VI semester

| CHEMISTRY OF HETEROCYCLIC COMPOUNDS | | | |
|---|---|---|---|
| Course Code | 21BSC61 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P:S) | 2:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning Objectives:**

CLO 1: Understand the basic concepts of heterocyclic compounds.

CLO 2: Emphasize on the synthesis and properties of four and five membered and other bicyclic rings.

CLO 3: Learn about five membered ring system with three and four hetero atoms.

CLO 4: To have an idea about the synthesis and properties of six membered and several Bi and Tricyclic System.

CLO 5: To understand the synthesis and properties of some important heterocyclic compounds

**Pedagogy (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to convince abstract concepts.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1 Fundamentals of Heterocyclic Compounds**

Introduction, nomenclature of heterocyclic compounds (Trivial and Systematic), classification of heterocyclic compounds, molecular orbital picture of pyrrole and pyridine. Three membered heterocyclic compounds with one & Two hetero atoms: Preparation and properties of Aziridine, Oxirane, Azetidine compounds.

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| Pedagogy | **Chalk and talk method and power point presentation-**Introduction, nomenclature of heterocyclic compounds (Trivial and Systematic), classification of heterocyclic compounds, molecular orbital picture of pyrrole and pyridine.<br>**Videos/learning materials:** Three membered heterocyclic compounds with one & Two heteroatoms: Preparation and properties of Aziridine, Oxirane, Azetidine, Oxetane compounds.<br>**Self-Study:** Nomenclature of heterocyclic compounds. |

**Module-2 Four & Five membered and some other Bicyclic system**

Four membered heterocyclic compounds: Preparation and properties of azetines, azetidines, oxetanes and thietanes. Five membered heterocyclic compounds with one heteroatom: Preparation and properties of pyrroles, furans and thiophenes. Five membered

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| heterocyclic compounds with two heteroatoms: Preparation and properties of pyrazoles, & imidazoles. | |
| Pedagogy | **Chalk and talk method and power point presentation-** Four membered heterocyclic compounds: Preparation and properties of azetines, azetidines, oxetanes and thietanes.<br>**Videos/learning materials:** Five membered heterocyclic compounds with one heteroatom: Preparation and properties of pyrroles, furans and thiophenes.<br>**Self-Study:** Five membered heterocyclic compounds with two heteroatoms: Preparation and properties of pyrazoles, & imidazoles. |
| **Module-3 Five membered heterocyclic compounds with Three/Four hetero atoms** | |
| Preparation and properties of triazole and tetrazoles. Bicyclic ring system of five membered heterocyclic compounds: Preparation and properties of indoles, benzofuran, benzothiophene and their substitution reactions. | |
| Pedagogy | **Chalk and talk method and power point presentation-** Preparation and properties of triazole and tetrazoles. Bicyclic ring system of five membered heterocyclic compounds: Preparation and properties of indoles, benzofuran, benzothiophene and their substitution reactions.<br>**Videos/learning materials:** Bicyclic ring system of five membered heterocyclic compounds: Preparation and properties of indoles, benzofuran and their substitution reactions.<br>**Self-Study:**Preparation and properties of benzothiophene and its substitution reactions. |
| **Module-4 Six membered and several Bi and Tricyclic system** | |
| Six membered heterocyclic compounds with one heteroatom: Preparation and properties of pyridines and pyrans. Six membered heterocyclic compounds with two heteroatoms: Preparation of pyrimidine, and dioxane, and their substitution reactions. Bi/tri-cyclic ring system of six membered heterocyclic compounds: Preparation and properties of quinolines,and their substitution reactions. | |
| Pedagogy | **Chalk and talk method and power point presentation-** Six membered heterocyclic compounds with one heteroatom: Preparation and properties of pyridines and pyrans. Bi/tri-cyclic ring system of six membered heterocyclic compounds: Preparation and properties of quinolines,and their substitution reactions.<br>**Videos/learning materials:** Six membered heterocyclic compounds with two heteroatoms: Preparation of pyrimidine and its substitution reactions.<br>**Self-Study:** Preparation of dioxane and its substitution reactions. |
| **Module-5 Some important Heterocyclic compounds** | |
| Preparation, properties and applications of Azocane, Thiocane, Furan, Guanethidin, Benzimidazoles.<br>Structures and applications of Vitamin B12. | |
| Pedagogy | **Chalk and talk method and power point presentation-**Preparation, properties and applications of Azocane, Thiocane, Furan, Guanethidin, Benzimidazoles.<br>**Videos/learning materials:** Structures and applications of Vitamin B12.<br>**Self-Study:** Preparation, properties and applications of Benzimidazoles. |
| **Course outcome (Course Skill Set)** | |

VI semester

At the end of the course the student will be able to:

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|---|---|
| **CO 1** | Understand the fundamentals of heterocyclic compounds. |
| **CO 2** | Describe the synthesis and properties of four and five membered and other bicyclic rings. |
| **CO 3** | Explain about five membered ring system with threeand four hetero atoms. |
| **CO 4** | Explain synthesis and properties of six membered and several Bi And Tricyclic System. |
| **CO 5** | Elucidate the synthesis and properties of some important heterocyclic compounds. |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

**Continuous Internal Evaluation:**

**Three Unit Tests each of 20 Marks (duration 01 hour)**

1. First test at the end of 5$^{th}$week of the semester
2. Second test at the end of the 10$^{th}$week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

**Two assignments each of 10 Marks**

4.First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13$^{th}$week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. **Each question is set for 20 marks**.

2. There will be **2 questions from each module**. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested learning Resources:**

**Books**


1. Heterocyclic chemistry. Thomas L. Gilchrist, Prentice Hall.
2. An introduction to the chemistry of Heterocyclic compounds. R. H. Acheson, John Wiley & Sons.
3. The chemistry of Heterocycles. Theophil Eicher, Siegfried, Hauptmann and Andreas Speicher. John Wiley & Sons.
4. Comprehensive Heterocyclic chemistry. A. R. Katritzky and C. W. Rees. Pergamon Press.
5. Vogel's Text Book of Practical Organic Chemistry. Brain. S. Furniss, Antony. J. Hannaford, Peter. W. G. Smith and Austin R. Tatchell. Pearson.
6. Gabor Krajsovszky Heterocyclic compounds, ISBN:978-615-5722-01-1.

