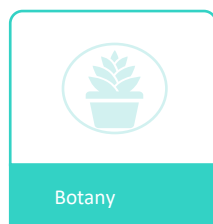
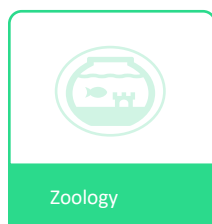
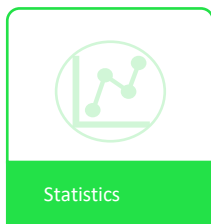
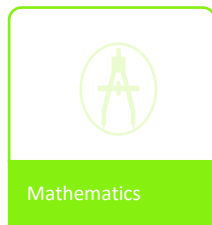
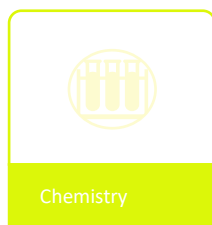
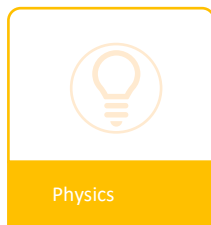


PROGRAMME PROJECT REPORT

Bachelor of Science Programme

(3 Year Programme in accordance with NEP-2020)



SCHOOL OF SCIENCES
U. P. Rajarshi Tandon Open University
Prayagraj

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1. Bachelor's Degree Programme

The National Education Policy (NEP) 2020 envisions a new vision that enable an individual to study one or more specialized areas of interest at a deep level, and also develop capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects. The NEP 2020 focuses on the formulation of expected learning outcomes for all higher education programmes. It states that “National Higher Education Qualifications Framework (NHEQF)” shall be align with the National Skills Qualifications Framework (NSQF) to ease the integration of vocational education into higher education. It also points out that higher education qualifications leading to a degree/diploma/certificate shall be described by the NHEQF in terms of Outcome Based Education (OBE).

The design of B.Sc. under UGC Choice Based Credit System (CBCS) programme in line with NHEQF offers opportunities and avenues to learn core subjects but also to explore additional avenues of learning beyond the core subjects for holistic development of a learner.

| | | |
|--|------------------------------------|------|
| Programme: | Bachelor of Science [B.Sc.] | |
| Year | First Introduction year: 2002 | |
| Revision of Programme in accordance with NEP-2020 | | |
| | Initiation year of revision | 2022 |
| | Completion year of revision | 2023 |

The salient advantages of the choice-based credit system are as follows:

- CBCS allows learner to choose inter-disciplinary, intra-disciplinary courses, skill-oriented courses (even from other disciplines according to their learning needs, interests and aptitude) and have more flexibility.
- CBCS offers flexibility for learner to study at different times and at different institutions to complete one course (ease of mobility of learner). Credits earned at one institution can be easily transferred to other universities.
- Learner may undertake as many credits as they can cope with without repeating all the courses in a given semester if they fail in one/more courses.
- Shift in focus from the teacher-centric to learner-centric education.

The uniform grading system will also enable potential employers in assessing the performance of the learner. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on learner's performance in examinations, guidelines framed by the UGC are followed. Hence, adoption of NHEQF helps to overcome the gap between university degree and employability by introducing skills and competencies in the graduates.

2. B.Sc. Programme

The structure and duration of undergraduate programme of Bachelor of Science in accordance with NEP 2020 includes multiple exit options within this period, with appropriate certifications:

- Level 5: a **certificate** after completing 1 year (2 semesters) of study in the chosen discipline or field, including vocational and professional areas;
- Level 6: a **diploma** after 2 years (4 semesters) of study;
- Level 7: a **Bachelor's** degree after a 3-year (6 semesters) programme.

2.1 Programme Mission & Objectives

In line with the mission of the University to provide flexible learning opportunities to all, particularly to those who could not join regular colleges or universities owing to social, economic and other constraints, the 3-year Undergraduate Programme in Science, B.Sc. aims at providing holistic and value based knowledge and guidance to promote scientific temper in everyday life. The program offers a platform to the learners to fulfill the eligible criteria in various scientific jobs in government and private sector.

The Programme aims at the following objectives:

1. To provide a sound academic base from which an advanced career in science can be developed.
2. To provide basic understanding about science among learners.
3. To develop academically competent and professionally motivated personnel, equipped with objective, critical thinking, right moral and ethical values that compassionately foster scientific temper with a sense of social responsibility.
4. To enable learner to become globally competent.
5. To inculcate entrepreneurial skills among learners.

2.2 Relevance of the Programme with Mission and Goals

The 3-year Undergraduate Programme in Science, B.Sc. is designed with the objective of equipping learners to cope with the emerging trends and challenges in the scientific domain. In congruence with goals of the University the Programme also focuses to provide skilled manpower to the society to meet global demands. The Programme is designed with three major subjects so that a successful learner can go for higher studies in any one of the major subjects of his/ her choice. The Programme also aims at making the learners fit for taking up various jobs.

2.3 Nature of Prospective Target Group of Learners

The Program is targeted to all individuals looking to earn a graduation degree for employment, further higher education, promotion in career and professional development.

2.4 Appropriateness of Programme to be conducted in ODL mode to acquire specific skills & competence

| Learning outcomes after Level 5 | | |
|---------------------------------|---|--|
| Learning Outcomes | Elements of the descriptor | Level 5 (Undergraduate Certificate) |
| LO 1 | Knowledge and understanding | <ul style="list-style-type: none">• knowledge of facts, concepts, principles, theories, and processes in multidisciplinary areas in science.• understanding of the linkages between various disciplines. |
| LO 2 | Skills required to perform and accomplish tasks | <ul style="list-style-type: none">• acquire cognitive and technical skills for selecting and using relevant methods, tools, and materials to assess the appropriateness of approaches to solving problems associated with the science. |
| LO 3 | Application of knowledge and skills | <ul style="list-style-type: none">• apply the acquired knowledge, and a range of cognitive and practical skills to select and use basic methods, tools, materials, and information to generate solutions to specific problems relating to the science. |

| | | |
|------|--|---|
| LO 4 | Generic learning outcomes | <ul style="list-style-type: none"> • listen carefully, read texts related to the science analytically and present information in a clear and concise manner. • express thoughts and ideas effectively in writing and orally and present the results/findings of the experiments carried out in a clear and concise manner to different groups. • meet own learning needs relating to the science. • pursue self-directed and self-managed learning to upgrade knowledge and skills required to pursue higher level of education and training. • gather and interpret relevant quantitative and qualitative data to identify problems, • critically evaluate the essential theories, policies, and practices by following scientific approach to knowledge development and take actions to generate solutions to specific problems associated with the science. • make judgement and take decision, based on analysis of data and evidence, for formulating responses to issues/problems associated with the science. |
| LO 5 | Constitutional, humanistic, ethical and moral values | <ul style="list-style-type: none"> • embrace constitutional, humanistic, ethical, and moral values and practice these values in real-life situations. |
| LO 6 | Employment ready skills, and entrepreneurship skills and mindset | <ul style="list-style-type: none"> • perform effectively in a defined job relating to the science. • ability to exercise responsibility for the completion of assigned tasks. |

| Learning outcomes after Level 6 | | |
|---------------------------------|---|--|
| Learning Outcomes | Elements of the descriptor | Level 6 (Undergraduate Diploma) |
| LO 1 | Knowledge and understanding | <ul style="list-style-type: none"> • theoretic al and technical knowledge in multidisciplinary contexts, • deeper knowledge and understanding of one of the learning areas and its underlying principles and theories, • procedural knowledge required for performing skilled or paraprofessional tasks associated with the chosen fields of learning. |
| LO 2 | Skills required to perform and accomplish tasks | <ul style="list-style-type: none"> • cognitive and technical skills required for performing and accomplishing complex tasks relating to the chosen fields of learning. • cognitive and technical skills required to analyse and synthesize ideas and information from a range of sources. • act on information to generate solutions to specific problem s associated with the chosen fields of learning. |
| LO 3 | Application of | <ul style="list-style-type: none"> • apply the acquired specialized or theoretical knowledge, and a |

| | | |
|------|--|--|
| | knowledge and skills | range of cognitive and practical skills to gather quantitative and qualitative data, |
| LO 4 | Generic learning outcomes | <ul style="list-style-type: none"> • listen carefully, read texts analytically and present complex information in a clear and concise manner, • communicate in writing and orally the information, arguments, and results of the experiments and studies conducted accurately and effectively. • critically evaluate the essential theories, policies, and practices by following scientific approach to knowledge development. • make judgement and take decision, based on the analysis and evaluation of information, for determining solutions to a variety of unpredictable problems. |
| LO 5 | Constitutional, humanistic, ethical and moral values | <ul style="list-style-type: none"> • embrace constitutional, humanistic, ethical, and moral values, and practice these values in life, |
| LO 6 | Employment ready skills, and entrepreneurship skills and mindset | <ul style="list-style-type: none"> • take up job/employment or professional practice requiring the exercise of full personal responsibility for the completion of tasks and for the outputs of own work. • exercise self- management within the guidelines of study and work contexts. • supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities. |

| Learning outcomes after Level 7 | | |
|--|---|---|
| Learning Outcomes | Elements of the descriptor | Level 7 (Bachelor in Science) |
| LO 1 | Knowledge and understanding | <ul style="list-style-type: none"> • comprehensive, factual, theoretical, and specialized knowledge in multidisciplinary contexts with depth in the underlying principles and theories. • knowledge of the current and emerging issues and developments. |
| LO 2 | Skills required to perform and accomplish tasks | <ul style="list-style-type: none"> • cognitive and technical skills required for performing and accomplishing complex tasks to evaluate and analyse complex ideas. • cognitive and technical skills required to generate solutions to specific problems. |
| LO 3 | Application of knowledge and skills | <ul style="list-style-type: none"> • apply the acquired specialized technical or theoretic alknowledge, and cognitive and practical skills to gather and analyse quantitative/ qualitative data to assess the appropriateness of different approaches to solving problems, |
| LO 4 | Generic learning outcomes | <ul style="list-style-type: none"> • listen carefully, to read text related to the chosen fields of learning analytically and present complex information in a clear and concise manner to different groups/audiences. • communicate in writing and orally the constructs and methodologies adopted for the studies undertaken relating to the chosen fields of learning, |

| | | |
|------|--|--|
| | | <ul style="list-style-type: none"> critically evaluate evidence for taking actions to generate solutions to specific problems based on empirical evidence. make judgement and take decisions based on the analysis and evaluation of information for formulating responses to problems, including real-life problems, |
| LO 5 | Constitutional, humanistic, ethical and moral values | <ul style="list-style-type: none"> embrace the constitutional, humanistic, ethical, and moral values, and practice these values in life. identify ethical issues in science, formulate coherent arguments about ethical and moral issues, including environmental and sustainable development issues. follow ethical practices in all aspects of research and development |
| LO 6 | Employment ready skills, and entrepreneurship skills and mindset | <ul style="list-style-type: none"> knowledge and essential skills set and competence that are necessary to: take up a professional job and professional practice, entrepreneurship skills and mindset required for setting up and running an economic enterprise or pursuing self-employment exercise management and supervision in the contexts of work or study activities involving unpredictable work processes and working environment |

2.5 Instructional Design

2.5.1 3-year B.Sc. Programme Structure

The University follows the credit system in all its programmes. One credit is equal to 30 hours of learner's study time which is equivalent to 15 lectures in conventional system. To earn a Bachelor's Degree, a learner has to earn 120 credits in minimum six semesters (three years) with 20 credits per semester. For earning 120 credits, a learner has to opt from the following categories of courses:

- Discipline Specific Core Courses
- Discipline Specific Electives Courses (DEC)
- Ability Enhancement Compulsory Courses (AECC)
- Skill Enhancement Courses (SEC)

Programme Structure of B.Sc. Programme under NHEQF

| Level | Year | Sem | First Selected Subject | Second Selected Subject | Third Selected Subject | Ability Enhancement Compulsory Course (AECC) | Skill Enhancement Course (SEC) | Discipline Specific Elective Course (DEC) | Literature Survey/ Research Project | Total credit |
|---------------------|------|-----------------|---|---|---|--|--------------------------------|---|-------------------------------------|--------------|
| | | | Discipline Specific Core papers with credit | Discipline Specific Core papers with credit | Discipline Specific Core papers with credit | | | | | |
| 5 | 1 | 1 st | 4 | 4 | 4 | 4 | 4 | - | - | 20 |
| | | 2 nd | 4 | 4 | 4 | 4 | 4 | - | - | 20 |
| 6 | 2 | 3 rd | 4 | 4 | 4 | 4 | 4 | - | - | 20 |
| | | 4 th | 4 | 4 | 4 | 4 | 4 | - | - | 20 |
| 7 | 3 | 5 th | - | - | - | - | 4 | 12 | 4 | 20 |
| | | 6 th | - | - | - | - | 4 | 12 | 4 | 20 |
| Total credit | | | 16 | 16 | 16 | 16 | 24 | 24 | 8 | 120 |

Explanation of terms used for categorization of courses:

- A. **Discipline Specific Core Courses:** A course, which should compulsorily be studied by a learner as a core requirement is termed as a Core course.
- B. **Elective Course (DE):** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course. The Elective course may be offered in following types:
- a) **Discipline Specific Elective Course (DCE):** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.
 - b) **Industrial Training/ Survey/ Research Project/ Field Work/Apprenticeship/ Dissertation/Internship:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a learner studies such a course on his own with an advisory support by a counsellor/faculty member. Currently, Literature survey and Research Project in 5th and 6th semester respectively is offered under code; **LS101N** and **RP102N**.
 - c) **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. In B.Sc. programme presently we are not offering any such course.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

- C. **Ability Enhancement Compulsory Courses (AECC):** AECC may be of two kinds: Ability Enhancement Courses (AEC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to knowledge enhancement. SEC courses are value-based and/or skillbased and are aimed at providing hands-on-training, competencies and skills.

(a) **Ability Enhancement Courses (AEC):** English Communication/Hindi Communication, Human Rights and Duties/Health & Hygiene, Environmental Science/Solid Waste Management, Disaster Management/Nutrition for Community.

(b)

| Semester | Ability Enhancement Courses (AECC) |
|----------|---|
| 1 | Ability Enhancement Course in English [AECEG] OR Ability Enhancement Course in Hindi [AECHD] |
| 2 | Ability Enhancement Course in Human Rights and Duties [AECHRD] OR Ability Enhancement Course in Health & Hygiene [AECHH] |
| 3 | Ability Enhancement Course in Environment Awareness [AECEA] OR Ability Enhancement Course in Solid Waste Management [AESWM] |
| 4 | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] |

(c) **Skill Enhancement Courses (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge. In B.Sc. programme. Presently we are not offering options to choose from pool, however courses are fixed for respective semesters.

