| 5 | **Acids Bases, Solvents and Reactions in non-aqueous solvents :-**<br>5.1 Definition of acids and bases, Arrhenius theory, Lowry bronsted theory (inbrief).<br>5.2 Lewis concept, Lux-flood theory, strength of acids and bases. Trends in strength of hydracids and oxacids, properties of solvents - M. P., B. P. dipole-moments, dielectric constant, Lewis acid-base character, protonicacidity,<br>5.3 Types of solvents. Hard & soft acids andbases | 09 |

**Reference :**

1. Introduction to electrochemistry by S. Glasstone2nd Ed. pages491-503.

**Course:** B.Sc. (NCCE.)IVSem. **Max. Marks:**50
**Paper Title:ANALYTICAL CHEMISTRY** **Paper No. :** NCCE-406

| Sr. No. | Details | No. of Lectures |
|---|---|---|
| | **ANALYTICAL CHEMISTRY** | |
| 1 | **Introduction to Analytical chemistry:-**<br>1.1. Importance, the analytical process, sampling (solid liquid andgases),<br>1.2. Hazards in sampling, sample treatment (aqueous acid, fluxes,ashing) | 5 |
| 2 | **Inorganic Qualitative Analysis**<br>2.1 Basic principles, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals.<br>2.2 Removal of interfering anions (phosphate and borate) Detection acidic radicals | 09 |
| 3 | **Analysis of Organic Compounds (Qualitative & Quantitative)**<br>3.1 Types of organic compounds. Characters tests and reactionsof different functionalgroups.<br>3.2 Analysis - Estimation of C, H(O) by combustion tube, Detection of nitrogen, sulphur,<br>3.3 Halogen and phosphorus by Lassaigen'stest.<br>3.4 Estamation of nitrogen by Duma'sKjeldahl'smethod. Estimation of Halogen, Sulphurandphosphorus by Cariousmethod.<br>3.5 Determination of empirical and molecular formula, Numericalproblems. | 11 |
| 4 | **Errors in Qualitative Analysis:-**<br>4.1 Accuracy and precision, methods of expressing accuracy, methods of expressing precision,<br>4.2 Classificationof errors, minimization of errors, significant figuresand computations,<br>4.3 Numericalproblems. | 8 |
| 5 | **Volumetric Analysis:-**<br>5.1 Introduction to volumetric analysis, calibration of apparatus (burette, pipette and volumetric flask) standard solution and their preparation. Various methods of expressing the concentration of solutions. Equivalent weight in different types of reactions, primary and secondary standard solutions, Numericalproblems.<br>5.2 **Classification of volumetric analysis**<br>a) Acid base (neutralization) titrations : Theory of indicators, theory of acid base indicators, mixed and universal indicators, neutralization curves for strong acid - strong base, weak acid -strong base, weak base - strong acid, weak acid - weak base, polybasic acid with strong base. Displacement titrations, choice ofindicators, numericalproblems. | 12 |

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| | **b) Oxidation-Reduction Titration:**<br>Principle, titration curves with reference to Fe (II) and Ce (IV) reactions , detection of end points, Numericalproblems.<br>c) **Complexomatric Titration:-** Principal, Mg- EDTA complex,Standardisation, | |

**Reference Books**


1. Analytical chemistry by G. D. Christain, John Weileyandsons, 5thEdition.
2. Fundamentals of Analytical chemistry by D. A. Skoog, D. M. West and F. J. Holler, 6thEdn.
3. A text book of macro and semi micro Qualitative analysis by A. I. Vogel, 5thEdition
4. Vogel'stext book of Quantitative Inorganic Analysis revised Edn. J. Barret, R. C. Danney, G.H. Jeffery and J. MendhamELBS.
5. Quantitative organic Analysis 4th Ed. A. I. VogelELBS
6. Quantitative Inorganic Analysis 4th Ed A. I. VogelELBS
7. Instrumental methods of chemical Analysis by Chatwal and Anand6thEdition
8. A text book of Quantitative Inorganic Analysis A. I. Vogel 3rdEdition.
9. Basic concept of analytical chemistry- S. M.Khopkar.
10. Instrumental methods of chemical analysis-Willard, Deen&Merrit-6thEdition.
11. Analytical chemistry bySkoog.