VI semester

| **Web links and Video Lectures (e-Resources)** |
| --- |
| 1. https://www.youtube.com/watch?v=0yPBkxy6m9A<br>2. https://www.youtube.com/watch?v=6b2gZA70xxg<br>3. https://www.youtube.com/watch?v=KDZ1jGjG5IE<br>4. https://www.youtube.com/watch?v=GpsmY8RGFWQ<br>5. https://www.youtube.com/watch?v=UGPX6eXz9Vk |
| **Activity Based Learning (suggested Activities in Class)/Practical based learning**<br>1. https://www.youtube.com/watch?v=LVGmOoPH10M<br>2. https://www.youtube.com/watch?v=U8I89EndzHQ |

**VI Semester**

| CHEMISTRY OF MATERIALS | | | |
|---|---|---|---|
| Course Code | **21BSC62** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

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| CLO 1 | Understand the most common and important optical material synthesis methods. |
| CLO 2 | Learn different types of industrial materials and their applications. |
| CLO 3 | importance of conducting polymers and fullerenes with their preparation methods |
| CLO 4 | Helps to learn basics of super conductors and its applications. |
| CLO 5 | Understand the synthetic methods and properties with applications of mechanical materials. |

**Pedagogy (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to convince abstract concepts.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

## Module-1 Optical Materials

**Optical Materials:** Introduction, classification & characteristics of Non-linear Optical (NLO) Materials. Definition, properties & applications of crystalline materials, ceramic materials, semiconducting materials (II-V, Si, Ge), glasses (silica, fluoride, chalcogenide); Preparation of optical polymers (organic & inorganic) materials by sol-gel technology, dyes (organic & inorganic); principal of material engineering of optical materials (dopants, impurities and defects).

| | |
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| **Pedagogy** | **Chalk and talk/power point presentation:** Definition, properties & applications of crystalline materials, ceramic materials, semiconducting materials (II-V, Si, Ge), glasses (silica, fluoride, chalcogenide);<br>**Videos/Learning material:** Preparation of optical polymers (organic & inorganic) materials by sol-gel technology, dyes (organic & inorganic); principal of material engineering of optical materials (dopants, impurities and defects).<br>**Self-study:** Introduction, classification & characteristics of Non-linear Optical (NLO) Materials |

## Module-2 Industrial Materials

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| **Industrial Materials**: Paints and Varnishes: Constituents of oil and emulsion paints and their role, constituents of varnishes.<br>**Fuels**: Characteristics, Calorific value and its determination using bomb calorimeter, Coal varieties, Gaseous fuels-advantages, constituents and their significance, production of Coal gas and composition of LPG, Octane number.<br>**Explosives**: Classification, preparation of dynamite and TNT.<br>**Propellants**: Characteristics, classification and their applications. | |
| **Pedagogy** | **Chalk and talk/power point presentation**: Paints and Varnishes: Constituents of oil and emulsion paints and their role, constituents of varnishes<br>**Videos/Learning material**: Calorific value and its determination using bomb calorimeter, production of Coal gas and composition of LPG,<br>**Self-study:** Coal varieties, Gaseous fuels-advantages, constituents and their significance. |
| **Module-3 Chemistry of Newer materials** | |
| **Conducting polymers**: Introduction, definition and examples - polyaniline, polyacetylene. Mechanism of conduction. Qualitative treatment of doping, Properties: elasticity with high electrical conductivities, Engineering and biological applications.<br>**Fullerenes:** Introduction, definition, Structure and Chemical reactions (redox reactions, electrophilic aromatic substitution and bromination) of $C_{60}$. Commercial uses of $C_{60}$. Carbon nanotubes - Introduction, definition, examples and structure. | |
| **Pedagogy** | **Chalk and talk/power point presentation**: Mechanism of conduction, Qualitative treatment of doping, Properties: elasticity with high electrical conductivities, Engineering and biological applications. Structure and Chemical reactions (redox reactions, electrophilic aromatic substitution and bromination) of $C_{60}$.<br>**Videos/Learning material:** Idea about new materials.<br>**Self-study:** Introduction to conducting polymers, definition and examples - polyaniline, polyacetylene. Carbon nanotubes - Introduction, definition, examples and structure. |
| **Module-4 Electronic Materials & Super conductors** | |
| **Electronic Materials:** Introduction, Properties, applications of molecular conductors, LEDs, LCDs<br>**Super conductors**: Introduction, definition, type1, type 2 and atypical. Preparation of high. temperature superconductor $Y_1Ba_2Cu_3O_{x+\delta}$, BCS theory (qualitative treatment only) and general applications of high temperature super conductors. | |
| **Pedagogy** | **Chalk and talk/power point presentation:** Properties, applications of molecular conductors, LEDs, LCDs<br>**Videos/Learning material**: BCS theory, LEDs<br>**Self-study:** applications of high temperature super conductors |
| **Module-5 Mechanical Materials** | |
| **Mechanical Materials:** Introduction, properties & applications advanced Ceramics (superhard materials, thermally resistant materials); Auxetic Materials Carbon: Properties & applications of diamond, graphite, buckyballs, nanotubes. Silica: Synthesis of silica glass; working & applications of fibre-optic cables; properties, production & applications of aerogels, zeolites & mesoporous materials. | |
| **Pedagogy** | **Chalk and talk/power point presentation**: Introduction, properties & applications advanced Ceramics (superhard materials, thermally resistant materials); Auxetic Materials<br>**Videos/Learning material**: Properties & applications of diamond, graphite<br>**Self-study:** applications of fibre-optic cables; properties, production & applications of aerogels, zeolites & mesoporous materials. |

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

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| **CO 1** | Understand properties & applications of Optical materials & principal of material engineering of optical materials. |
| **CO 2** | Describe the classification & preparation explosives & propellants. |
| **CO 3** | Analyse the importance of conducting polymers including fullerenes ($C_{60}$) and its commercial uses. |
| **CO 4** | Explain properties, applications of LEDs & LCDs. |
| **CO 5** | Elucidate production & applications of mechanical materials including silica materials. |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

**Continuous Internal Evaluation:**

**Three Unit Tests each of 20 Marks (duration 01 hour)**

1. First test at the end of 5$^{th}$week of the semester
2. Second test at the end of the 10$^{th}$week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

**Two assignments each of 10 Marks**

4.First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13$^{th}$week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. **Each question is set for 20 marks**.