The format of **Skill Enhancement Courses** for different combination is given below:

| S. No. | Combination of three courses | Semester, course code and credits | | | | | |
|--------|------------------------------|-----------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | | 1 st sem | 2 nd sem | 3 rd sem | 4 th sem | 5 th sem | 6 th sem |
| | | Course code/ Credit | Course code/ Credit | Course code/ Credit | Course code/ Credit | Course code/ Credit | Course code/ Credit |
| 1. | PCM | SBSEVS-01N/(4) | SBSCH-02N/(04) | SBSCH-01N/(04) | SBSPHS-02N/(04) | SBSMM-03N/(04) | SBSSTAT-04N/(04) |
| 2. | PCS | SBSEVS-01N/(4) | SBSCH-02N/(04) | SBSCH-01N/(04) | SBSPHS-02N/(04) | SBSMM-03N/(04) | SBSSTAT-04N/(04) |
| 3. | PMCs | SBSEVS-01N/(4) | SBSCS-02N/(4) | SBSCS-01 N/(04) | SBSPHS-02N/(04) | SBSMM-03N/(04) | SBSSTAT-04N/(04) |
| 4. | PMS | SBSEVS-01N/(4) | SBSCS-02N/(4) | SBSCS-01 N/(04) | SBSPHS-02N/(04) | SBSMM-03N/(04) | SBSSTAT-04N/(04) |
| 5. | PSCs | SBSEVS-01N/(4) | SBSCS-02N/(4) | SBSCS-01 N/(04) | SBSPHS-02N/(04) | SBSMM-03N/(04) | SBSSTAT-04N/(04) |
| 6. | MSCs | SBSEVS-01N/(4) | SBSCS-02N/(4) | SBSCS-01N/(04) | SBSPHS-02N/(04) | SBSMM-03N/(04) | SBSSTAT-04N/(04) |
| 7. | BZC | SBSEVS-01N/(4) | SBSCH-02N/(04) | SBSCH-01N/(04) | SBSBY-02N/(04) | SBSZY-03N/(04) | SBSBCH-04N/(04) |
| 8. | BZBch | SBSEVS-01N/(4) | SBSCH-02N/(04) | SBSBCH-01N/(04) | SBSBY-02N/(04) | SBSZY-03N/(04) | SBSBCH-04N/(04) |
| 9. | PCsEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSCS-01 N/(04) | SBSPHS-02N/(04) | SBSCS-02N/(4) | SBSSTAT-04N/(04) |
| 10. | PCEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSCH-01N/(04) | SBSPHS-02N/(04) | SBSCH-01N/(4) | SBSSTAT-04N/(04) |
| 11. | PSEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSCH-01 N/(04) | SBSPHS-02N/(04) | SBSCH-02N/(4) | SBSSTAT-04N/(04) |
| 12. | BCEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSCH-01N/(04) | SBSBY-02N/(04) | SBSZY-03N/(04) | SBSBCH-04N/(04) |
| 13. | BZEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSBCH-01N/(04) | SBSZY-02N/(04) | SBSZY-03N/(04) | SBSSTAT-04N/(04) |
| 14. | ZCEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSCH-01N/(04) | SBSZY-02N/(04) | SBSZY-03N/(04) | SBSSTAT-04N/(04) |
| 15. | BBchEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSBCH-01N/(04) | SBSBY-02N/(04) | SBSZY-03N/(4) | SBSBCH-04N/(04) |
| 16. | ZBchEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSBCH-01N/(04) | SBSBY-02N/(04) | SBSZY-03N/(04) | SBSBCH-04N/(04) |
| 17. | PMEVS | SBSEVS-01N/(4) | SBSEVS-02N/(4) | SBSCH-02N/(04) | SBSPHS-02N/(04) | SBSMM-03N/(04) | SBSSTAT-04N/(04) |

It is mandatory for every learner to offer any combination of subjects listed below to complete his/her program for the degree. Total credits allotted against each course of all three subjects together with AECC and SEC will be 120 distributed in 06 semesters (three years) separately.

The List of Skill Enhancement courses offered in B.Sc. programme is given below:

| Course Code | Skill Enhancement Courses | Credit |
|-------------|--|--------|
| SBSEVS-01N | Energy Resources and Green Technology | 4 |
| SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| SBSCH-01N | Organic Chemistry II (Advance Organic Chemistry) | 4 |
| SBSCH-02N | Advance Analytical Chemistry | 4 |
| SBSCS-01N | Discrete Mathematics | 4 |
| SBSCS-02N | Python Programming Programming | 4 |
| SBSBCH-01N | Bio-analytical techniques | 4 |
| SBSBCH-04N | Clinical biochemistry | 4 |
| SBSZY-02N | Fundamental of Animal Behavior | 4 |
| SBSZY-03N | Economic zoology and environmental biology | 4 |
| SBSPHS-02N | Modern physics | 4 |
| SBSBY-02N | Ecology | 4 |
| SBSMM-03N | Elementary Analysis | 4 |
| SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 |

Combinations of undergraduate science programs:

The learner has to offer any one of the following combinations:

| Life Science Group | Physical Science Group |
|--|---|
| BZC: Botany, Zoology, Chemistry | PCM: Physics, Chemistry, Mathematics |
| BZBch: Botany, Zoology, Biochemistry | PCS: Physics, Chemistry, Statistics |
| BCEVS: Botany, Chemistry, Environmental Science | PMCs: Physics, Mathematics, Computer Science |
| BZEVS: Botany, Zoology, Environmental Science | PMS: Physics, Mathematics, Statistics |
| ZCEVS: Zoology, Chemistry, Environmental Science | PSCs: Physics, Statistics, Computer Science |
| BBchEVS: Botany, Biochemistry, Environmental Science | MSCs: Mathematics, Statistics, Computer Science |
| ZBchEVS: Zoology, Biochemistry, Environmental Science | PCEVS: Physics, Chemistry, Environmental Science |
| | PCsEVS: Physics, Computer Science, Environmental Science |
| | PSEVS: Physics, Statistics, Environmental Science |
| | PMEVS: Physics, Mathematics, Environmental Science |

- A learner has to study and pass the 20 credits each from the three selected **Core Course** (subjects) in the first and second year.
- The learner has to choose and study one paper out of AECEG or ACEHD in first semester, AECHRD or AECHH in second semester, AECEA or AECSWM in third semester and AECNC or AECDM in fourth semester, each of 4 credits under **Ability Enhancement Compulsory Courses**.
- Under **Skill Enhancement Courses**, it is compulsory to study 24 credit papers from 1st to 6th semester.
- The learner has to choose any two groups among A, B, C, D, E, F, G, H and I from **Discipline Specific Elective Course** in each selected subject in fifth and sixth semester. The Selection criterion for **Discipline Specific Elective Course (DEC)** for 5th and 6th Semester is given below:

| Subjects/ semester | Physics (Group A) | | Chemistry (Group B) | | Mathematics (Group C) | | Computer Science (Group D) | | Statistics (Group E) | | Biochemistry (Group F) | | Botany (Group G) | | Zoology (Group H) | | Environmental Science (Group I) | |
|--------------------------|----------------------|--------|------------------------|--------|--------------------------|--------|-------------------------------|--------|-------------------------|------------|---------------------------|--------|---------------------|--------|----------------------|--------|------------------------------------|--------|
| | Paper code | credit | Paper code | credit | Paper code | credit | Paper code | credit | Paper code | Paper code | Paper code | credit | Paper code | credit | Paper code | credit | Paper code | credit |
| 5 th Semester | DECPHS-105N | 2 | DECCH E-105N | 2 | DECMM-109N | 2 | DECCS-105N | 2 | DECSTA T-105N | 2 | DECBCHE-105N | 2 | DECBY-105N | 2 | DECZY-105N | 2 | DECEVS-105N | 2 |
| | DECPHS-106N | 2 | DECCH E-106N | 2 | DECMM-110N | 2 | DECCS-106N | 2 | DECSTA T-106N | 2 | DECBCHE-106N | 2 | DECBY-106N | 2 | DECZY-106N | 2 | DECEVS-106N | 2 |
| | DECPHS-107N(P) | 2 | DECCH E-107N(P) | 2 | DECMM-111N(P) | 2 | DECCS-107N(P) | 2 | DECSTA T-107N(P) | 2 | DECBCHE-107N(P) | 2 | DECBY-107N(P) | 2 | DECZY-107N(P) | 2 | DECEVS-107N(P) | 2 |
| 6 th Semester | DECPHS-108N | 2 | DECCH E-108N | 2 | DECMM-112N | 2 | DECCS-108N | 2 | DECSTA T-108N | 2 | DECBCHE-108N | 2 | DECBY-108N | 2 | DECZY-108N | 2 | DECEVS-108N | 2 |
| | DECPHS-109N | 2 | DECCH E-109N | 2 | DECMM-113N | 2 | DECCS-109N | 2 | DECSTA T-109N | 2 | DECBCHE-109N | 2 | DECBY-109N | 2 | DECZY-109N | 2 | DECEVS-109N | 2 |
| | DECPHS-110N(P) | 2 | DECCH E-110N(P) | 2 | DECMM-114N(P) | 2 | DECCS-110N(P) | 2 | DECSTA T-110N(P) | 2 | DECBCHE-110N(P) | 2 | DECBY-110N(P) | 2 | DECZY-110N(P) | 2 | DECEVS-110N(P) | 2 |

In this way, the learner must complete his 40 credit in the first year, 40 credit in the second year and 40 credits in the third year totaling of 120 credits.

2.5.2 Course curriculum: The details of syllabus is given in Appendix-I

2.5.3 Language of Instruction: SLM will be provided in English. However, learner can write assignment and give Term End Examination (TEE) either in Hindi or English.

2.5.4 Duration of the Programme

Minimum duration in years: 03

Maximum duration in years: 06

2.5.5 Faculty & Support Staff requirement

Professor (3), Associate Professor (1), Assistant Professor (9) and support staff (3)

2.6 Instructional Delivery Mechanisms

The Open University system is more learner-oriented, and the student is an active participant in the teaching-learning process. Most of the instructions are imparted through distance rather than face-to-face communication.

The University follows a multi-media approach for instruction. It comprises of:

- self-instructional printed material (Self Learning Material)
- audio and video lectures
- face-to-face counselling
- assignments

- laboratory work
- Project work in some courses
- teleconference/web conference
- Web Enabled Academic Support Portal

2.6.1 Self-Learning Material

The Self Learning Material (SLMs) are prepared in line with the UGC guidelines on preparation of SLMs. The prepared study materials are self-instructional in nature.

The course material is divided into blocks. Each block contains a few units. Lessons, which are called Units, are structured to facilitate self-study. The units of a block have similar nature of contents. The first page of each block indicates the numbers and titles of the units comprising the block. In the first block of each course, we start with course introduction. This is followed by a brief introduction to the block. After the block introduction, emphasis is given on contribution of ancient Indian knowledge into that specific course. Next, each unit begins with an introduction to talk about the contents of the unit. The list of objectives are outlined to expect the learning based outcome after working through the unit. This is followed by the main body of the unit, which is divided into various sections and sub-sections. Each unit is summarized with the main highlights of the contents.

Each unit have several “Check Your Progress” Questions and Terminal Questions /exercises. These questions help the learner to assess his/her understanding of the subject contents. At the end of units, additional references/books/suggested online weblink for MOOCs/Open Educational Resources for additional reading are suggested.

2.6.2 Audio and Video lectures

Apart from SLM, audio and video lectures have been prepared for some courses. The audio-video material is supplementary to print material. The video lectures are available at YouTube channel of university

2.6.3 Counselling Classes

The face to face (F2F) counselling classes are conducted at head quarter and study centers. The purpose of such a contact class is to answer some of questions and clarify the doubts of learner which may not be possible through any other means of communication. Well experienced counsellors at study centers provide counselling and guidance to the learner in the courses that (s)he has chosen for study. The counselling sessions for each of the courses will be held at suitable intervals throughout the whole academic session. The time table for counselling classes are displayed at head quarter as well as by the coordinator of study center, however, attending counselling sessions is not compulsory. It is noted that to attend the counselling sessions, learner has to go through the course materials and note down the points to be discussed as it is not a regular class or lectures.

2.6.4 Assignments

The purpose of assignments is to test the comprehension of the learning material that learner receives and also help to get through the courses by providing self-feedback to the learner. The course content given in the SLM will be sufficient for answering the assignments.

Assignments constitute the continuous evaluation component of a course. The assignments are available at the SLM section of the home page of university website. In any case, learner has to submit assignment before appearing in the examination for any course. The

assignments of a course carry 30% weightage while 70% weightage is given to the term-end examination (TEE). The marks obtained by learner in the assignments will be counted in the final result. Therefore, It is advised to take assignments seriously. However, there will be no written assignments for Lab courses.

2.6.5 Laboratory Work

Laboratory courses are an integral component of the B.Sc. programme. While designing the curricula for laboratory courses, particular care has been taken to weed out experiments not significant to the present-day state of the discipline. Importance has been given to the utility of an experiment with respect to real life experience, development of experimental skills, and industrial applications. It is planned to phase the laboratory courses during suitable periods (such as summer or autumn vacations) so that in-service persons can take them without difficulty. Laboratory courses worth 2 credits will require full-time presence of the student at the Study Centre for one week continuously. During this time a student has to work for around 60 hours. Around 40 hours would be spent on experimental work and the remaining time will be used for doing calculations, preparations of records, viewing or listening to the video/audio programmes.

2.6.6 Teleconference/Web conference

Teleconference/web conference, using done through ZOOM/webex in form of online special counselling sessions is another medium to impart instruction to and facilitate learning for a distance learner. The students concerned would be informed about the teleconferencing schedule and the place where it is to be conducted by sending bulk SMS.

2.6.7 Web Enabled Academic Support Portal

The University also provide Web Enabled Academic Support Portal to access the course materials, assignments, and other learning resources.

2.6.8 Learner Support Service Systems

(a) Study Centre

A Study Centre has following major functions:

- (i) **Counselling:** Counselling is an important aspect of Open University System. Face to face contact-cum-counselling classes for the courses will be provided at the Study Centre. The detailed programme of the contact-cum-counselling sessions will be sent to the learner by the Coordinator of the Study Centre. In these sessions learner will get an opportunity to discuss with the Counsellors his/her problems pertaining to the courses of study.
- (ii) **Evaluation of Assignments:** The evaluation of Tutor Marked Assignments (TMA) will be done by the Counsellors at the Study Centre. The evaluated assignments will be returned to the learner by the Coordinator of Study Centre with tutor comments and marks obtained in TMAs. These comments will help the learner in his/her studies.
- (iii) **Library:** Every Study Centre will have a library having relevant course materials, reference books suggested for supplementary reading prepared for the course(s).
- (iv) **Information and Advice:** The learner will be given relevant information about the courses offered by the University. Facilities are also provided to give him/her guidance in choosing courses.
- (v) **Interaction with fellow-students:** In the Study Centre learner will have an opportunity to interact with fellow students. This may lead to the formation of self-help groups.

(b) Learner Support Services (LSS)

The University has formed an LSS cell at the head quarter. The LSS cell coordinate with the Study Centre to get rid of any problem faced by the learner.