**Course:** B.Sc. (NCCE.) IV Sem. **Max. Marks:** 50

## B.Sc. Non Conventional and Conventional Energy
## Semester IV
## Skill Enhancement Course

Note : Any one skill enhancement course to be chosen out of two either 'SEC-2(C): Study of Robotics,' Or
'SEC-2(D): Mechatronics ,'

**Course:** B.Sc. (NCCE.) IV Sem. **Max. Marks:** 50

**Course:**B.Sc.(NCCE.) III Sem. **Max. Marks:** 50

**Paper Title: SEC-2(C) Study of Robotics** **Paper No. :** NCCE-415(c)-T

| Chapter | Details | No. of Lectures |
|---|---|---|
| | **Study of Robotics** | |
| 1. | **Introduction**<br>Defination and History of robotics,Automation and Robot anatomy, Robot classification, Drive technology, Envelope geomentry, Motion control method, Robot speciation, Part of robot. | 08 |
| 2. | **Robot Motion Analysis**<br>Introduction to manipulator kinematics, homogeneneous transformations and robot kinematics, manipulator path control, robot dynamics, comfiguration of a robot controller, Robot End Effectors: Types of end effectors, mechanical grippers, Other types of grippers, tools as end effectors, robot/end effector interface, concideration in gripper selection and design, problem. Sensors in Robotics: Tranducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, uses of sensors in robotics, problems. | 10 |
| 3. | **Machine Vision**<br>Introduction in machine vision, sensing and digitizing function in machine vision, image processing and analysis, training the vision system, robotic applications, problems.<br>Robot programming: Methods of robot programming, lead through programming methods, a robot program as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods, problems.<br>Artificial Intelligence (AI): Introduction & doals of AI in research, AI techniques, LISP programming, AI & robotics, LISP in factory, robotic paradigms, Problems. | 12 |
| 4. | **Robots in Automatic Processing Opeations**<br>Introduction, Spot welding, continuous arc welding, Sprey coating, other processing operations. | 05 |
| 5. | **Assembly & Inspection**<br>Assembly and robotics assembly automation, parts presentation methods, assembly operations, compliance and remote centre compliance (RCC) device, assembly system comfigurations, adaptable programmable assembly system, designing for robotic assembly, inspecton automation. | 10 |

**TEXT-BOOKS:**

1. Mikell P. Groover. Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and AshishDutta, Industrial Robotics: Technology, Programming and Applications, 2nd Edition, Tata McGraw Hill, 2012.

2. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, "Introduction to Autonomous Mobile Robots, 2nd Edition, PHI, 2011.

**Course:** B.Sc. (NCCE.) IV Sem. **Max. Marks:** 50

**REFERENCE**

1. S. P. SukhatMT, Solar Energy: Principle of Thermal Collection and Storage, Tata McGraw Hill (1984).
2. C. S. Solanki, Solar Photovoltaic's: Fundamental Applications and Technologies, Prentice Hall of India, 2009. L.L. Freris, Wind Energy Conversion System, Prentice Hall, 1990.

**Course:** B.Sc. (NCCE.) IV Sem. **Max. Marks:** 50
**Course:**B.Sc.(NCCE.) III Sem. **Max. Marks:**50
**Paper Title: SEC-2(D) Mechatronics** **Paper No. :** NCCE-415(D)-T

| Chapter | Details | No. of Lectures |
|---|---|---|
| | **Mechatronics** | |
| 1. | **Introduction of Sensors and Tranducers**<br>Introduction to Mechatronics systems, elements, Advantages and and practical of Mechatronic Systems. Various types of sensors and tranducers used in Mechatronics system such as pressure sensors, temperature sensors, velocity sensors, Acceleration sensors, Selection of sensors. | 10 |
| 2. | **Signal Conditioning**<br>Types of electronic signals, Need for signal processing, Operational amplifiers: Types classification and application, Opto-isolators, Protection devices. | 08 |
| 3. | **Data Representation**<br>Analogue to Digital and digital to analogue Converters, Interfacing devices, Electro Magnetic Relays, Data Representation Systems, Displays, Seven segment displays, LCD displays, Printers, Data loggers, Data Acquisition Cards/Systems. | 08 |
| 4. | **Electrical Drives**<br>Types of Electrical Motors, Ac and DC motors, DC servomotors, Stepper motors, linear motors, etc, Pneumatics and Hydraulics Componanta of Pneumatics systems,actuators, direction control valves, Pneumatics air preparation, FRL unit, method of actuation of valves, Sequencing of Pneumatics cylinders using Cascade and shift register methods. Electro-Pneumatics circuits using single and double solenoid methods. Hydraulic cylinders, Design of cylinder, Design of Piston and piston rod, Valves, Poppet valve, house pipes and design of tubing, Meter-in and Meter-out circuits. | 10 |
| 5. | **Introduction to Microprocessor**<br>Introduction, Features of 886, Architecture of 8086 a) Registers b) ALU c) Address Buffer d) Adress / Data Buffer e) Interrupt control f) Timing & control circuitry, Pin connection of 8086. | 09 |

**REFERENCE**

1. HMT Limited, Mechatronics, TataMcGraw-Hill, 1998.
2. Boltan, W., Mechatronics: Electronic Control System in Mechanical Engineering.
3. Pearson Education Asia, 1999.
4. Raven, Automatic Control Engineering, McGraw Hill, New Tork, 1986.