2. There will be **2 questions from each module**. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**

1. A.R. West, Solid State Chemistry and its applications
2. C.N.R. Rao, Chemical approaches to synthesis of inorganic materials
3. V. Raghavan, Materials Science & Engineering: A first course, 5th ed., PHI Learning, 2004.
4. W.D. Kingery, Introduction to Ceramics, 2nd ed., John Wiley & Sons, 1999.
5.W.D. Callister, D.G. Rethwisch, Materials science and Engineering: An Introduction, 8th ed., Wiley, 2010

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/113/106/113106101/
2. https://nptel.ac.in/courses/115105122

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- https://www.youtube.com/watch?v=UjMbwS0LOkU
- https://www.youtube.com/watch?v=aQx5Xd6S1ys
- https://www.youtube.com/watch?v=Yo6JI_bzUzo
- https://www.youtube.com/watch?v=vYkyUqUa6vU

**VI Semester**

| ORGANIC CHEMISTRY LAB | | | |
|---|---|---|---|
| Course Code | 21BSCL63 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 1:0:2 | SEE Marks | 50 |
| | | Total Marks | 100 |
| Credits | 02 | Exam Hours | 03 |

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

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| **CO 1** | To demonstrate synthetic skills by carrying out different experiments. |
| **CO 2** | To develop the skill for the separation and qualitative analysis of binary mixtures of organic compounds. |

| SL.NO | Experiments (Any 10 experiments to be performed) |
|---|---|
| 1 | Preparation of benzylic acid from benzoin. |
| 2 | Oxidation of cyclohexanol to adipic acid. |
| 3 | Distillation of mixture of organic compounds. |
| 4 | Preparation of aniline from nitrobenzene & its physical characterisation (boiling point). |
| 5 | Thin layer chromatography: Separation of plant pigments. |
| 6 | Isolation of caffeine from tea |
| 7 | Isolation of carotene from carrot |
| 8 | Estimation of acid group from a given organic acid. |
| 9 | Synthesis and characterisation of iodoform. |
| 10 | Determination of melting points of given samples (Naphthalene and Benzoic acid) |
| 11 | Structural elucidation of some simple organic compounds by UV, IR. (Online mode) |
| 12 | Structural elucidation of some simple organic compounds by NMR, Mass spectra. (Online mode) |

**Assessment Details (both CIE and SEE)**

**Continuous Internal Evaluation:**The marks awarded in case of practical shallbe based on the weekly evaluation of laboratory journals/reports after the conduction of every experiment and one practical test.

**Semester End Evaluation:** The practical examinations to be conducted as per the time table of University in a batch wise strength of students not more than 10-15 per batch.

1. All laboratory experiments are to be included for practical examination, except Sl/No 11 & 12.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiner
4. Change of experiments is allowed only once and 15% Marks allotted to the procedure part to be made zero

**Suggested Learning Resources:**

**Books:** 1. Experiments in organic chemistry, Louis F.Fieser.
2. Practical organic chemistry by Mann F.G. and Saunders.
3. Vogel's text book of practical organic chemistry, 5th edition B.S.Furniss,A.J.Hannaford,

P.W.G Smith A.R.Tatehell.
4. Elementary practical organic chemistry, part-I,II &III: Quantitative organic analysis, by Arthur I, Vogel
5. Laboratory manual of Organic chemistry by B.B.Dey and M.V. Sitaraman.
6. Natural products: A laboratory guide by Raphelikan.

**VI SEMESTER**

| MEDICINAL CHEMISTRY | | | |
|---|---|---|---|
| Course Code | 21BSC641 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P:S) | 2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 25 | Total Marks | 100 |
| Credits | 2 | Exam Hours | 3 |

**Course Learning Objectives:**

CLO 1: Understand the basic concepts of medicinal chemistry.

CLO 2: Design and development of analgesics agents, antipyretic agents, anti-inflammatory agents.

CLO 3: Structure activity relationship of antibiotics and Aminoglycosides.

CLO 4: To know the Synthesis, mode of action of Cardiovascular drugs and Aminoglycosides

CLO 5: To understand the Structure Activity Relationship of Non Steroidal Anti-inflammatory drugs.

**Pedagogy (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to convince abstract concepts.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1 Introduction to medicinal chemistry**

Physicochemical properties in relation to biological action: Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.

**Drug metabolism**: Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism.

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| Pedagogy | **Chalk and talk, Power point presentation:** Physicochemical properties in relation to biological action: Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.<br>**Videos: Drug metabolism**: Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism.<br>**Self-Study:** Introduction to stereo chemistry. |

**Module-2 Drug discovery, design and development**

Basic Retrosynthetic approach. Definition, example and structure of the following classes of drugs: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol,