2.7 Procedure for admissions, curriculum transaction and evaluation

2.7.1 Admission Procedure

- (a) The detailed information regarding admission will be given on the UPRTOU website and on the admission portal. Learners seeking admission shall apply online.
- (b) Direct admission to 3-year B.Sc. program is offered to the interested candidates.
- (c) **Eligibility:** The candidate should pass the 10+2 level with science group. To opt B.Sc. life science combination, candidate should pass 10+2 with Biology and to opt for B.Sc. Physical Science combination, candidate should pass 10+2 with Mathematics.

2.7.2 Programme Fee: Rs. 8000 / year. The fee is deposited through online admission portal only.

2.7.3 Evaluation

The evaluation consists of two components: (1) continuous evaluation through assignments, and (2) term-end examination. Learner must pass both in continuous evaluation as well as in the term-end examination of a course to earn the credits assigned to that course. For each course there shall be one written Terminal Examination. The evaluation of every course shall be in two parts that is 30% internal weightage through assignments and 70% external weightage through terminal exams.

| | |
|--------------------------|-------------------|
| (a) Theory course | Max. Marks |
| Terminal Examination | 70 |
| Assignment | 30 |
| Total | 100 |

| | |
|--------------------------------|-------------------|
| (b) Practical course: | Max. Marks |
| Terminal Practical Examination | 100 |

Marks of Terminal Practical Examinations shall be awarded as per following scheme:

| | | |
|------|-------------------------------------|----|
| i. | Write up /theory work | 30 |
| ii. | Viva-voce | 30 |
| iii. | Execution/Performance/Demonstration | 20 |
| iv. | Lab Record | 20 |

The following 10-Point Grading System for evaluating learners' achievement is used for CBCS programmes:

10-Point Grading System in the light of UGC-CBCS Guidelines

| Letter Grade | Grade Point | % Range |
|--------------------|---------------|--|
| O (Outstanding) | 10 | 91-100 |
| A+ (Excellent) | 9 | 81-90 |
| A (Very Good) | 8 | 71-80 |
| B+ (Good) | 7 | 61-70 |
| B (Above Average) | 6 | 51-60 |
| C (Average) | 5 | 41-50 |
| P (Pass) | 4 | 36-40 |
| NC (Not Completed) | 0 | 0-35 |
| Ab (Absent) | 0 | |
| Q | Qualified | Applicable only for Non-Credit courses |
| NQ | Not Qualified | |

Learner is required to score at least a ‘P’ grade (36% marks) in both the continuous evaluation (assignments) as well as the term-end examination. In the overall computation also, learner must get at least a ‘P’ grade in each course to be eligible for the B. Sc. degree.

Computation of CGPA and SGPA

(a) Following formula shall be used for calculation of CGPA and SGPA

| | |
|--|---|
| For jth semester $SGPA (S_j) = \frac{\sum (C_i * G_i)}{\sum C_i}$ | where, C_i = number of credits of the i th course in j th semester G_i = grade point scored by the learner in the i th course in j th semester. |
| $CGPA = \frac{\sum (C_j * S_j)}{\sum C_j}$ | where, S_j = SGPA of the j th semester C_j = total number of credits in the j th semester |

The CGPA and SGPA shall be rounded off up to the two decimal points. (For e.g., if a learner obtained 7.2345, then it will be written as 7.23 or if s(he) obtained 7.23675 then it will be written as 7.24)

CGPA will be converted into percentage according to the following formula:

$$\text{Equivalent Percentage} = \text{CGPA} * 9.5$$

(b) Award of Division

The learner will be awarded division according to the following table:

| Division | Classification |
|--------------------------|--------------------------------------|
| 1 st Division | 6.31 or more and less than 10 CGPA |
| 2 nd Division | 4.73 or more and less than 6.31 CGPA |
| 3 rd Division | 3.78 or more and less than 4.73 CGPA |

2.7.4 Multiple Entry and Multiple Exit options

The 3-year B.Sc. programme is an Outcome-Based Education (OBE) for qualifications of different types. The qualification types and examples of title/nomenclature for qualifications within each type are indicated in Table 1.

| Level | Qualification title | Programme duration | Entry Option | Exit option |
|--------------|--------------------------------------|---|---|---|
| 5 | Undergraduate Certificate in Science | Programme duration: First year (first two semesters) of the B.Sc. programme | 10+2 level with science group | Exit followed by an exit 10- credit bridge course(s) lasting two months, including at least 6- credit job-specific internship/apprenticeship |
| 6 | Undergraduate Diploma in Science | Programme duration: First two years (first four semesters) of the of the B.Sc. programme | Undergraduate Certificate obtained after completing the first year (two semesters) of the B.Sc. programme | Exit followed by an exit 10- credit bridge course(s) lasting two months, including at least 6- credit job-specific internship/apprenticeship |
| 7 | Bachelor in Science | Programme duration: First three years (first six semesters) of the of the B.Sc. programme | Undergraduate diploma obtained after completing two years (four semesters) of the B.Sc. programme | Exit followed by an exit 10- credit bridge course(s) lasting two months, including at least 6- credit job-specific internship/apprenticeship |

Exit requirements from Level 5 to Level 7

| Level | Year | Credits | Required Bridge Course of 10 credit to exit from each Level | | | Award of Certificate/Diploma/Degree |
|---------|------|---------|---|------------------|----------------------|--------------------------------------|
| Level 5 | 1 | 40 | courses | Credits | Durati on | Undergraduate Certificate in Science |
| | | | job-specific skill course | 4 | 02 – 03 months | |
| | | | job-specific internship/apprenticeship | 6 | | |
| | | | | Total: 10 | | |
| Level 6 | 2 | 40 | courses | Credits | Durati on | Undergraduate Diploma in Science |
| | | | job-specific skill course | 4 | 02 – 03 months | |
| | | | job-specific internship/apprenticeship | 6 | | |
| | | | | Total: 10 | | |
| Level 7 | 3 | 40 | courses | Credits | Durati on | Bachelor in Science |
| | | | job-specific skill course | 4 | 02 – 03 months | |
| | | | job-specific internship/apprenticeship | 6 | | |
| | | | | Total: 10 | | |

Norms for 10- credit bridge course(s):

- The job-specific skill course is of 4 credits. Only assignment has to be submitted by learner with 100% evaluation weightage.
- The job-specific internship/apprenticeship of 02-03 months or more of 6 credits, after 2nd or 4th semester, will be mandatory for the learners desirous of exiting with a certificate or Diploma, respectively. The continuing learners may, however, undergo optional research internships after 2nd / 4th semester, to enhance their research capabilities, by engagement as interns in HEI/Research Institute/Industrial R&D labs/any other organization.
- Under exit option from Level 5 to 7, the learner can choose HEI/Research Institute/Industrial R&D labs/any organization (Private/State Govt/Central Govt.) for internship/apprenticeship for job-specific bridge course by own or choose job-specific bridge course from the list provided by the University. After successful completion, he/she submit the certificate obtained from organization to the Training & Placement (T & P) Office of the University to get Undergraduate certificate/diploma for successful completion. The monitoring of such learners shall be done by T & P Cell.
- Evaluation of Bridge Course of 10 credit to exit from each Level**

| Bridge Course components | Credit | Mode of Evaluation |
|--|-----------|--|
| (a) job-specific skill course | 4 | Assignment |
| (b) job-specific internship/apprenticeship | 6 | Test/Viva voce/Practical conducted at organization level |
| Total credits | 10 | |

- Following is the list of courses under 10 credit bridge course.

| Level | Bridge course/ 10 credit | | | Concerned Person to contact |
|-------|--------------------------|---------------------------|----------------------------------|--------------------------------------|
| | Course Code / 4 credit | Job specific Course Title | Internship Domain Area/ 6 credit | |
| 5 | BCOT-01 | Office Tools | DTP Publishing | In-charge, Training & Placement Cell |
| 6 | BCCPLT-02 | CPLT | Laboratory Technique | |

2.8 Requirement of the laboratory support and Library Resources

The practical sessions are held in the science laboratories of the Study Centre. In these labs, the learner will have the facility to use the equipment and consumables relevant to the syllabus. The SLM, supplementary text audio and video material of the various courses of the program is available through the online study portal of the University. The University also have a subscription of National Digital Library to provide the learners with the ability to enhance access to information and knowledge of various courses of the programme.

2.9 Cost estimate of the programme and the provisions

3-year B.Sc. programme consists of 111 courses and 20 laboratory courses. One course is of 2 credits which consists of approx. 10 units. The total approximated expenditure on the development of 111 courses is:

| S. No. | Item | Cost per Unit (writing & editing) | Total cost (Rs.) |
|--------------|--|-----------------------------------|------------------|
| 1 | Total no. of units in 111 courses = 1110 | 4500 | 495000 |
| 2 | BOS Meetings, etc. | 300000 | 300000 |
| Total | | | 525000 |

2.10 Quality assurance mechanism and expected programme outcomes

(a) **Quality assurance mechanism:** The program structure is developed under the guidance of the Board of studies comprising external expert members of the concerned subjects followed by the School board. The program structure and syllabus is approved by the Academic Council of the University. The course structure and syllabus is reviewed time to time according to the feedback received from the stakeholders and societal needs.

The Centre for Internal Quality Assurance will monitor, improve and enhance effectiveness of the program through the following:

- ✓ Annual academic audit
- ✓ Feedback analysis for quality improvement
- ✓ Regular faculty development programs
- ✓ Standardization of learning resources
- ✓ Periodic revision of program depending upon the changing trends by communicating to the concerned school

(b) Expected programme outcomes (POs)

| | | |
|-------------------------------------|-------------|---|
| Knowledge and understanding | PO1 | Demonstrate a fundamental/coherent understanding of the academic field of science, its different learning areas and applications, and its linkages with related disciplinary areas/subjects |
| Skills related to specialization | PO 2 | Demonstrate skills involving the constructive use of knowledge in the subfields of physical and life science, and other related fields of science in a range of settings, including for pursuing higher studies related to the science. |
| Application of knowledge and skills | PO 3 | Identify and apply appropriate principles and methodologies to solve different types of problems with well-defined solutions. |
| | PO 4 | Apply knowledge of typical and atypical development across the lifespan of an individual |
| Generic learning outcomes | PO 5 | Communicate accurately the findings of the experiments/investigations while relating the conclusions/findings to relevant theories of science. |
| | PO 6 | Read texts and research papers analytically and present complex information and the findings of the experiments/investigations while relating the conclusions to relevant courses in science. |

Combinations, Detailed Programme Structure & Syllabus

| S. No. | Groups | Programme structure for different combinations | Page No. |
|---------------|-----------------------|---|----------|
| 1. | Life Sciences | BZC: Botany, Zoology, Chemistry | |
| 2. | | BZBch: Botany, Zoology, Biochemistry | |
| 3. | | BCEVS: Botany, Chemistry, Environmental Science | |
| 4. | | BZEVS: Botany, Zoology, Environmental Science | |
| 5. | | ZCEVS: Zoology, Chemistry, Environmental Science | |
| 6. | | BBchEVS: Botany, Biochemistry, Environmental Science | |
| 7. | | ZBchEVS: Zoology, Biochemistry, Environmental Science | |
| 8. | Physical Sciences | PCM: Physics, Chemistry, Mathematics | |
| 9. | | PCS: Physics, Chemistry, Statistics | |
| 10. | | PMCs: Physics, Mathematics, Computer Science | |
| 11. | | PMS: Physics, Mathematics, Statistics | |
| 12. | | PSCs: Physics, Statistics, Computer Science | |
| 13. | | MSCs: Mathematics, Statistics, Computer Science | |
| 14. | | PCEVS: Physics, Chemistry, Environmental Science | |
| 15. | | PCsEVS: Physics, Computer Science, Environmental Science | |
| 16. | | PSEVS: Physics, Statistics, Environmental Science | |
| 17. | | PMEVS: Physics, Mathematics, Environmental Science | |
| S. No. | Syllabus | | |
| 1. | Physics | | |
| 2. | Chemistry | | |
| 3. | Mathematics | | |
| 4. | Biochemistry | | |
| 5. | Botany | | |
| 6. | Zoology | | |
| 7. | Computer Science | | |
| 8. | Statistics | | |
| 9. | Environmental Science | | |

C-1: Combination (Botany, Zoology, Chemistry)

| Semester | Course Code | Title of course | Credits |
|---|--|--|-----------|
| I | Compulsory Core Course | | |
| | UGBY -101N | Cytology and Genetic | 2 |
| | UGCHE-101N | Inorganic Chemistry I (Basic Inorganic Chemistry) | 2 |
| | UGZY-101N | Animal Physiology | 2 |
| | UGBY -101(P)N | Practical Work based on UGBY -101N | 2 |
| | UGCHE-101(P)N | Practical Work based on UGCHE-101N | 2 |
| | UGZY-101(P)N | Practical Work Based on UGZY -101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 | |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGBY -102N | Plant Physiology | 2 |
| | UGCHE-102N | Organic Chemistry I (Basic Organic Chemistry) | 2 |
| | UGZY-102N | Diversity of Animal life | 2 |
| | UGBY -102(P)N | Practical Work based on UGBY -102N | 2 |
| | UGCHE-102(P)N | Practical Work based on UGCHE-102N | 2 |
| | UGZY-102(P)N | Practical Work Based on UGZY -102N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-02N | Advance Analytical Chemistry | 4 |
| | Ability Enhancement Course | | |
| AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 | |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGBY -103N | Plant Diversity-I | 2 |
| | UGCHE-103N | Physical Chemistry I (Basic Physical Chemistry) | 2 |
| | UGZY-103N | Genetic and Cell Biology | 2 |
| | UGBY -103(P)N | Practical Work based on UGBY -103N | 2 |
| | UGCHE-103(P)N | Practical Work based on UGCHE-103N | 2 |
| | UGZY-103(P)N | Practical Work Based on UGZY -103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-01N | Organic Chemistry II (Advance Organic Chemistry) | 4 |
| | Ability Enhancement Course | | |
| AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 | |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGBY -104N | Plant Diversity-II | 2 |
| | UGCHE-104N | Inorganic Chemistry II (Advance Inorganic Chemistry) | 2 |
| | UGZY-104N | Hemichordata and Chordata | 2 |
| | UGBY -104(P)N | Practical Work based on UGBY -104N | 2 |
| | UGCHE-104(P)N | Practical Work based on UGCHE-104N | 2 |
| | UGZY-104(P)N | Practical Work Based on UGZY -104N | 2 |
| | Skill Enhancement Course | | |
| | SBSBY-02N | Ecology | 4 |
| | Ability Enhancement Course | | |
| AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 | |
| Total Credit (4th Semester) | | | 20 |

| | | | | | |
|---|---|---|--|---|---|
| V | Skill Enhancement Course | | | | |
| | SBSZY03N | Economic zoology and environmental biology | | 4 | |
| | Discipline Centric Elective Course (Chose any two group from G, B and H) | | | | |
| | Group-G | DCEBY -105N | Embryology and Morphogenesis | | 2 |
| | | DCEBY -106N | Plant Pathology and Microbiology | | 2 |
| | | DCEBY -107(P)N | Practical Work based on DCEBY -105N and DCEBY -106N | | 2 |
| | Group-B | DCECHE -105N | Physical Chemistry II (Advance Physical Chemistry) | | 2 |
| | | DCECHE -106N | Inorganic Chemistry III (Selected Topics In Inorganic Chemistry) | | 2 |
| | | DCECHE-107(P)N | Practical Work based on DCECHE -105N and DCECHE -106N | | 2 |
| | Group-H | DCEZY -105N | Animal distribution and ecology | | 2 |
| DCEZY -106N | | Taxonomy and Evolution | | 2 | |
| DCEZY -107(P)N | | Practical Work based on DCEZY -105N and DCEZY -106N | | 2 | |
| Literature Survey | | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | | 4 | | |
| Total Credit (5th Semester) | | | 20 | | |
| VI | Skill Enhancement Course | | | | |
| | SBSBCH-04N | Clinical biochemistry | | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | | |
| | Group-G | DCEBY -108N | Molecular Genetics and Biotechnology | | 2 |
| | | DCEBY -109N | Paleobotany, Palynology and Economic | | 2 |
| | | DCEBY -110(P)N | Practical Work based on DCEBY -108N and DCEBY -109N | | 2 |
| | Group-B | DCECHE -108N | Organic Chemistry III (Selected Topics In Organic Chemistry) | | 2 |
| | | DCECHE -109N | Physical Chemistry III (Selected Topics In Physical Chemistry) | | 2 |
| | | DCECHE-110(P)N | Practical Work based on DCECHE -108N and DCECHE -109N | | 2 |
| | Group-H | DCEZY -108N | Developmental Biology | | 2 |
| DCEZY -109N | | Molecular Biology and Genetic Engineering | | 2 | |
| DCEZY -110(P)N | | Practical Work Based on DCEZY -108N & DCEZY -109N | | 2 | |
| Research Project | | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | | 4 | | |
| Total Credit (6th Semester) | | | 20 | | |

C-2: Combination (Botany, Zoology, Biochemistry)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGBY -101N | Cytology and Genetic | 2 |
| | UGBCH-101N | Introduction to biochemistry | 2 |
| | UGZY-101N | Animal Physiology | 2 |
| | UGBY -101(P)N | Practical Work based on UGBY -101N | 2 |
| | UGBCH-101(P)N | Practical Work Based on UGBCH -101N | 2 |
| | UGZY-101(P)N | Practical Work Based on UGZY -101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGBY -102N | Plant Physiology | 2 |
| | UGBCH-102N | Nutritional biochemistry | 2 |
| | UGZY-102N | Diversity of Animal life | 2 |
| | UGBY -102(P)N | Practical Work based on UGBY -102N | 2 |
| | UGBCH-102(P)N | Practical Work Based on UGBCH -102N | 2 |
| | UGZY-102(P)N | Practical Work Based on UGZY -102N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-02N | Advance Analytical Chemistry | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGBY -103N | Plant Diversity-I | 2 |
| | UGBCH-103N | Intermediary metabolism | 2 |
| | UGZY-103N | Genetic and Cell Biology | 2 |
| | UGBY -103(P)N | Practical Work based on UGBY -103N | 2 |
| | UGBCH-103(P)N | Practical Work Based on UGBCH -103N | 2 |
| | UGZY-103(P)N | Practical Work Based on UGZY -103N | 2 |
| | Skill Enhancement Course | | |
| | SBSBCH-01N | Bio-analytical techniques | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGBY -104N | Plant Diversity-II | 2 |
| | UGBCH-104N | Enzymology | 2 |
| | UGZY-104N | Hemichordata and Chordata | 2 |
| | UGBY -104(P)N | Practical Work based on UGBY -104N | 2 |
| | UGBCH-104(P)N | Practical Work Based on UGBCH -104N | 2 |
| | UGZY-104(P)N | Practical Work Based on UGZY -104N | 2 |
| | Skill Enhancement Course | | |
| | SBSBY-02N | Ecology | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |
| Total Credit (4th Semester) | | | 20 |

| | | | | |
|---|---|---|---|---|
| V | Skill Enhancement Course | | | |
| | SBSZY-03N | Economic zoology and environmental biology | 4 | |
| | Discipline Centric Elective Course (Chose any two group from G, F and H) | | | |
| | Group-G | DCEBY -105N | Embryology and Morphogenesis | 2 |
| | | DCEBY -106N | Plant Pathology and Microbiology | 2 |
| | | DCEBY -107(P)N | Practical Work based on DCEBY -105N and DCEBY -106N | 2 |
| | Group-F | DCEBCH -105N | Microbiology | 2 |
| | | DCEBCH -106N | Spectroscopy | 2 |
| DCEBCH -107(P)N | | Practical Work Based on DCEBCH -105N & DCEBCH -106N | 2 | |
| Group-H | DCEZY-105N | Animal distribution and ecology | 2 | |
| | DCEZY -106N | Taxonomy and Evolution | 2 | |
| | DCEZY -107(P)N | Practical Work based on DCEZY -105N and DCEZY -106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSBCH-04 | Clinical biochemistry | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-G | DCEBY -108N | Molecular Genetics and Biotechnology | 2 |
| | | DCEBY -109N | Paleobotany, Palynology and Economic | 2 |
| | | DCEBY -110(P)N | Practical Work based on DCEBY -108N and DCEBY -109N | 2 |
| | Group-F | DCEBCH -108N | Plant biochemistry | 2 |
| | | DCEBCH -109N | Immunology | 2 |
| | | DCEBCH -110(P)N | Practical Work Based on DCEBCH -108N & DCEBCH -109N | 2 |
| | Group-H | DCEZY -108N | Developmental Biology | 2 |
| DCEZY -109N | | Molecular Biology and Genetic Engineering | 2 | |
| DCEZY -110(P)N | | Practical Work Based on DCEZY -108N & DCEZY -109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | | 20 | |

C-3: Combination (Botany, Chemistry, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGBY -101N | Cytology and Genetic | 2 |
| | UGCHE-101N | Inorganic Chemistry I (Basic Inorganic Chemistry) | 2 |
| | UGEVS-101N | Fundamentals of Environmental Sciences | 2 |
| | UGBY -101(P)N | Practical Work based on UGBY -101N | 2 |
| | UGCHE-101(P)N | Practical Work based on UGCHE-101N | 2 |
| | UGEVS-101(P)N | Practical Work based on UGEVS-101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGBY -102N | Plant Physiology | 2 |
| | UGCHE-102N | Organic Chemistry I (Basic Organic Chemistry) | 2 |
| | UGEVS-102N | Ecology and Biodiversity Conservation | 2 |
| | UGBY -102(P)N | Practical Work based on UGBY -102N | 2 |
| | UGCHE-102(P)N | Practical Work based on UGCHE-102N | 2 |
| | UGEVS-102(P)N | Practical Work based on UGEVS-102N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGBY -103N | Plant Diversity-I | 2 |
| | UGCHE-103N | Physical Chemistry I (Basic Physical Chemistry) | 2 |
| | UGEVS-103N | Environmental Microbiology and Biotechnology | 2 |
| | UGBY -103(P)N | Practical Work based on UGBY -103N | 2 |
| | UGCHE-103(P)N | Practical Work based on UGCHE-103N | 2 |
| | UGEVS-103(P)N | Practical Work based on UGEVS-103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-01N | Organic Chemistry II (Advance Organic Chemistry) | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGBY -104N | Plant Diversity-II | 2 |
| | UGCHE-104N | Inorganic Chemistry II (Advance Inorganic Chemistry) | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGBY -104(P)N | Practical Work based on UGBY -104 | 2 |
| | UGCHE-104(P)N | Practical Work based on UGCHE-104 | 2 |
| | UGEVS-104(P)N | Practical Work based on UGEVS-104N | 2 |
| | Skill Enhancement Course | | |
| | SBSBY-02N | Ecology | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |

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|---|---|---|--|---|
| | Total Credit (4th Semester) | | 20 | |
| V | Skill Enhancement Course | | | |
| | SBSZY-03N | Economic zoology and environmental biology | 4 | |
| | Discipline Centric Elective Course (Chose any two group from G, F and H) | | | |
| | Group-G | DCEBY -105N | Embryology and Morphogenesis | 2 |
| | | DCEBY -106N | Plant Pathology and Microbiology | 2 |
| | | DCEBY -107(P)N | Practical Work based on DCEBY -105N and DCEBY -106N | 2 |
| | Group-F | DCECHE -105N | Physical Chemistry II (Advance Physical Chemistry) | 2 |
| | | DCECHE -106N | Inorganic Chemistry III (Selected Topics In Inorganic Chemistry) | 2 |
| DCECHE-107(P)N | | Practical Work based on DCECHE -105N and DCECHE -106N | 2 | |
| Group-H | DCEVS-105N | Environmental Pollutions | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | 2 | |
| | DCEVS-107(P)N | Practical Work based on DCEVS-105N & DCEVS-106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | 20 | | |
| VI | Skill Enhancement Course | | | |
| | SBSBCH-04 | Clinical biochemistry | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-G | DCEBY -108N | Molecular Genetics and Biotechnology | 2 |
| | | DCEBY -109N | Paleobotany, Palynology and Economic | 2 |
| | | DCEBY -110(P)N | Practical Work based on DCEBY -108 and DCEBY -109N | 2 |
| | Group-F | DCECHE -108N | Molecular Genetics and Biotechnology | 2 |
| | | DCECHE -109N | Paleobotany, Palynology and Economic | 2 |
| DCECHE-110(P)N | | Practical Work based on DCEBY -108 and DCEBY -109 | 2 | |
| Group-H | DCEVS-108 | Statistics and Environmental Quality Assessment | 2 | |
| | DCEVS-109 | Environmental geology and earth resources | 2 | |
| | DCEVS-110P | Practical Work based on DCEVS-108N & DCEVS-109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | 20 | | |

C-4: Combination (Botany, Zoology, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGBY -101N | Cytology and Genetic | 2 |
| | UGZY-101N | Animal Physiology | 2 |
| | UGEVS-101N | Fundaments of Environmental Sciences | 2 |
| | UGBCH-101(P)N | Practical Work Based on UGBCH -101N | 2 |
| | UGZY-101(P)N | Practical Work Based on UGZY -101N | 2 |
| | UGBY -101(P)N | Practical Work based on UGBY -101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 16 |
| II | Compulsory Core Course | | |
| | UGBY -102N | Plant Physiology | 2 |
| | UGZY-102N | Diversity of Animal life | 2 |
| | UGEVS-102 | Ecology and Biodiversity Conservation | 2 |
| | UGBCH-102(P)N | Practical Work Based on UGBCH -102N | 2 |
| | UGZY-102(P)N | Practical Work Based on UGZY -102N | 2 |
| | UGBY -102(P)N | Practical Work based on UGBY -102N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGBY -103N | Plant Diversity-I | 2 |
| | UGZY-103N | Genetic and Cell Biology | 2 |
| | UGEVS-103 | Environmental Microbiology and Biotechnology | 2 |
| | UGBCH-103(P)N | Practical Work Based on UGBCH -103N | 2 |
| | UGZY-103(P)N | Practical Work Based on UGZY -103N | 2 |
| | UGBY -103(P)N | Practical Work based on UGBY -103N | 2 |
| | Skill Enhancement Course | | |
| | SBSBCH-01N | Bio-analytical techniques | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGBY -104N | Plant Diversity-II | 2 |
| | UGZY-104N | Hemichordata and Chordata | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGBCH-104(P)N | Practical Work Based on UGBCH -104N | 2 |
| | UGZY-104(P)N | Practical Work Based on UGZY -104N | 2 |
| | UGBY -104(P)N | Practical Work based on UGBY -104N | 2 |
| | Skill Enhancement Course | | |
| | SBSZY-02N | Fundamental of Animal Behavior | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |
| Total Credit (4th Semester) | | | 20 |

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| V | Skill Enhancement Course | | | |
| | SBSZY-03N | Economic zoology and environmental biology | 4 | |
| | Discipline Centric Elective Course (Chose any two group from G, F and H) | | | |
| | Group-G | DCEBY -105N | Embryology and Morphogenesis | 2 |
| | | DCEBY -106N | Plant Pathology and Microbiology | 2 |
| | | DCEBY -107(P)N | Practical Work based on DCEBY -105N and DCEBY -106N | 2 |
| | Group-F | DCEZY -105N | Animal distribution and ecology | 2 |
| | | DCEZY -106N | Taxonomy and Evolution | 2 |
| DCEZY -107(P)N | | Practical Work based on DCEZY -105N and DCEZY -106N | 2 | |
| Group-H | DCEVS-105N | Environmental Pollutions | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | 2 | |
| | DCEVS-107(P)N | Practical Work based on DCEVS-105N & DCEVS-106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-G | DCEBY -108N | Molecular Genetics and Biotechnology | 2 |
| | | DCEBY -109N | Paleobotany, Palynology and Economic | 2 |
| | | DCEBY -110(P)N | Practical Work based on DCEBY -108N and DCEBY -109N | 2 |
| | Group-F | DCEZY -108N | Developmental Biology | 2 |
| | | DCEZY -109N | Molecular Biology and Genetic Engineering | 2 |
| | | DCEZY -110(P)N | Practical Work Based on DCEZY -108 & DCEZY -109 | 2 |
| | Group-H | DCEVS-108N | Statistics and Environmental Quality Assessment | 2 |
| DCEVS-109N | | Environmental geology and earth resources | 2 | |
| DCEVS-110P | | Practical Work based on DCEVS-108N & DCEVS-109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | | 20 | |

C-5: Combination (Zoology, Chemistry, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|--|--|-----------|
| I | Compulsory Core Course | | |
| | UGZY-101N | Animal Physiology | 2 |
| | UGCHE-101N | Inorganic Chemistry I (Basic Inorganic Chemistry) | 2 |
| | UGEVS-101N | Fundamentals of Environmental Sciences | 2 |
| | UGZY-101(P)N | Practical Work Based on UGZY -101N | 2 |
| | UGCHE-101(P)N | Practical Work based on UGCHE-101N | 2 |
| | | | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 | |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGZY-102N | Diversity of Animal life | 2 |
| | UGCHE-102N | Organic Chemistry I (Basic Organic Chemistry) | 2 |
| | UGEVS-102 | Ecology and Biodiversity Conservation | 2 |
| | UGZY-102(P)N | Practical Work Based on UGZY -102N | 2 |
| | UGCHE-102(P)N | Practical Work based on UGCHE-102N | 2 |
| | | | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 | |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGZY-103N | Genetic and Cell Biology | 2 |
| | UGCHE-103N | Physical Chemistry I (Basic Physical Chemistry) | 2 |
| | UGEVS-103 | Environmental Microbiology and Biotechnology | 2 |
| | UGZY-103(P)N | Practical Work Based on UGZY -103N | 2 |
| | UGCHE-103(P)N | Practical Work based on UGCHE-103N | 2 |
| | | | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-01N | Organic Chemistry II (Advance Organic Chemistry) | 4 |
| | Ability Enhancement Course | | |
| AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 | |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGZY-104N | Hemichordata and Chordata | 2 |
| | UGCHE-104N | Inorganic Chemistry II (Advance Inorganic Chemistry) | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGZY-104(P)N | Practical Work Based on UGZY -104N | 2 |
| | UGCHE-104(P)N | Practical Work based on UGCHE-104N | 2 |
| | | | 2 |
| | Skill Enhancement Course | | |
| | SBSZY-02N | Fundamental of Animal Behavior | |
| | Ability Enhancement Course | | |
| AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 | |