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| lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides); antiviral agents (Acyclovir). | |
| Pedagogy | **Chalk and talk, Power point presentation:** Basic Retrosynthetic approach. Definition, example and structure of the following classes of drugs: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol);<br>**Videos:** Antibacterial and antifungal agents (Sulphonamides); antiviral agents (Acyclovir).<br>**Self-Study:**Sulphamethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir). |
| **Module-3 Antibiotics** | |
| Introduction, Nomenclature, Structure activity relationship of the following classes. β-Lactam antibiotics: Penicillin, Cephalosporin, Aminoglycosides: Streptomycin, Tetracycline: Tetracycline, Doxycycline. | |
| Pedagogy | **Chalk and talk, Power point presentation:** Introduction, Nomenclature, Structure activity relationship of the following classes. β-Lactam antibiotics: Penicillin, Cephalosporin, Aminoglycosides: Streptomycin, Tetracycline: Tetracycline, Doxycycline.<br>**Videos:**<br>**Self-Study:** Nomenclature |
| **Module-4 Cardiovascular drugs** | |
| Introduction, classification of Cardiovascular drugs, Cardiovascular diseases. Synthesis, mode of action and uses of sorbitrate and verapamil.<br>Anti-tuberculosis drugs: Introduction, synthesis and mode of action of Para-Aminosalicylic Acid (PAS), Isoniazid (INH) ethambutol and ethionamide. | |
| Pedagogy | **Chalk and talk, Power point presentation:** Introduction, Cardiovascular diseases. Synthesis, mode of action and uses of sorbitrate and verapamil.<br>**Videos:** Anti-tuberculosis drugs: Introduction, synthesis and mode of action of Para-Aminosalicylic Acid (PAS), Isoniazid (INH) ethambutol and ethionamide.<br>**Self-Study:** Classification of Cardiovascular drugs. |
| **Module-5 Non Steroidal Anti-inflammatory drugs** | |
| Definition, Types of pain, Classification of NSAID, Structure Activity Relationship of Indole Acetic Acid derivatives, Structure Activity Relationship of Salicylic acid derivatives. Preparation, mode of action, therapeutic uses and adverse effect of compounds – Indomethacin, Tolmetin Sodium. | |
| Pedagogy | **Chalk and talk, Power point presentation:** Definition, Structure Activity Relationship of Indole Acetic Acid derivatives, Structure Activity Relationship of Salicylic acid derivatives.<br>**Videos:** Preparation, mode of action, therapeutic uses and adverse effect of compounds – Indomethacin, Tolmetin Sodium.<br>**Self-Study:** Types of pain, Classification of NSAID. |

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

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| **CO 1** | Understand the fundamentals of medicinal chemistry. |
| **CO 2** | Design and develop various medicinal compounds. |
| **CO 3** | Explain the structure activity relationship of various drugs |

| CO 4 | Explain synthesis and mode of action of different drugs. |
|---|---|

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

**Continuous Internal Evaluation:**

**Three Unit Tests each of 20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

**Two assignments each of 10 Marks**

4.First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. **Each question is set for 20 marks**.

2. There will be **2 questions from each module**. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested learning Resources:**

**Books**


1. Burger's Medicinal Chemistry and Drug Discovery by Abraham D.J., Vol I to IV. John Wiley and Sons Inc., New York.
2. Foye's Principles of Medicinal Chemistry by Lemke T.L., Williams D.A., Roche V.F. and Zito S.W., Lippincott Williams and Wilkins.
3. An Introduction to Medicinal Chemistry by Patrick Graham, L., Oxford University Press.
4. Introduction to Principles of Drug Design by Smith and Williams.
5. Medicinal Chemistry Second Revised Edition by Nadendle, Pharmamed Press.
6. Medicinal and Pharmaceutical Chemistry by Singh H. and Kapoor V.K., VallabhPrakashan, Delhi.
7. Reactions, Rearrangments and Reagents by S.N.Sanyal ,Bharathi bhavan publishers.


**Web links and Video Lectures (e-Resources)**

1. https://www.youtube.com/watch?v=mR3NbqpTe3s
2. https://www.youtube.com/watch?v=_nH_RodthIg
3. https://www.youtube.com/watch?v=kUCxJz7KLC8
4. https://www.youtube.com/watch?v=T5VWmjeSl64
5. https://www.youtube.com/watch?v=uV3tDI1XG-k

**Activity Based Learning (suggested Activities in Class)/Practical based learning**

1. https://karger.com/mpp/article/22/1/2/203287/Team-Based-Learning-Applied-to-a-Medicinal
2. https://www.ijper.org/article/19

**VI SEMESTER**

**VI SEMESTER**

| FUNCTIONAL ORGANIC COMPOUNDS | | | |
|---|---|---|---|
| Course Code | 21BSC642 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P:S) | 2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 25 | Total Marks | 100 |
| Credits | 2 | Exam Hours | 3 |

**Course Learning Objectives:**

CLO 1 Understand the preparation of alkyl and aryl halides.

CLO 2 To know the synthesis of alcohols and phenols and their reactions.

CLO 3 Understand the synthesis of aldehydes and ketones and their reactions.

CLO 4 Discern the synthesis of aromatic hydrocarbons and its substituted reactions.

CLO 5 To know the synthesis of various nitrogen containing functional groups.

**Pedagogy (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to convince abstract concepts.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

## Module-1 Alkyl & Aryl Halides

**Alkyl Halides**: Types of Nucleophilic Substitution ($S_N1$, $S_N2$ and $S_Ni$) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation. Williamson's ether synthesis: Elimination vs substitution.

**Aryl Halides**: Preparation: from phenol, Sandmeyer&Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent.

| | |
|---|---|
| Pedagogy | **Chalk and talk: Alkyl Halides**: Types of Nucleophilic Substitution ($S_N1$, $S_N2$ and $S_Ni$) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation.<br>**Power point presentation, Videos: Aryl Halides**: Preparation: from phenol, Sandmeyer&Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent.<br>**Self-Study:**Williamson's ether synthesis: Elimination vs substitution. |

## Module-2 Aromatic Hydrocarbons

**Aromatic Hydrocarbons** :Preparation of benzene from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactionsof benzene: Electrophilic substitution: nitration, halogenation and