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|---|---|---|--|---|
| | Total Credit (4th Semester) | | 20 | |
| V | Skill Enhancement Course | | | |
| | SBSZY03N | Economic zoology and environmental biology | 4 | |
| | Discipline Centric Elective Course (Chose any two group from G, B and H) | | | |
| | Group-G | DCEZY -105N | Animal distribution and ecology | 2 |
| | | DCEZY -106N | Taxonomy and Evolution | 2 |
| | | DCEZY -107(P)N | Practical Work based on DCEZY -105N and DCEZY -106N | 2 |
| | Group-B | DCECHE -105N | Physical Chemistry II (Advance Physical Chemistry) | 2 |
| | | DCECHE -106N | Inorganic Chemistry III (Selected Topics In Inorganic Chemistry) | 2 |
| DCECHE-107(P)N | | Practical Work based on DCECHE -105N and DCECHE -106N | 2 | |
| Group-H | DCEVS-105N | Environmental Pollutions | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | 2 | |
| | DCEVS-107(P)N | Practical Work based on DCEVS-105N & DCEVS-106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | 20 | | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-G | DCEZY -108N | Developmental Biology | 2 |
| | | DCEZY -109N | Molecular Biology and Genetic Engineering | 2 |
| | | DCEZY -110(P)N | Practical Work Based on DCEZY -108N & DCEZY -109N | 2 |
| | Group-B | DCECHE -108N | Organic Chemistry III (Selected Topics In Organic Chemistry) | 2 |
| | | DCECHE -109N | Physical Chemistry III (Selected Topics In Physical Chemistry) | 2 |
| | | DCECHE-110(P)N | Practical Work based on DCECHE -108N and DCECHE -109N | 2 |
| | Group-H | DCEVS-108 | Statistics and Environmental Quality Assessment | 2 |
| DCEVS-109 | | Environmental geology and earth resources | 2 | |
| DCEVS-110P | | Practical Work based on DCEVS-108N & DCEVS-109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | 20 | | |

C-6 Combination (Botany, Biochemistry, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGBY -101N | Cytology and Genetic | 2 |
| | UGBCH-101N | Introduction to biochemistry | 2 |
| | UGEVS-101N | Fundaments of Environmental Sciences | 2 |
| | UGBY -101(P)N | Practical Work based on UGBY -101N | 2 |
| | UGBCH-101(P)N | Practical Work Based on UGBCH -101N | 2 |
| | UGEVS-101(P)N | Practical Work Based on UGEVS-101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGBY -102N | Plant Physiology | 2 |
| | UGBCH-102N | Nutritional biochemistry | 2 |
| | UGEVS-102 | Ecology and Biodiversity Conservation | 2 |
| | UGBY -102(P)N | Practical Work based on UGBY -102N | 2 |
| | UGBCH-102(P)N | Practical Work Based on UGBCH -102N | 2 |
| | UGEVS-102(P)N | Practical Work Based on UGEVS-102N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGBY -103N | Plant Diversity-I | 2 |
| | UGBCH-103N | Intermediary metabolism | 2 |
| | UGEVS-103 | Environmental Microbiology and Biotechnology | 2 |
| | UGBY -103(P)N | Practical Work based on UGBY -103N | 2 |
| | UGBCH-103(P)N | Practical Work Based on UGBCH -103N | 2 |
| | UGEVS-103(P)N | Practical Work Based on UGEVS-103N | 2 |
| | Skill Enhancement Course | | |
| | SBSBCH-01N | Bio-analytical techniques | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGBY -104N | Plant Diversity-II | 2 |
| | UGBCH-104N | Enzymology | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGBY -104(P)N | Practical Work based on UGBY -104N | 2 |
| | UGBCH-104(P)N | Practical Work Based on UGBCH -104N | 2 |
| | UGEVS-104(P)N | Practical Work Based on UGEVS-104N | 2 |
| | Skill Enhancement Course | | |
| | SBSBY-02N | Ecology | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |
| Total Credit (4th Semester) | | | 20 |

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|---|---|---|---|---|
| V | Skill Enhancement Course | | | |
| | SBSZY-03N | Economic zoology and environmental biology | 4 | |
| | Discipline Centric Elective Course (Chose any two group from G, F and H) | | | |
| | Group-G | DCEBY -105N | Embryology and Morphogenesis | 2 |
| | | DCEBY -106N | Plant Pathology and Microbiology | 2 |
| | | DCEBY -107(P)N | Practical Work based on DCEBY -105N and DCEBY -106N | 2 |
| | Group-F | DCEBCH -105N | Microbiology | 2 |
| | | DCEBCH -106N | Spectroscopy | 2 |
| DCEBCH -107(P)N | | Practical Work Based on DCEBCH -105N & DCEBCH -106N | 2 | |
| Group-H | DCEVS-105N | Environmental Pollutions | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | 2 | |
| | DCEVS-107(P)N | Practical Work based on DCEVS-105N & DCEVS-106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSBCH-04 | Clinical biochemistry | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-G | DCEBY -108N | Molecular Genetics and Biotechnology | 2 |
| | | DCEBY -109N | Paleobotany, Palynology and Economic | 2 |
| | | DCEBY -110(P)N | Practical Work based on DCEBY -108N and DCEBY -109N | 2 |
| | Group-F | DCEBCH -108N | Plant biochemistry | 2 |
| | | DCEBCH -109N | Immunology | 2 |
| | | DCEBCH -110(P)N | Practical Work Based on DCEBCH -108N & DCEBCH -109N | 2 |
| | Group-H | DCEVS-108N | Statistics and Environmental Quality Assessment | 2 |
| DCEVS-109N | | Environmental geology and earth resources | 2 | |
| DCEVS-110(P)N | | Practical Work based on DCEVS-108N & DCEVS-109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | | 20 | |

C-7: Combination (Zoology, Biochemistry, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGZY-101N | Animal Physiology | 2 |
| | UGBCH-101N | Introduction to biochemistry | 2 |
| | UGEVS-101N | Fundamentals of Environmental Sciences | 2 |
| | UGZY-101(P)N | Practical Work Based on UGZY -101N | 2 |
| | UGBCH-101(P)N | Practical Work Based on UGBCH -101N | 2 |
| | UGEVS-101(P)N | Practical Work Based on UGEVS-101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGZY-102N | Diversity of Animal life | 2 |
| | UGBCH-102N | Nutritional biochemistry | 2 |
| | UGEVS-102N | Ecology and Biodiversity Conservation | 2 |
| | UGZY-102(P)N | Practical Work Based on UGZY -102N | 2 |
| | UGBCH-102(P)N | Practical Work Based on UGBCH -102N | 2 |
| | UGEVS-102(P)N | Practical Work Based on UGEVS-102N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGZY-103N | Genetic and Cell Biology | 2 |
| | UGBCH-103N | Intermediary metabolism | 2 |
| | UGEVS-103N | Environmental Microbiology and Biotechnology | 2 |
| | UGZY-103(P)N | Practical Work Based on UGZY -103N | 2 |
| | UGBCH-103(P)N | Practical Work Based on UGBCH -103N | 2 |
| | UGEVS-103(P)N | Practical Work Based on UGEVS-103N | 2 |
| | Skill Enhancement Course | | |
| | SBSBCH-01N | Bio-analytical techniques | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGZY-104N | Hemichordata and Chordata | 2 |
| | UGBCH-104N | Enzymology | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGZY-104(P)N | Practical Work Based on UGZY -104N | 2 |
| | UGBCH-104(P)N | Practical Work Based on UGBCH -104N | 2 |
| | UGEVS-104(P)N | Practical Work Based on UGEVS-104N | 2 |
| | Skill Enhancement Course | | |
| | SBSBY-02N | Ecology | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |
| Total Credit (4th Semester) | | | 20 |

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|---|---|---|---|---|---|
| V | Skill Enhancement Course | | | | |
| | SBSZY-03N | Economic zoology and environmental biology | | 4 | |
| | Discipline Centric Elective Course (Chose any two group from G, F and H) | | | | |
| | Group-G | DCEZY-105N | Animal distribution and ecology | | 2 |
| | | DCEZY-106N | Taxonomy and Evolution | | 2 |
| | | DCEZY-107(P)N | Practical Work based on DCEZY -105N and DCEZY -106N | | 2 |
| | Group-F | DCEBCH-105N | Microbiology | | 2 |
| | | DCEBCH-106N | Spectroscopy | | 2 |
| DCEBCH-107(P)N | | Practical Work Based on DCEBCH -105N & DCEBCH -106N | | 2 | |
| Group-H | DCEVS-105N | Environmental Pollutions | | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | | 2 | |
| | DCEVS-107(P)N | Practical Work based on DCEVS-105N & DCEVS-106N | | 2 | |
| Literature Survey | | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | | 4 | | |
| Total Credit (5th Semester) | | | 20 | | |
| VI | Skill Enhancement Course | | | | |
| | SBSBCH-04 | Clinical biochemistry | | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | | |
| | Group-G | DCEZY-108N | Developmental Biology | | 2 |
| | | DCEZY-109N | Molecular Biology and Genetic Engineering | | 2 |
| | | DCEZY-110(P)N | Practical Work Based on DCEZY -108N & DCEZY -109N | | 2 |
| | Group-F | DCEBCH-108N | Plant biochemistry | | 2 |
| | | DCEBCH-109N | Immunology | | 2 |
| | | DCEBCH-110(P)N | Practical Work Based on DCEBCH -108N & DCEBCH -109N | | 2 |
| | Group-H | DCEVS-108N | Statistics and Environmental Quality Assessment | | 2 |
| DCEVS-109N | | Environmental geology and earth resources | | 2 | |
| DCEVS-110(P)N | | Practical Work based on DCEVS-108N & DCEVS-109N | | 2 | |
| Research Project | | | | | |
| UGRP-102N | | | | | |
| Total Credit (6th Semester) | | | 20 | | |

C-8: Combination (Physics, Chemistry, Mathematics)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|---|--------------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGCHE-101N | Inorganic Chemistry I (Basic Inorganic Chemistry) | 2 |
| | UGMM-101N | Differential Calculus | 2 |
| | UGMM-102N | Analytical Geometry | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101N | 2 |
| | UGCHE-101(P)N | Practical Work based on UGCHE-101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGCHE-102N | Organic Chemistry I (Basic Organic Chemistry) | 2 |
| | UGMM-103N | Integral Calculus | 2 |
| | UGMM-104N | Differential Equation | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102N | 2 |
| | UGCHE-102(P)N | Practical Work based on UGCHE-102N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-02N | Advance Analytical Chemistry | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGCHE-103N | Physical Chemistry I (Basic Physical Chemistry) | 2 |
| | UGMM-105N | Mechanics-I (Statics and Dynamics) | 2 |
| | UGMM-106N | Mechanics-II (Dynamics and Hydrodynamics) | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103N | 2 |
| | UGCHE-103(P)N | Practical Work based on UGCHE-103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-01N | Organic Chemistry II (Advance Organic Chemistry) | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGCHE-104N | Inorganic Chemistry II (Advance Inorganic Chemistry) | 2 |
| | UGMM-107N | Linear Algebra | 2 |
| | UGMM-108N | Calculus of function of several variable and Vector Calculus | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104N | 2 |
| | UGCHE-104(P)N | Practical Work based on UGCHE-104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPHS-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community or Ability Enhancement Course in Disaster Management | 4 4 |
| Total Credit (4th Semester) | | | 20 |
| Skill Enhancement Course | | | |

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|---|---|--|--|---|
| V | SBSMM-03N | Elementary Analysis | 4 | |
| | Discipline Centric Elective Course (Chose any two group from A, B and C) | | | |
| | Group-A | DCEPHS -105N | Optics | 2 |
| | | DCEPHS -106N | Thermal Physics | 2 |
| | | DCEPHS-107(P)N | Practical Work based on DCEPHS -105N and DCEPHS -106N | 2 |
| | Group-B | DCECHE -105N | Physical Chemistry II (Advance Physical Chemistry) | 2 |
| | | DCECHE -106N | Inorganic Chemistry III (Selected Topics In Inorganic Chemistry) | 2 |
| | | DCECHE-107(P)N | Practical Work based on DCECHE -105N and DCECHE -106N | 2 |
| Group-C | DCEMM -109N | Abstract Algebra | 2 | |
| | DCEMM -110N | Number Theory | 2 | |
| | DCEMM-111(P)N | Viva Voce | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04 | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N | Quantum mechanics and spectroscopy | 2 |
| | | DCEPHS -109N | Solid State Physics and Advanced Electronics | 2 |
| | | DCEPHS-110(P)N | Practical Work based on DCEPHS-108N and DCEPHS-109N | 2 |
| | Group-B | DCECHE -108N | Organic Chemistry III (Selected Topics In Organic Chemistry) | 2 |
| | | DCECHE -109N | Physical Chemistry III (Selected Topics In Physical Chemistry) | 2 |
| | | DCECHE-110PN | Practical Work based on DCECHE -108N and DCECHE -109N | 2 |
| | Group-C | DCEMM -112N | Advance Analysis | 2 |
| DCEMM -113N | | Function of Complex Variable | 2 | |
| DCEMM-114(P)N | | Viva Voce | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | | 20 | |
| Grand Total Credit (All Semesters) | | | 120 | |

C-9: Combination (Physics, Chemistry, Statistics)

| Semester | Course Code | Title of course | Credits |
|---|---|--|-----------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGCHE-101N | Inorganic Chemistry I (Basic Inorganic Chemistry) | 2 |
| | UGSTAT-101N | Statistical Methods | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101N | 2 |
| | UGCHE-101(P)N | Practical Work based on UGCHE-101N | 2 |
| | UGSTAT-101(P)N | Practical Work based on UGSTAT -101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 | |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGCHE-102N | Organic Chemistry I (Basic Organic Chemistry) | 2 |
| | UGSTAT-102N | Probability, Distribution and Statistical Inference | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102N | 2 |
| | UGCHE-102(P)N | Practical Work based on UGCHE-102N | 2 |
| | UGSTAT-102(P)N | Practical Work based on UGSTAT -102N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-02N | Advance Analytical Chemistry | 4 |
| | Ability Enhancement Course | | |
| AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 | |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGCHE-103N | Physical Chemistry I (Basic Physical Chemistry) | 2 |
| | UGSTAT-103N | Sampling Theory and Design of Experiments | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103N | 2 |
| | UGCHE-103(P)N | Practical Work based on UGCHE-103N | 2 |
| | UGSTAT-103(P)N | Practical Work based on UGSTAT -103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-01N | Organic Chemistry II (Advance Organic Chemistry) | 4 |
| | Ability Enhancement Course | | |
| AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 | |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGCHE-104N | Inorganic Chemistry II (Advance Inorganic Chemistry) | 2 |
| | UGSTAT-104N | Applied Statistics | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104N | 2 |
| | UGCHE-104(P)N | Practical Work based on UGCHE-104N | 2 |
| | UGSTAT-104(P)N | Practical Work based on UGSTAT -104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPHS-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community or Ability Enhancement Course in Disaster Management | 4 4 | |

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|---|---|---|--|---|
| | Total Credit (4th Semester) | | 20 | |
| V | Skill Enhancement Course | | | |
| | SBSMM-03N | Elementary Analysis | 4 | |
| | Discipline Centric Elective Course (Chose any two group from A, B and E) | | | |
| | Group-A | DCEPHS -105N | Optics | 2 |
| | | DCEPHS -106N | Thermal Physics | 2 |
| | | DCEPHS-107(P)N | Practical Work based on DCEPHS -105N and DCEPHS -106N | 2 |
| | Group-B | DCECHE -105N | Physical Chemistry II (Advance Physical Chemistry) | 2 |
| | | DCECHE -106N | Inorganic Chemistry III (Selected Topics In Inorganic Chemistry) | 2 |
| DCECHE-107(P)N | | Practical Work based on DCECHE -105N and DCECHE -106N | 2 | |
| Group-E | DCESTAT -105N | Advance Statistical Inference | 2 | |
| | DCESTAT -106N | Basic Knowledge of Statistical Softwares | 2 | |
| | DCESTAT-107(P)N | Practical Work based on DCESTAT -105N and DCESTAT -106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | 20 | | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N | Quantum mechanics and spectroscopy | 2 |
| | | DCEPHS -109N | Solid State Physics and Advanced Electronics | 2 |
| | | DCEPHS-110(P)N | Practical Work based on DCEPHS-108N and DCEPHS-109N | 2 |
| | Group-B | DCECHE -108N | Organic Chemistry III (Selected Topics In Organic Chemistry) | 2 |
| | | DCECHE -109N | Physical Chemistry III (Selected Topics In Physical Chemistry) | 2 |
| | | DCECHE-110(P)N | Practical Work based on DCECHE -108N and DCECHE -109N | 2 |
| | Group-E | DCESTAT-108N | Official Statistics | 2 |
| DCESTAT -109N | | Operation Research | 2 | |
| DCESTAT-110(P)N | | Practical Work based on DCESTAT -108N and DCESTAT -109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | 20 | | |

C-10: Combination (Physics, Mathematics, Computer Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGCS-101N | Computer Fundamental & PC Software | 2 |
| | UGMM-101N | Differential Calculus | 2 |
| | UGMM-102N | Analytical Geometry | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101N | 2 |
| | UGCS-101(P)N | Practical Work based on UGCS -101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGCS-102N | C Programming | 2 |
| | UGMM-103N | Integral Calculus | 2 |
| | UGMM-104N | Differential Equation | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102N | 2 |
| | UGCS-102(P)N | Practical Work based on UGCS -102 | 2 |
| | Skill Enhancement Course | | |
| | SBSCS-02N | Python Programming | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGCS-103N | Data Structures | 2 |
| | UGMM-105N | Mechanics-I (Statics and Dynamics) | 2 |
| | UGMM-106N | Mechanics-II (Dynamics and Hydrodynamics) | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103N | 2 |
| | UGCS-103(P)N | Practical Work based on UGCS -103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCS-01N | Discrete Mathematics | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGCS-104N | Introduction to Database Management System | 2 |
| | UGMM-107N | Linear Algebra | 2 |
| | UGMM-108N | Calculus of function of several variable and Vector Calculus | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104N | 2 |
| | UGCS-104(P)N | Practical Work based on UGCS -104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPHS-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |
| Total Credit (4th Semester) | | | 20 |

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| V | Skill Enhancement Course | | | |
| | SBSMM-03N | Elementary Analysis | 4 | |
| | Discipline Centric Elective Course (Chose any two group from A, D and C) | | | |
| | Group-A | DCEPHS -105N | Optics | 2 |
| | | DCEPHS -106N | Thermal Physics | 2 |
| | | DCEPHS-107(P)N | Practical Work based on DCEPHS -105N and DCEPHS -106N | 2 |
| | Group-D | DCECS -105N | Computer Network | 2 |
| | | DCECS -106N | Operating System | 2 |
| DCECS-107(P)N | | Practical Work based on DCECS -106N | 2 | |
| Group-C | DCEMM -109N | Abstract Algebra | 2 | |
| | DCEMM -110N | Number Theory | 2 | |
| | DCEMM-111(P)N | Viva Voce | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N | Quantum mechanics and spectroscopy | 2 |
| | | DCEPHS -109N | Solid State Physics and Advanced Electronics | 2 |
| | | DCEPHS-110(P)N | Practical Work based on DCEPHS-108N and DCEPHS-109N | 2 |
| | Group-D | DCECS -108N | C++ and Object Oriented Programming | 2 |
| | | DCECS -109N | Software Engineering | 2 |
| | | DCECS-110(P) | Practical Work based on DCECS -108N | 2 |
| | Group-C | DCEMM -112N | Advance Analysis | 2 |
| DCEMM -113N | | Function of Complex Variable | 2 | |
| DCEMM-114(P)N | | Viva Voce | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | | 20 | |

C-11: Combination (Physics, Mathematics, Statistics)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGSTAT-101N | Statistical Methods | 2 |
| | UGMM-101N | Differential Calculus | 2 |
| | UGMM-102N | Analytical Geometry | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101N | 2 |
| | UGSTAT-101(P)N | Practical Work based on UGSTAT -101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGSTAT -102N | Probability, Distribution and Statistical Inference | 2 |
| | UGMM-103N | Integral Calculus | 2 |
| | UGMM-104N | Differential Equation | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102N | 2 |
| | UGSTAT -102(P)N | Practical Work based on UGSTAT -102N | 2 |
| | Skill Enhancement Course | | |
| | SBSCS-02N | Python Programming | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 OR 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGSTAT -103N | Sampling Theory and Design of Experiments | 2 |
| | UGMM-105N | Mechanics-I (Statics and Dynamics) | 2 |
| | UGMM-106N | Mechanics-II (Dynamics and Hydrodynamics) | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103N | 2 |
| | UGSTAT -103(P)N | Practical Work based on UGSTAT -103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCS -01N | Discrete Mathematics | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 OR 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGSTAT -104N | Applied Statistics | 2 |
| | UGMM-107N | Linear Algebra | 2 |
| | UGMM-108N | Calculus of function of several variable and Vector Calculus | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104N | 2 |
| | UGSTAT -104(P)N | Practical Work based on UGSTAT -104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPPH-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 OR 4 |
| Total Credit (4th Semester) | | | 20 |

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| V | Skill Enhancement Course | | | |
| | SBSMM-03N | Elementary Analysis | 4 | |
| | Discipline Centric Elective Course (Chose any two group from A, E and C) | | | |
| | Group-A | DCEPHS -105N | Optics | 2 |
| | | DCEPHS -106N | Thermal Physics | 2 |
| | | DCEPHS-107(P)N | Practical Work based on DCEPHS -105N and DCEPHS -106N | 2 |
| | Group-E | DCESTAT -105N | Advance Statistical Inference | 2 |
| | | DCESTAT -106N | Basic Knowledge of Statistical Softwares | 2 |
| DCESTAT-107(P)N | | Practical Work based on DCESTAT -105N and DCESTAT -106N | 2 | |
| Group-C | DCEMM -109N | Abstract Algebra | 2 | |
| | DCEMM -110N | Number Theory | 2 | |
| | DCEMM-111(P)N | Viva Voce | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N | Quantum mechanics and spectroscopy | 2 |
| | | DCEPHS -109N | Solid State Physics and Advanced Electronics | 2 |
| | | DCEPHS-110(P)N | Practical Work based on DCEPHS-108N and DCEPHS-109N | 2 |
| | Group-D | DCESTAT -108N | Official Statistics | 2 |
| | | DCESTAT -109N | Operation Research | 2 |
| DCESTAT-110(P)N | | Practical Work based on DCESTAT -108N and DCESTAT -109N | 2 | |
| Group-C | DCEMM -112N | Advance Analysis | 2 | |
| | DCEMM -113N | Function of Complex Variable | 2 | |
| | DCEMM-114(P)N | Viva Voce | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | | 20 | |

C-12: Combination (Physics, Statistics, Computer Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGCS-101N | Computer Fundamental & PC Software | 2 |
| | UGSTAT-101N | Statistical Methods | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101N | 2 |
| | UGCS-101(P)N | Practical Work based on UGCS -101N | 2 |
| | UGSTAT-101(P)N | Practical Work based on UGSTAT -101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGCS-102N | C Programming | 2 |
| | UGSTAT-102N | Probability, Distribution and Statistical Inference | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102N | 2 |
| | UGCS-102(P)N | Practical Work based on UGCS -102N | 2 |
| | UGSTAT-102(P)N | Practical Work based on UGSTAT -102N | 2 |
| | Skill Enhancement Course | | |
| | SBSCS-02N | Python Programming | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGCS-103N | Data Structures | 2 |
| | UGSTAT-103N | Sampling Theory and Design of Experiments | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103N | 2 |
| | UGCS-103(P)N | Practical Work based on UGCS -103N | 2 |
| | UGSTAT-103(P)N | Practical Work based on UGSTAT -103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCS-01N | Discrete Mathematics | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGCS-104N | Introduction to Database Management System | 2 |
| | UGSTAT-104N | Applied Statistics | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104N | 2 |
| | UGCS-104(P)N | Practical Work based on UGCS -104N | 2 |
| | UGSTAT-104(P)N | Practical Work based on UGSTAT -104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPHS-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |

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| | Total Credit (4th Semester) | | 20 | |
| V | Skill Enhancement Course | | | |
| | SBSMM-03N | Elementary Analysis | 4 | |
| | Discipline Centric Elective Course (Chose any two group from A, B and E) | | | |
| | Group-A | DCEPHS -105N DCEPHS -106N DCEPHS-107(P)N | Optics Thermal Physics Practical Work based on DCEPHS -105N and DCEPHS -106N | 2 2 2 |
| | Group-D | DCECS -105N DCECS -106N DCECS-107(P)N | Computer Network Operating System Practical Work based on 106N | 2 2 2 |
| | Group-E | DCESTAT -105N DCESTAT-106N DCESTAT-107(P)N | Advance Statistical Inference Basic Knowledge of Statistical Softwares Practical Work based on DCESTAT -105N and DCESTAT -106N | 2 2 2 |
| | Literature Survey | | | |
| | UGLS-101N | Literature Survey of Elected Subject-1 | 4 | |
| | Total Credit (5th Semester) | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N DCEPHS -109N DCEPHS-110(P)N | Quantum mechanics and spectroscopy Solid State Physics and Advanced Electronics Practical Work based on DCEPHS-108 and DCEPHS-109 | 2 2 2 |
| | Group-D | DCECS -108N DCECS -109N DCECS-110(P)N | C++ and Object Oriented Programming Software Engineering Practical Work based on 108N | 2 2 2 |
| | Group-E | DCESTAT -108N DCESTAT -109N DCESTAT-110(P)N | Official Statistics Operation Research Practical Work based on DCESTAT -108N and DCESTAT -109N | 2 2 2 |
| | Research Project | | | |
| | UGRP-102N | Research Project on Elected Subject-2 | 4 | |
| | Total Credit (6th Semester) | | 20 | |

C-13: Combination (Mathematics, Statistics, Computer Science)

| Semester | Course Code | Title of course | Credits |
|---|--|--|-----------|
| I | Compulsory Core Course | | |
| | UGSTAT -101N | Statistical Methods | 2 |
| | UGCS-101N | Computer Fundamental & PC Software | 2 |
| | UGMM-101N | Differential Calculus | 4 |
| | UGMM-102N | Analytical Geometry | |
| | UGSTAT -101(P)N | Practical Work based on UGSTAT -101N | 2 |
| | UGCS-101(P)N | Practical Work based on UGCS -101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 | |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGSTAT -102N | Probability, Distribution and Statistical Inference | 2 |
| | UGCS-102N | C Programming | 2 |
| | UGMM-103N | Integral Calculus | 2 |
| | UGMM-104N | Differential Equation | 2 |
| | UGSTAT -102(P)N | Practical Work based on UGSTAT -102N | 2 |
| | UGCS-102(P)N | Practical Work based on UGCS -102N | 2 |
| | Skill Enhancement Course | | |
| | SBSCS-02N | Python Programming | 4 |
| | Ability Enhancement Course | | |
| AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 | |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGSTAT -103N | Sampling Theory and Design of Experiments | 2 |
| | UGCS-103N | Data Structures | 2 |
| | UGMM-105N | Mechanics-I (Statics and Dynamics) | 2 |
| | UGMM-106N | Mechanics-II (Dynamics and Hydrodynamics) | 2 |
| | UGSTAT -103(P)N | Practical Work based on UGSTAT -103N | 2 |
| | UGCS-103(P)N | Practical Work based on UGCS -103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCS-01N | Discrete Mathematics | 4 |
| | Ability Enhancement Course | | |
| AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 | |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGSTAT -104N | Applied Statistics | 2 |
| | UGCS-104N | Introduction to Database Management System | 2 |
| | UGMM-107N | Linear Algebra | 2 |
| | UGMM-108N | Calculus of function of several variable and Vector Calculus | 2 |
| | UGSTAT -104(P)N | Practical Work based on UGSTAT -104N | 2 |
| | UGCS-104(P)N | Practical Work based on UGCS -104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPPH-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 | |
| Total Credit (4th Semester) | | | 20 |
| Skill Enhancement Course | | | |
| SBSMM-03N | Elementary Analysis | 4 | |