<table>
<tr><td colspan="2">sulphonation. Friedel-Craft's reaction (alkylation and acylation). Side chain oxidation of alkyl benzenes.Reactions of naphthalene phenanthrene and anthracene Structure. Important derivatives of naphthalene and anthracene.</td></tr>
<tr><td>Pedagogy</td><td>Chalk and talk: Aromatic Hydrocarbons :Preparation of benzene from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactionsof benzene: Friedel-Craft's reaction (alkylation and acylation). Side chain oxidation of alkyl benzenes.Reactions of naphthalene phenanthrene and anthracene Structure.<br>Power point presentationVideos: Electrophilic substitution: nitration, halogenation and sulphonation.<br>Self-Study: Important derivatives of naphthalene and anthracene.</td></tr>
<tr><td colspan="2">Module-3 Aldehydes & Ketones</td></tr>
<tr><td colspan="2">Aldehydes and ketones (Formaldehyde, and acetone). Preparation from acid chlorides and from nitriles. Reactions-Reaction with HCN. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff-Kishner reduction. Meerwein-Pondorff Verley reduction.</td></tr>
<tr><td>Pedagogy</td><td>Chalk and talk: Aldehydes and ketones (Formaldehyde, and acetone). Preparation from acid chlorides and from nitriles. Clemensen reduction and Wolff-Kishner reduction. Meerwein-Pondorff Verley reduction.<br>Power point presentation, Videos: Reactions-Reaction with HCN. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation.<br>Self-Study:Clemensen reduction and Wolff-Kishner reduction.</td></tr>
<tr><td colspan="2">Module-4 Reactions & rearrangements</td></tr>
<tr><td colspan="2">Introduction to rearrangement reactions: Baeyer villager Rearrangement, Beckmann Rearrangement, Claisen Rearrangement, Fries Rearrangement, Hofmann Rearrangement & Wolff Rearrangement.</td></tr>
<tr><td>Pedagogy</td><td>Chalk and talk: Introduction to rearrangement reactions: Baeyer villager Rearrangement.<br>Power point presentation, Videos: Beckmann Rearrangement, Claisen Rearrangement, Fries Rearrangement, Hofmann Rearrangement.<br>Self-Study: Wolff Rearrangement.</td></tr>
<tr><td colspan="2">Module-5 Named Organic Reactions</td></tr>
<tr><td colspan="2">Named Organic Reactions:Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabrielphthalimide synthesis, Carbylamine reaction, Mannich reaction, Distinction between 1°, 2°and 3°amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.</td></tr>
<tr><td>Pedagogy</td><td>Chalk and talk: Named Organic Reactions: Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity;<br>Power point presentation, Videos: Preparation and properties: Gabrielphthalimide synthesis, Carbylamine reaction, Mannich reaction, Diazonium Salts: Preparation and their synthetic applications.<br>Self-Study: Distinction between 1°, 2°and 3°amines with Hinsberg reagent and nitrous acid.</td></tr>
<tr><td colspan="2">Course outcome (Course Skill Set)<br>At the end of the course the student will be able to:<br>CO 1 Understand the preparation of alkyl and aryl halides.</td></tr>
</table>

| | |
|---|---|
| **CO 2** | Know the synthetic procedure of alcohols, phenols, aldehydes and ketones. |
| **CO 3** | Write the substitution reactions for aromatic hydrocarbons. |
| **CO 4** | To prepare various nitrogen containing functional groups. |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

**Continuous Internal Evaluation:**

**Three Unit Tests each of 20 Marks (duration 01 hour)**

1. First test at the end of 5$^{th}$ week of the semester
2. Second test at the end of the 10$^{th}$ week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

**Two assignments each of 10 Marks**

4.First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13$^{th}$ week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. **Each question is set for 20 marks**.

2. There will be **2 questions from each module**. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested learning Resources:**

**Books**


1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt.Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.=(Pearson Education).
3. Graham Solomons, T.W. Organic Chemistry, McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013
4. B. Y. Paula, Organic Chemistry, 3rd Edition, Pearson Education, Inc.(Singapore), New Delhi, reprint, 2002
5. Jerry March, Advanced Organic Chemistry, 4th Edition, John Wiley And Sons, New York, 1992.
6. Sehan. N. Ege, Organic Chemistry, Structure And Reactivity, 3rd Edition, A.I.T.B.S., New Delhi, 1998.
7. Reactions, Rearrangments and Reagents by S.N.Sanyal ,Bharathi bhavan publishers.


**Web links and Video Lectures (e-Resources)**

1. https://www.youtube.com/watch?v=zb8ZvJq9ngA&list=PL88zE4oO5RTG3qzDEJnyyEJ7zyapnAH9G
2. https://www.youtube.com/watch?v=16yFG8arIp0
3. https://www.youtube.com/watch?v=EN_-fp4J7AY

4. https://www.youtube.com/watch?v=QUi90BL9hU4
5. https://www.youtube.com/watch?v=RjccXQZa6Jc

**Activity Based Learning (suggested Activities in Class)/Practical based learning**

1. https://vlab.amrita.edu/index.php?sub=2&brch=191&sim=345&cnt=2
2. https://www.chemedx.org/blog/activity-introducing-organic-functional-groups
3. https://files.eric.ed.gov/fulltext/EJ1218426.pdf

**VI-Semester**

| Semiconductors & Electronics | | | |
|---|---|---|---|
| Course Code | **21BSS651** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:1:0:1 | SEE Marks | 50 |
| Total Hours of Pedagogy | 25 | Total Marks | 100 |
| Credits | 02 | Exam Hours | 03 Hours |

**Course Objectives:**

- The course enables student to learn the fundamental physics of semiconductor materials,
- The course covers the working and applications of various logic gates

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills in physics.
2. Seminars and Quizzes may be arranged for students in respective subjects to develop skills.
3. Encourage the students for group learning to improve their creativity and analytical skills.
4. While teaching show how every concept can be applied to the real world. This helps the students to expand understanding level.
5. Support and guide the students for self-study.
6. Ask some higher order thinking questions in the class, which promotes critical thinking.
7. Inspire the students towards the studies by giving new ideas and examples.