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| V | Discipline Centric Elective Course (Chose any two group from E, D and C) | | | |
| | Group-E | DCESTAT -105N DCESTAT -106N DCESTAT-107(P)N | Advance Statistical Inference Basic Knowledge of Statistical Softwares Practical Work based on DCESTAT -105N and DCESTAT -106N | 2 2 2 |
| | Group-D | DCECS -105N DCECS -106N DCECS -107(P)N | Computer Network Operating System Practical Work based on 106N | 2 2 2 |
| | Group-C | DCEMM -109N DCEMM -110N DCEMM-111(P)N | Abstract Algebra Number Theory Viva Voce | 2 2 2 |
| | Literature Survey | | | |
| | UGLS-101N | Literature Survey of Elected Subject-1 | | 4 |
| | Total Credit (5th Semester) | | | 20 |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | | 4 |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-E | DCESTAT -108N DCESTAT -109N DCESTAT-110(P)N | Official Statistics Operation Research Practical Work based on DCESTAT -108N and DCESTAT -109N | 2 2 2 |
| | Group-D | DCECS-108N DCECS -109N DCECS -110(P)N | C++ and Object Oriented Programming Software Engineering Practical Work based on 108N | 2 2 2 |
| | Group-C | DCEMM -112N DCEMM -113N DCEMM-114(P)N | Advance Analysis Function of Complex Variable Viva Voce | 2 2 2 |
| | Research Project | | | |
| UGRP-102N | Research Project on Elected Subject-2 | | 4 | |
| Total Credit (6th Semester) | | | 20 | |

C-14: Combination (Physics, Chemistry, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|---|--------------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGCHE-101N | Inorganic Chemistry I (Basic Inorganic Chemistry) | 2 |
| | UGEVS-101N | Fundamentals of Environmental Sciences | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101N | 2 |
| | UGCHE-101(P)N | Practical Work based on UGCHE-101N | 2 |
| | UGEVS-101(P)N | Practical Work Based on UGEVS-101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGCHE-102N | Organic Chemistry I (Basic Organic Chemistry) | 2 |
| | UGEVS-102 | Ecology and Biodiversity Conservation | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102N | 2 |
| | UGCHE-102(P)N | Practical Work based on UGCHE-102N | 2 |
| | UGEVS-102(P)N | Practical Work Based on UGEVS-102N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGCHE-103N | Physical Chemistry I (Basic Physical Chemistry) | 2 |
| | UGEVS-103 | Environmental Microbiology and Biotechnology | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103N | 2 |
| | UGCHE-103(P)N | Practical Work based on UGCHE-103N | 2 |
| | UGEVS-103(P)N | Practical Work Based on UGEVS-103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCHHE-01N | Organic Chemistry II (Advance Organic Chemistry) | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGCHE-104N | Inorganic Chemistry II (Advance Inorganic Chemistry) | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104N | 2 |
| | UGCHE-104(P)N | Practical Work based on UGCHE-104N | 2 |
| | UGEVS-104(P)N | Practical Work Based on UGEVS-104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPHS-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community or Ability Enhancement Course in Disaster Management | 4 4 |
| Total Credit (4th Semester) | | | 20 |

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| V | Skill Enhancement Course | | | |
| | SBSICHE-02N | Advance Analytical Chemistry | 4 | |
| | Discipline Centric Elective Course (Chose any two group from A, B and E) | | | |
| | Group-A | DCEPHS -105N | Optics | 2 |
| | | DCEPHS -106N | Thermal Physics | 2 |
| | | DCEPHS-107(P)N | Practical Work based on DCEPHS -105 and DCEPHS -106 | 2 |
| | Group-B | DCECHE -105N | Physical Chemistry II (Advance Physical Chemistry) | 2 |
| | | DCECHE -106N | Inorganic Chemistry III (Selected Topics In Inorganic Chemistry) | 2 |
| DCECHE-107(P)N | | Practical Work based on DCECHE -105 and DCECHE -106 | 2 | |
| Group-E | DCEVS-105N | Environmental Pollutions | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | 2 | |
| | DCEVS-107(P)N | Practical Work based on DCEVS-105N & DCEVS-106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | 20 | | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N | Quantum mechanics and spectroscopy | 2 |
| | | DCEPHS -109N | Solid State Physics and Advanced Electronics | 2 |
| | | DCEPHS-110(P)N | Practical Work based on DCEPHS-108 and DCEPHS-109 | 2 |
| | Group-B | DCECHE -108N | Organic Chemistry III (Selected Topics In Organic Chemistry) | 2 |
| | | DCECHE -109N | Physical Chemistry III (Selected Topics In Physical Chemistry) | 2 |
| | | DCECHE-110(P)N | Practical Work based on DCECHE -108 and DCECHE -109 | 2 |
| | Group-E | DCEVS-108 | Statistics and Environmental Quality Assessment | 2 |
| DCEVS-109 | | Environmental geology and earth resources | 2 | |
| DCEVS-110P | | Practical Work based on DCEVS-108N & DCEVS-109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | 20 | | |

C-15: Combination (Physics, Computer Science, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGCS-101N | Computer Fundamental & PC Software | 2 |
| | UGEVS-101N | Fundamentals of Environmental Sciences | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101N | 2 |
| | UGCS-101(P)N | Practical Work based on UGCS -101N | 2 |
| | UGEVS-101(P)N | Practical Work Based on UGEVS-101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGCS-102N | C Programming | 2 |
| | UGEVS-102 | Ecology and Biodiversity Conservation | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102N | 2 |
| | UGCS-102(P)N | Practical Work based on UGCS -102N | 2 |
| | UGEVS-102(P)N | Practical Work based on UGEVS-102N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGCS-103N | Data Structures | 2 |
| | UGEVS-103 | Environmental Microbiology and Biotechnology | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103N | 2 |
| | UGCS-103(P)N | Practical Work based on UGCS -103N | 2 |
| | UGEVS-103(P)N | Practical Work Based on UGEVS-103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCS-01N | Discrete Mathematics | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGCS-104N | Introduction to Database Management System | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104N | 2 |
| | UGCS-104(P)N | Practical Work based on UGCS -104N | 2 |
| | UGEVS-104(P)N | Practical Work Based on UGEVS-104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPHS-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |
| Total Credit (4th Semester) | | | 20 |

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| V | Skill Enhancement Course | | | |
| | SBSCS-02N | Python Programming | | 4 |
| | Discipline Centric Elective Course (Chose any two group from A, B and E) | | | |
| | Group-A | DCEPHS -105N | Optics | 2 |
| | | DCEPHS -106N | Thermal Physics | 2 |
| | | DCEPHS-107(P)N | Practical Work based on DCEPHS -105N and DCEPHS -106N | 2 |
| | Group-D | DCECS -105N | Computer Network | 2 |
| | | DCECS -106N | Operating System | 2 |
| DCECS-107(P)N | | Practical Work based on 106N | 2 | |
| Group-E | DCEVS-105N | Environmental Pollutions | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | 2 | |
| | DCEVS-107P | Practical Work based on DCEVS-105N & DCEVS-106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | | | | |
| Total Credit (5th Semester) | | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | | 4 |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N | Quantum mechanics and spectroscopy | 2 |
| | | DCEPHS -109N | Solid State Physics and Advanced Electronics | 2 |
| | | DCEPHS-110(P)N | Practical Work based on DCEPHS-108 and DCEPHS-109 | 2 |
| | Group-D | DCECS -108N | C++ and Object Oriented Programming | 2 |
| | | DCECS -109N | Software Engineering | 2 |
| | | DCECS-110(P)N | Practical Work based on 108 | 2 |
| | Group-E | DCEVS-108N | Statistics and Environmental Quality Assessment | 2 |
| DCEVS-109N | | Environmental geology and earth resources | 2 | |
| DCEVS-110(P)N | | Practical Work based on DCEVS-108 & DCEVS-109 | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | | 4 | |
| Total Credit (6th Semester) | | | 20 | |

C-16: Combination (Physics, Statistics, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|--|---|-----------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGSTAT-101N | Statistical Methods | 2 |
| | UGEVS-101N | Fundamentals of Environmental Sciences | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101N | 2 |
| | UGSTAT-101(P)N | Practical Work based on UGSTAT -101N | 2 |
| | | | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 | |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGSTAT-102N | Probability, Distribution and Statistical Inference | 2 |
| | UGEVS-102 | Ecology and Biodiversity Conservation | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102N | 2 |
| | UGSTAT-102(P)N | Practical Work based on UGSTAT -102N | 2 |
| | | | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 | |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGSTAT-103N | Sampling Theory and Design of Experiments | 2 |
| | UGEVS-103 | Environmental Microbiology and Biotechnology | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103N | 2 |
| | UGSTAT-103(P)N | Practical Work based on UGSTAT -103N | 2 |
| | UGEVS-103(P)N | Practical Work Based on UGEVS-103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-02N | Advance Analytical Chemistry | 4 |
| | Ability Enhancement Course | | |
| AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 | |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGSTAT-104N | Applied Statistics | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104N | 2 |
| | UGSTAT-104(P)N | Practical Work based on UGSTAT -104N | 2 |
| | UGEVS-104(P)N | Practical Work Based on UGEVS-104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPHS-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 | |

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| | Total Credit (4th Semester) | | 20 | |
| V | Skill Enhancement Course | | | |
| | SBSMM-03N | Elementary Analysis | 4 | |
| | Discipline Centric Elective Course (Chose any two group from A, B and E) | | | |
| | Group-A | DCEPHS -105N | Optics | 2 |
| | | DCEPHS -106N | Thermal Physics | 2 |
| | | DCEPHS-107(P)N | Practical Work based on DCEPHS -105N and DCEPHS -106N | 2 |
| | Group-D | DCESTAT -105N | Advance Statistical Inference | 2 |
| | | DCESTAT-106N | Basic Knowledge of Statistical Softwares | 2 |
| DCESTAT-107(P)N | | Practical Work based on DCESTAT -105N and DCESTAT -106N | 2 | |
| Group-E | DCEVS-105N | Environmental Pollutions | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | 2 | |
| | DCEVS-107(P)N | Practical Work based on DCEVS-105N & DCEVS-106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | 4 | | |
| Total Credit (5th Semester) | | 20 | | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | 4 | |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N | Quantum mechanics and spectroscopy | 2 |
| | | DCEPHS -109N | Solid State Physics and Advanced Electronics | 2 |
| | | DCEPHS-110(P)N | Practical Work based on DCEPHS-108N and DCEPHS-109N | 2 |
| | Group-D | DCESTAT -108N | Official Statistics | 2 |
| | | DCESTAT -109N | Operation Research | 2 |
| DCESTAT-110(P)N | | Practical Work based on DCESTAT -108N and DCESTAT -109N | 2 | |
| Group-E | DCEVS-108 | Statistics and Environmental Quality Assessment | 2 | |
| | DCEVS-109 | Environmental geology and earth resources | 2 | |
| | DCEVS-110P | Practical Work based on DCEVS-108N & DCEVS-109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | 4 | | |
| Total Credit (6th Semester) | | 20 | | |

C-17: Combination (Physics, Mathematics, Environmental Science)

| Semester | Course Code | Title of course | Credits |
|---|-----------------------------------|--|--------------|
| I | Compulsory Core Course | | |
| | UGPHS -101N | Vector, Mechanics and General Physics | 2 |
| | UGMM-101N | Differential Calculus | 2 |
| | UGEVS-101N | Fundaments of Environmental Sciences | 2 |
| | UGPHS -101(P)N | Practical Work based on UGPHS -101 | 2 |
| | UGMM-102N | Analytical Geometry | 2 |
| | UGEVS-101(P)N | Practical Work Based on UGEVS-101N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-01N | Energy Resources and Green Technology | 4 |
| | Ability Enhancement Course | | |
| | AECEG OR AECHD | Ability Enhancement Course in English OR Ability Enhancement Course in Hindi | 4 OR 4 |
| Total Credit (1st Semester) | | | 20 |
| II | Compulsory Core Course | | |
| | UGPHS -102N | Oscillation, waves and electrical circuits | 2 |
| | UGMM-103N | Integral Calculus | 2 |
| | UGEVS-102N | Ecology and Biodiversity Conservation | 2 |
| | UGPHS -102(P)N | Practical Work based on UGPHS -102 | 2 |
| | UGMM-104N | Differential Equation | 2 |
| | UGEVS-102(P)N | Practical Work Based on UGEVS-102N | 2 |
| | Skill Enhancement Course | | |
| | SBSEVS-02N | Environmental Impact Assessment and Legislation | 4 |
| | Ability Enhancement Course | | |
| | AECHRD OR AECHH | Ability Enhancement Course in Human Rights and Duties OR Ability Enhancement Course in Health & Hygiene | 4 4 |
| Total Credit (2nd Semester) | | | 20 |
| III | Compulsory Core Course | | |
| | UGPHS -103N | Electromagnetism | 2 |
| | UGMM-105N | Mechanics-I (Statics and Dynamics) | 2 |
| | UGEVS-103N | Environmental Microbiology and Biotechnology | 2 |
| | UGPHS -103(P)N | Practical Work based on UGPHS -103 | 2 |
| | UGMM-106N | Mechanics-II (Dynamics and Hydrodynamics) | 2 |
| | UGEVS-103(P)N | Practical Work Based on UGEVS-103N | 2 |
| | Skill Enhancement Course | | |
| | SBSCH-02N | Advance Analytical Chemistry | 4 |
| | Ability Enhancement Course | | |
| | AECEA OR AECSWM | Ability Enhancement Course in Environment Awareness Or Ability Enhancement Course in Solid Waste Management | 4 4 |
| Total Credit (3rd Semester) | | | 20 |
| IV | Compulsory Core Course | | |
| | UGPHS -104N | Analog and Digital Electronics | 2 |
| | UGMM-107N | Linear Algebra | 2 |
| | UGEVS-104N | Plant Physiology and Biochemistry | 2 |
| | UGPHS -104(P)N | Practical Work based on UGPHS -104 | 2 |
| | UGMM-108N | Calculus of function of several variable and Vector Calculus | 2 |
| | UGEVS-104(P)N | Practical Work Based on UGEVS-104N | 2 |
| | Skill Enhancement Course | | |
| | SBSPHS-02N | Modern physics | 4 |
| | Ability Enhancement Course | | |
| | AECNC OR AECDM | Ability Enhancement Course in Nutrition for Community [AECNC] OR Ability Enhancement Course in Disaster Management [AECDM] | 4 4 |
| Total Credit (4th Semester) | | | 20 |