**Module-1**

**Band Theory of Solids:** **05 Hours**

Introduction, Classification of solids based on electrical properties and energy band gap, band structure of semiconductors, Types of semiconductors- Intrinsic & extrinsic semiconductor, Majority and minority charge carriers. Concentration of electrons and holes in intrinsic semiconductors(derivation), law of mass action, Relation between Fermi level and Energy gap in an Intrinsic semiconductor (derivation). Electrical Conductivity in an intrinsic semiconductor. Hall effect (qualitative) & its applications.

| | |
|---|---|
| **Pedagogy** | Chalk and talk, Power point presentation, Videos<br>**Self study Component:** band structure of semiconductors. |

**Module-2**

**Transistors:** **05 Hours**

Junction Transistor, types and their working, Transistor Current components, Common Base (CB), Common Collector (CC), Common Emitter (CE) configuration characteristics and its graphical analysis, Current gains α and β, Relations between α and β. Load line(ac & dc), Operating Point, Transistor amplifier in CE mode.

| | |
|---|---|
| **Pedagogy** | Chalk and talk, Power point presentation, Videos<br>**Self study Component:** Junction transistors. |

**Module-3**

**Field Effect Transistor(FET):** **05 Hours**

Construction of JFEET, idea of channel formation, pinch- off voltage, Transfer and output characteristics. MOSFET: MOS Diode, Basic construction of MOSFET and working, I-V characteristics, enhancement and depletion modes, Complimentary MOS (CMOS)

| | |
|---|---|
| **Pedagogy** | Chalk and talk, Power point presentation, Videos<br>**Self study Component:** Complimentary MOS (CMOS) |

**Module-4**

**Oscillators:** **05 Hours**

Concept of, Feedback Positive negative feedback Sinusoidal oscillators: Tuned oscillators-Barkhausen criterion for oscillations, Hartley and Colpitt's oscillators. RC oscillators – Phase shift oscillator and Wien Bridge oscillator.

| | |
|---|---|
| **Pedagogy** | Chalk and talk, Power point presentation, Videos<br>**Self study Component:** Wien Bridge oscillator |

**Module-5**

**Logic Gates:** **05 Hours**

Boolean Algebra & Logic gates: Basic Postulates and Fundamental Theorems of Boolean Algebra, De Morgan's theorems, Switching Equivalent Circuits of Basic Gates, Truth Tables and Symbolic Representation of OR, AND, NOT, NAND, NOR, XOR, XNOR Gates (realization using Transistor), NAND and NOR Gates as Universal Gates. Half adder and Full adder circuits.

| | |
|---|---|
| **Pedagogy** | Chalk and talk, Power point presentation, Videos<br>**Self-study Component:** Boolean Algebra |

**Course outcome (Course Skill Set):**

At the end of the course the students will be able to:

1. Capable to distinguish materials based on their band structure
2. Explain different types of transistors.
3. Understand the fundamentals of FET's.
4. Gain knowledge of the various types of oscillators.
5. Apply the knowledge of Boolean algebra in various logic circuits.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE).

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Text books:**


1. Modern Physics, R.Murugeshan & Er.K.Shivaprasath, S.Chand (2015).
2. Semiconductor Device Fundamentals, Robert F. Pierret, Pearson education
3. Solid state Physics,S. O. Pillai, New age International Publishers
4. Hand Book of Electronics, Gupta and Kumar, Pragati Prakasan, Meerut
5. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, Tata McGraw Hill
6. Fundamentals ofE ectrical & Electronic Engineering, B L Theraja, S.Chand Publishing.


**Reference books**:


1. Physics for degree students, C L Arora and P. S. Hemme, S Chand Publications

2. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
3. Introduction to Solid State Physics, Charles Kittel, Wiley India Pvt. Ltd.
4. Basic Electronics Solid state, B.L. Theraja, S.Chand Publishing.
5. Principles of Electronics – V.K.Mehta and Rohit Mehta S.Chand Publishing.

Web links and Video Lectures (e-Resources):

1. https://youtu.be/k6ZxP9Yr02E
2. https://youtu.be/JA3sCmrv11M
3. https://youtu.be/mHAyQhz0ILE
4. https://youtu.be/N01BYteinzE
5. https://www.classcentral.com/course/swayam-fundamentals-of-electronic-device-fabrication-14080

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

https://youtu.be/c0fs-sNWmMM
https://nptel.ac.in
https://swayam.gov.in
https://vlab.amrita.edu

**B.Sc. Honors (Physics/Chemistry)**

**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**

**SEMESTER - VI**

| **Linear Programming, Probability and Statistics** | | | |
|---|---|---|---|
| Course Code | **21BSS653** | CIE | 50 |
| Teaching Hours/Week (L: T: P: S) | 2:1:0:0 | SEE | 50 |
| Total Hours of Pedagogy | 25 | Total | 100 |
| Credits | 2 | Exam Hours | 3hrs |

**Course Learning Objectives:**

The course will enable students to:

- Provide graphical solution of linear programming problems with two variables, and illustrate the concept of convex set and extreme points.
- Solve linear programming problems using simplex method.
- Familiar with correlation of bi-Variate data
- Understand the basic concepts of probability theory

**Pedagogy (General Instructions)**

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematical Science Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity)

**Module-1:**

Linear Programming Problem: Convexity and Basic Feasible Solutions. Formulation and examples, Graphical Solution, Convex and polyhedral sets, Extreme points, Basic solutions, Basic feasible solutions, Correspondence between basic feasible solutions and extreme points.

**Self-study:** Definition of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR,

**(RBT Levels: L1, L2 and L3)** **5 hours**

| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
|---|---|

**Module-2: Simplex Method**

Canonical and Standard form of LP problem, Optimality criterion, slack and surplus variables, Solutions to LPP by Simplex method, Artificial Variable, Big-M Method and Two-Phase Simplex Method.

**Self-study:** Degeneracy in LPP.

**(RBT Levels: L1, L2 and L3)** **5 hours**

| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
|---|---|

**Module-3: Curve fitting and Regression Analysis**

**Curve fitting**: $y = ax + b, y = ax^2 + bx + c$

Karl-Pearson's Correlation coefficient, Rank correlation, Lines of Regressions.

**Self-study: Curve fitting -** $y = ax^b$

**(RBT Levels: L1, L2 and L3)** **5 hours**

| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
|---|---|

**Module-4: Probability**

Introduction, Sample space, Events, Mutually exclusive events, Exhaustive events, Independent events, Definition of probability, Axioms of Probability, Conditional probability, Baye's Theorem.

**Self-study:** Permutation and combinations.

**(RBT Levels: L1, L2 and L3)** **5 hours**

| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
|---|---|

**Module-5: Random variable**

Random Variable, Discrete and Continuous random variables, Probability distribution and density functions, Mean, Variance and standard deviation. Binomial and Poisson distribution. Normal distribution.

**Self-study:** Uniform and Exponential distribution.

**(RBT Levels: L1, L2 and L3)** **5 hours**

| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
|---|---|

**Course outcome:**

At the end of the course, the student will be able to:

- Formulate as L.P.P and derive optimal solutions to linear programming problems.
- Solving LPP by graphical method, Simplex method, Big-M method.
- Analyse and design various statistical problems.
- To understand the scenarios to apply suitable probability distribution models.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

**Books Recommended:**


1. Operations Research, An Introduction, Seventh Edition, Hamdy A. Taha, PHI Private Limited, 2006.
2. Operations Research, S D Sharma Kedarnath Ramnath & Company.
3. Operations Research, Theory and Applications, Sixth Edition, J K Sharma, Trinity Press, Laxmi Publications Pvt. Ltd. 2016.
4. S C Gupta and V K Kapoor, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition.
5. B S Grewal (2021). Higher Engineering Mathematics, 44th Edition, Khanna Publishers.


**Web links and Video Lectures (e-Resources):**

- http://ocw.mit.edu/courses/mathematics/
- http://www.foureir-series.com/
- http://mathworld.wolfram.com/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning**

- Quiz
- Group assignment
- Seminars

**B.Sc. Honors (Physics/Chemistry/Mathematics)**

**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**

**SEMESTER - VI**

| **Subject Name: Sociology** | | | |
|---|---|---|---|
| Course Code | **21BSO661** | CIE | 50 |
| Teaching Hours/Week (L: T: P: S) | 2:1:0:0 | SEE | 50 |
| Total Hours of Pedagogy | 25 | Total | 100 |
| Credits | 2 | Exam Hours | 3hrs |

**Course Learning Objectives:**

The course will enable students to:

1. To understand the nature of sociology
2. To know about culture and socialization
3. To know the Social change and its research in the society
4. To understand Indian society and its unity and diversity
5. To know about social movements and its impact on the society in general

**Pedagogy (General Instructions)**

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematical Science Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity)

**Module-1: Nature of sociology**

Introdution, Meaning and definition of sociology, Basic Concepts of Sociology, Social Process - Meaning, definition and types. Culture and Socialization.

**(RBT Levels: L1, L2)** **5 hours**

| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
|---|---|

**Module-2: Culture and Socialization**

Culture : Meaning, definition and Characteristics. Types of Culture : Material and Non-material Culture. : culture lag. Socialization : Meaning and Definition. Stages of : Oral, anal, oedipal, adolescence and adulthood. Agencies of Socialization : (Family, peer groups, schools, mass media and state) The Role of culture in socialization.

**(RBT Levels: L1, L2)** **5 hours**

| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
|---|---|

**Module-3: Social Change & Social Research**

| | |
|---|---|
| Social change : Meaning, definition and characteristics of social Change - Forms of Social change. Factors for social change. Social Research : Meaning, definition, Sources of Data. Society and Environment : Meaning, Definition and Types. | |
| **(RBT Levels: L1, L2 and L3)** | **5 hours** |
| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
| **Module-4: Indian society** | |
| Unity in diversity: Nature of diversity, regional, linguistics, cultural & ethnic, Nature of Unity in India. National integration: meaning and definitions, Challenges to national integration. Social inequality: meaning and definitions, Exclusion and inclusion concept. | |
| **(RBT Levels: L1, L2 and L3)** | **5 hours** |
| Pedagogy | Chalk and talk method/PowerPoint Presentation. |
| **Module-5: Social movements and social changes in India** | |
| Social movements in India: Meaning, definitions of social movements, components of social movements, types of social movements. Westernization and its effects, modernisation and its impact, Globalization, Concept of Global Outlook. | |
| **(RBT Levels: L1, L2 and L3)** | **5 hours** |
| Pedagogy | Chalk and talk method/PowerPoint Presentation. |

**Course outcome:**

At the end of the course, the student will be able to analyse and understand about:

- The nature of sociology and its area
- Indian culture and socialization in different perspectives
- Social change and its research in the society
- Indian society and its unity and diversity
- social movements and its impact on the society in general

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hour**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

**Books Recommended:**

**Text Books:**

1. **Introduction to Sociology**, Prescribed textbook for first PUC, 2021-2022, Published by Department of Pre University education, Government of Karnataka
2. **Sociology of Indian society,** Prescribed textbook for Second PUC, 2021-2022, Published by Department of Pre University education, Government of Karnataka
3. Handbook on Sociology, VTU study material

**Reference Books:**

1. **NATURE AND SCOPE OF SOCIOLOGY** by **MSC. Asutosh** (Author), Publisher : Asutosh (10 March 2022).
2. **Essential Sociology** Second Edition by Nitin Sangwan (Author), Seema (Author), Shruti Jakhar (Author), Publisher : EduGali; Second Edition (1 January 2022).

**Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Quiz
- Group assignment
- Seminars

**B.Sc. Honors (Physics/Chemistry/Mathematics)**

**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**

**SEMESTER - VI**

| **Subject Name:** FINANCE & BANKING | | | |
|---|---|---|---|
| Course Code | **21BSO662** | CIE | 50 |
| Teaching Hours/Week (L: T: P: S) | 2:1:0:0 | SEE | 50 |
| Total Hours of Pedagogy | 25 | Total | 100 |
| Credits | 2 | Exam Hours | 3hrs |

**Course Learning Objectives:**

The course will enable students to:

CO1. To explain fundamental banking concepts.
CO2. To explain and use the banking system.
CO3. To develop and implement new ideas and innovations in banking service operations and procedures.
CO4. To improve organisational effectiveness.
CO5. To proper utilization of financial resources.

**Pedagogy (General Instructions)**

Teaching-Learning Process (General Instructions) These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not be only the traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video to explain various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher Order Thinking) questions in the class, which promotes critical thinking.
5. Introduce Topics in manifold representations.
6. Show the different ways to analyze the research problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps Improve the students' understanding.

**Module-1**

**Banking System in India**

Meaning, Definitions, Features of a bank – Meaning, definition and features of banking – Features of Indian Banking System – Reserve Bank Of India – Role and Functions, Commercial Banks – Role and Functions.

**Teaching- Learning Process**: Chalk and talk method / PowerPoint Presentation.

**(RBT Levels: L1, L2 and L3)** **5 hours**

**Module-2**

**Banking Products**

Bank Accounts – Saving Bank Accounts, Current Accounts, Recurring deposit accounts, fixed deposit accounts, NRI accounts, pigmy accounts, and other special accounts. – Procedures and docs involved in opening bank accounts (offline and online).

**Teaching-Learning Process**: Chalk and talk method / PowerPoint Presentation

**(RBT Levels: L1, L2 and L3)** **5 hours**

**Module-3**

**Recent Innovations in Banking**

E-Banking, Telebanking, Internet banking, Mobile banking, NEFT, RTGS, EFT, UPI, IMPS, ATM, Debit card, credit card, MICR Cheques, Crypto Currency, Central bank digital currency.

**Teaching-Learning Process**: Chalk and talk method / PowerPoint Presentation

**(RBT Levels: L1, L2 and L3)** **5 hours**

**Module-4**

**Financial Management**

Meaning of finance – Business finance, Importance of business finance - Financial requirements-working Capital requirements and fixed capital requirements

**Teaching-Learning Process**: Chalk and talk method / PowerPoint Presentation

**(RBT Levels: L1, L2 and L3)** **5 hours**

**Module-5:**

**Sources of finance**

Methods of rising finance- Equity and preference shares, Debentures, and bonds, retained earnings, public deposits, loan from commercial banks, financial institutions, trade credits.

**Teaching-Learning Process**: Chalk and talk method / PowerPoint Presentation

**(RBT Levels: L1, L2 and L3)** **5 hours**

**Course outcome:**

At the end of the course, the student will be able to:

CO 1. Understand the fundamental function of banking
CO 2. Analyze the banking products and decision making.
CO 3. Comprehend emerging trends in banking.
CO 4. Understand the basic financial concepts
CO 5. Estimate the working capital & fixed capital requirements

**Assessment Details (both CIE and SEE)**

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**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

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Two assignments each of **10 Marks**

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**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

**Books Recommended:**

1. Dr. Guruprasad B G & Udaykumar C. (2022) **"Banking Innovations",** Sapna Book House
2. Verma J C (1997) **"Venture Capital Financing"** , SAGE Publications
3. H R Machiraju (2019) **"Indian Financial System",** Vikas Publishing House
4. B S Raman (Recent Edition) **"Business Studies"** , United Publishers

**Web links and Video Lectures (e-Resources):**

https://irjhis.com/paper/IRJHIS2111015.pdf
https://www.capitalone.com/bank/money-management/banking-basics/banking-products-and-services

**Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Quiz
- Group assignment
- Seminars

**VI Semester**

| Intellectual Property Rights | | | |
|---|---|---|---|
| Course Code | 21IPR67 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 25 | Total Marks | 100 |
| Credits | 02 | Exam Hours | 03 |

| | |
|---|---|
| CLO 1 | To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries. |
| CLO 2 | To disseminate knowledge on patents, patent regime in India and abroad and registration aspects |
| CLO 3 | To disseminate knowledge on trademarks and registration aspects |
| CLO 4 | To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects |
| CLO 5 | To aware about current trends in IPR and Govt. steps in fostering IPR |

**Pedagogy (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

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1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to convince abstract concepts.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

## Module-1 Overview of Intellectual Property

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994.

| | |
|---|---|
| **Pedagogy** | **Chalk and talk/power point presentation:**<br>**Videos/Learning material:**<br>**Self-study:** |

## Module-2 Patents

Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board.

| | |
|---|---|
| **Pedagogy** | **Chalk and talk/power point presentation:**<br>**Videos/Learning material:**<br>**Self-study:** |

| Module-3 Copyrights | |
|---|---|
| Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights. | |
| **Pedagogy** | **Chalk and talk/power point presentation:**<br>**Videos/Learning material:**<br>**Self-study:** |
| **Module-4 Trademarks** | |
| Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board. | |
| **Pedagogy** | **Chalk and talk/power point presentation:**<br>**Videos/Learning material:**<br>**Self-study:** |
| **Module-5 Other forms of IP** | |
| **Design:**Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection<br>**Geographical Indication (GI)**<br>Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection, India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP - IPR in current scenario with case studies. | |
| **Pedagogy** | **Chalk and talk/power point presentation:**<br>**Videos/Learning material:**<br>**Self-study:** |

**Course outcome (Course Skill Set)**

At the end of the course the student will be able to:

| | |
|---|---|
| **CO 1** | Discuss the basics of IPR |
| **CO 2** | Understand the principles of patenting. |
| **CO 3** | Understand the procedure and importance of Copyrights. |
| **CO 4** | Explain the concepts of trademarks and licensing. |
| **CO 5** | Understand the design and Geographical indication (GI). |

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The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**


1. Nithyananda, K V. (2019). *Intellectual Property Rights: Protection and Management*. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). *Intellectual Property Rights*. India, IN: PHI learning Private Limited.
3. Ahuja, V K. (2017). *Law relating to Intellectual Property Rights*. India, IN: Lexis Nexis.
4. Journal of Intellectual Property Rights (JIPR): NISCAIR


**Web links and Video Lectures (e-Resources):**

1. http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)