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| V | Skill Enhancement Course | | | |
| | SBSMM-03N | Elementary Analysis | | 4 |
| | Discipline Centric Elective Course (Chose any two group from A, E and C) | | | |
| | Group-A | DCEPHS -105N | Optics | 2 |
| | | DCEPHS -106N | Thermal Physics | 2 |
| | | DCEPHS-107(P)N | Practical Work based on DCEPHS -105N and DCEPHS -106N | 2 |
| | Group-E | DCEMM -109N | Abstract Algebra | 2 |
| | | DCEMM -110N | Number Theory | 2 |
| DCEMM-111(P)N | | Viva Voce | 2 | |
| Group-C | DCEVS-105N | Environmental Pollutions | 2 | |
| | DCEVS-106N | Remote Sensing, GIS and Hydrology | 2 | |
| | DCEVS-107(P)N | Practical Work based on DCEVS-105N & DCEVS-106N | 2 | |
| Literature Survey | | | | |
| UGLS-101N | Literature Survey of Elected Subject-1 | | 4 | |
| Total Credit (5th Semester) | | | 20 | |
| VI | Skill Enhancement Course | | | |
| | SBSSTAT-04N | Numerical Methods & Basic Computer Knowledge | | 4 |
| | Discipline Centric Elective Course (Chose any two group as per Sem. V) | | | |
| | Group-A | DCEPHS -108N | Quantum mechanics and spectroscopy | 2 |
| | | DCEPHS -109N | Solid State Physics and Advanced Electronics | 2 |
| | | DCEPHS-110(P)N | Practical Work based on DCEPHS-108N and DCEPHS-1098 | 2 |
| | Group-D | DCEMM -112N | Advance Analysis | 2 |
| | | DCEMM -113N | Function of Complex Variable | 2 |
| DCEMM-114(P)N | | Viva Voce | 2 | |
| Group-C | DCEVS-108N | Statistics and Environmental Quality Assessment | 2 | |
| | DCEVS-109N | Environmental geology and earth resources | 2 | |
| | DCEVS-110(P)N | Practical Work based on DCEVS-108N & DCEVS-109N | 2 | |
| Research Project | | | | |
| UGRP-102N | Research Project on Elected Subject-2 | | 4 | |
| Total Credit (6th Semester) | | | 20 | |

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|----|---------------------|---|
| 1. | APPENDIX-I | Detailed Programme Structure & Syllabus |
| 2. | APPENDIX-II | Guidelines for Research Project (UGRP-102N) is available at link: http://14.139.237.190/upload_pdf/01_02_2023_Guidelines_fo_Project_Lit_Survey_Dissertation.pdf |
| 3. | APPENDIX-III | Guidelines for Preparing report on Literature Survey is available at link: http://14.139.237.190/upload_pdf/01_02_2023_Common_Guidelines_for_Literature_Review.pdf |
| 4. | APPENDIX-IV | Internship Policy: Guidelines and Procedures (With Effect From Academic Year 2023-24) is available at link: http://14.139.237.190/upload_pdf/01_02_2023_Guidelines_for_Internship.pdf |

Year-2023-2024

Syllabus of B.Sc./B.A. Programme: [Subject Name: Statistics]

In accordance with NEP-2020

| Year | Semester | Course Code | Title of Paper | Theory/ Practical | Credit | Min. Marks | Max. Marks |
|----------------------|----------|---|---|----------------------|-----------|---------------|---------------|
| 1 st Year | I | UGSTAT -101 (N) | Statistical Methods | Theory | 2 | 36 | 100 |
| | | UGSTAT -101 (NP) | Practical and Viva voce | Practical | 2 | 36 | 100 |
| | II | UGSTAT -102 (N) | Probability, Distribution and Statistical Inference | Theory | 2 | 36 | 100 |
| | | UGSTAT -102 (NP) | Practical and Viva voce | Practical | 2 | 36 | 100 |
| 2 nd Year | III | UGSTAT -103 (N) | Sampling Theory and Design of Experiments | Theory | 2 | 36 | 100 |
| | | UGSTAT -103 (NP) | Practical and Viva voce | Practical | 2 | 36 | 100 |
| | IV | UGSTAT -104(N) | Applied Statistics | Theory | 2 | 36 | 100 |
| | | UGSTAT -104 (NP) | Practical and Viva voce | Practical | 2 | 36 | 100 |
| 3 rd Year | V | Discipline Centric Elective Course | | | | | |
| | | DECSTAT -105 (N) | Advance Statistical Inference | Theory | 2 | 36 | 100 |
| | | DECSTAT -106 (N) | Basic Knowledge of Statistical Softwares | Theory | 2 | 36 | 100 |
| | | DECSTAT -107 (NP) | Practical and Viva voce | Practical | 2 | 36 | 100 |
| | VI | Discipline Centric Elective Course | | | | | |
| | | DECSTAT -108 (N) | Official Statistics | Theory | 2 | 36 | 100 |
| | | DECSTAT -109 (N) | Operation Research | Theory | 2 | 36 | 100 |
| | | DECSTAT -110 (NP) | Practical and Viva voce | Practical | 2 | 36 | 100 |
| | | Skill Enhancement Course | | | | | |
| | | SBSSTAT-04 (N) | Numerical Methods & Basic Computer Knowledge | Theory | 4 | 36 | 100 |
| Total Credit | | | | | 32 | 540 | 1500 |

Syllabus

of

B. Sc. (Statistics) / B. A. (Statistics)

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: I | Semester: I |
| Subject: Statistics | | |
| Course Code: UGSTAT -101 N | Course Title: <i>Statistical Methods</i> | |
| <p>CO: To summarize the data and to obtain its salient features from the vast mass of original data. To understand the concept of attributes. To understand and analyze and also interpret the data through graphical and diagrammatical representation of the data. Acquainting the Learner with various statistical methods. To introduce students to different measurement scales, qualitative and quantitative and discrete and continuous data. To help learner to organize data into frequency distribution graphs, including bar graphs, histograms, polygons, and Ogives. Students should be able to understand the purpose for measuring central tendency, variation, skewness and kurtosis and should be able to compute them as well. Learners should be able to understand and compute various statistical measures of correlation, fitting of curve and regression, theory of Attributes.</p> | | |
| <p>Course Outcomes:</p> <p>CO1:Learner will be able to understand about the concept of data collection, tabulation and also about its graphical and diagrammatical representation.</p> <p>CO 2:This course provides the knowledge about all measures of central tendency and measures of dispersion with its merits, demerits and further applications</p> <p>CO 3:Learner will gain sufficient knowledge about moments, skewness and kurtosis.</p> <p>CO 4: Lerner will able to handle data with use of raw moments for ungrouped data, raw moments for grouped data, Central moments, Interrelationship between various moments, effect of change of origin and scale on moments, Charlier's checks, Sheppard's correction for moments Factorial moments.</p> <p>CO 5: Learner should persist knowledge of correlation, inter and intra class correlation and regression</p> <p>CO 6: For the qualitative analysis, learner will able to understand theory of attributes and dichotomous classifications and measures of association.</p> | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Data Collection and Its Representation | |
| Unit I | Data Collection and Tabulation : Meanings, Definitions and Applications of Statistics, Measurements and Scale, Measurements of qualitative data, Methods of data collection, Types of data. | |
| Unit II | Representation of Data- I (Diagrammatical representation): Frequency distribution, Tabulation of data, Diagrammatical Representation of data, Bar diagram, Multiple bar diagram, Divided bar diagram, Percentage bar diagram, Pie chart, Pictogram, leaf chart, | |
| Unit III | Representation of Data- I (Graphical representation): Graphical representation of frequency distribution, Histogram, Frequency polygon, Frequency curve, Ogive. | |
| Block 2 | Measures of Central Tendency and Dispersion | |
| Unit IV | Measures of Central Tendency: Types of measures of central tendency, Arithmetic mean, Fundamental Theorems on Arithmetic mean, Geometric mean, Harmonic mean, Median, Mode, Percentiles, Deciles, and Quartiles. | |
| Unit V | Measures of Dispersion : Types of measures of Dispersion, Range, Mean Deviation, Variance and Standard deviation, Effect of change of origin and scale, Relationship between measures of central tendency and measures of dispersion, Coefficient of variation. | |
| Block 3 | Moments, Skewness and Kurtosis | |

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| Unit VI | Moments, Raw Moments and Central Moments : Definition of moments, raw moments for ungrouped data, raw moments for grouped data, Central moments, Factorial moments, Interrelationship between various moments, effect of change of origin and scale on moments, Charlier's checks, Sheppard's correction for moments. |
| Unit VII | Skewness and Kurtosis: Definition of skewness, Measures of skewness, Pearson's coefficient, Bowley's coefficients, Kurtosis, Measures of Kurtosis, effect of change of origin and scale. |
| Block 4 | Correlation and Regression |
| Unit VIII | Bivariate Data and Correlation: Scatter Diagram, Karl Pearson's coefficient of correlation, Properties of correlation coefficient, limits of correlation coefficient, Effect of change of origin and scale on correlation coefficient. |
| Unit IX | Regression: Regressions, linear regression model, principal of least square, Regression lines, Regression coefficient, Properties of Regression coefficients. |
| Unit X | Correlation and Intra Class Correlation: Rank correlation coefficient, Spearman's rank correlation coefficients, rank correlation coefficient for tied ranks, Intra-class correlation, some remarks on Intra-class correlation. |
| Unit XI | Theory of Attributes: Combinations, Classes and Class frequencies of Attributes, Dichotomous Classification, Consistency of data, joint distribution of attributes, Contingency tables, Independence and Association of Attributes, Measures of Association, Yates Correction. |

Suggested Text Book Readings:

- Bhat B.R, Srivenkatramana T and Rao Madhava K.S.(1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
- Croxton F.E, Cowden D.J and Kelin S (1973): Applied General Statistics, Prentice Hall of India.
- Goon A.M., Gupta M.K., Das Gupta. B. (1991): Fundamentals of Statistics, Vol.I, World Press, Calcutta.
- Anderson T.W and Sclove S.L (1978) An Introduction to the Statistical Analysis of Data, Houghton Mifflin\Co.
- Cooke, Cramer and Clarke (): Basic Statistical Computing, Chapman and Hall.
- Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill
- Snedecor G.W and Cochran W. G. (1967): Statistical Methods. Iowa State University, Press.
- Spiegel, M. R. (1967): Theory & Problems of Statistics, Schaum's Publishing Series.
- Gupta S. C. and Kapoor V. K. (1999): Fundamentals of Mathematical Statistics, , S. Chand Publication, Delhi

This course can be opted as an elective by the students of following subjects:

U.G/P.G. in Mathematics, Data Science, Computer Science, Agricultural Sciences, all Life Sciences and Social Sciences subjects students etc.

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Learner can join this for their own knowledge: <https://onlinecourses.nptel.ac.in/noc>, Regression Analysis, Prof. Soumen Maity

Electronic media and other digital components in the curriculum:

Choose any one or more than one:(Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)

| S. No. | Course Code | Title | Uploaded Date & link |
|--------|--------------|----------------------|--|
| 1. | UGSTAT – 101 | Correlation Analysis | uploaded on 25.09.2020, https://youtu.be/G4U98nAh78c |

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| 2. | UGSTAT – 101 Block – IV, Unit – X (Module – 3) | Statistical Methods, Correlation and Regression (Two Variables and Association), Rank Correlation and Intra Class Correlation | uploaded on 05.09.2020 , <u>https://youtu.be/L1RLSOjiORs</u> |
| 3. | UGSTAT – 101 Block – IV, Unit – IX (Module – 2) | Statistical Methods, Correlation and Regression (Two Variables and Association), Regression Analysis | uploaded on 27.08.2020 , <u>https://youtu.be/s9z9yHhITVE</u> |
| 4. | UGSTAT – 101 Block – IV, Unit – VIII (Module – 1) | Statistical Methods, Correlation and Regression (Two Variables and Association), Bivariate Data and Correlation | uploaded on 26.08.2020 , <u>https://youtu.be/1Bsi3YW3ySo</u> |
| 5. | UGSTAT – 01 Block – III | Statistical Methods, Moments, Skewness and Kurtosis | uploaded on 18.06.2019 , <u>https://youtu.be/SNAZ8U2Mhjl</u> |
| 6. | UGSTAT – 01 Block – II, Unit – II | Statistical Methods, Measures of Central Tendency and Dispersion, Measures of Dispersion | uploaded on 11.06.2019 , <u>https://youtu.be/E1c9t8kXJOO</u> |
| 7. | UGSTAT – 01 Block – II, Unit – I | Statistical Methods, Measures of Central Tendency and Dispersion, Measures of Central Tendency | uploaded on 05.01.2019 , <u>https://youtu.be/JIPZjEyiLA</u> |
| 8. | UGSTAT – 01 Block – I | Statistical Methods, Data Collection and Its Representation | uploaded on 05.01.2019 , <u>https://youtu.be/JwKFj74qICQ</u> |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: I | Semester: I |
| Subject: Statistics | | |
| Course Code: UGSTAT-101NP | | Course Title: <i>Practical and Viva voce</i> |
| Course Objectives: The main objective of this course is to develop a skill to: understand the practical methods and tests related to estimation of real-life data. | | |
| Course Outcomes: | | |
| CO1: Learner should be able to solve the numerical problems related with measures of central tendency. | | |
| CO2: Learner should be able to solve the numerical problems related with measures of dispersion. | | |
| CO3: Learner should be able to solve the numerical problems related with skewness and kurtosis. | | |
| CO4: Learner should be able to solve the numerical problems related with correlation and regression. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| <i>Practical based on UGSTAT-101N</i> | | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: I | Semester: II |
| Subject: Statistics | | |
| Course Code: UGSTAT -102 (N) | Course Title: <i>Probability, Distribution and Statistical Inference</i> | |
| Course Objectives: To understand the concept of random variables, probability distributions and expectation. Understanding probability theory at basic and advance level, random variables and also their convergences at weak and strong levels. Different probability distribution (discrete and continuous). Learner will also gain the knowledge about small sample test, large sample test as well as non parametric tests. | | |
| Course Outcomes: | | |
| CO1: Learner will able to understand the concept of random experiment, random variables, probability, conditional probability and also Baye's Theorem. | | |
| CO2: Under this course, learner gain knowledge about the basics of probability distributions, expectations, inequalities for moments, moment generating functions etc. | | |
| CO3: This course gives the complete knowledge about discrete distributions and their properties and also the limiting case, relation between the discrete distributions and also fitting of distribution. | | |
| CO4: This course gives the complete knowledge about continuous distributions and their properties and also the limiting case, relation between them and also the lack of memory property, area property. | | |
| CO5: In this course, learner will have the knowledge of the inferential statistics in which they able to understand about estimation, procedure of estimation, properties of estimators and also the properties of good estimators and also knowledge about the Fisher's transformations. | | |
| CO6: This course also provide the knowledge of testing of hypothesis, critical region, types of errors, test of significance; which helps for making the scientific and statistical decisions. | | |
| CO7: This course gives knowledge about large sample test, parametric and nonparametric tests | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Probability Theory | |
| Unit I | Random experiments and Probability: Deterministic and random experiments, Sample space, Events, Algebra of Events, Axiomatic definition of Probability, Classical definition of Probability, Statistical definition of probability, Addition Theorem of Probability | |
| Unit II | Conditional Probability: Conditional probability, Multiplicative theorem of Probability, Independent events, Partition of sample space, Baye's Theorem. | |
| Block 2 | Probability Distributions and Expectations | |
| Unit III | Random Variables and Probability Distributions: Definition and types of random variable, Cumulative distribution function and its properties, Probability Mass Function, Probability Density Function.. | |
| Unit IV | Expectation: Definition and types of Mathematical Expectation, Moments in terms of expectation, Mathematical and Multiplication theorems of Expectation, other theorems on expectation | |
| Unit V | Inequalities for Moments: Cauchy-Schwartz Inequality, Markov's inequality, Chebyshev's inequality. | |
| Block 3 | Concept of Probability Distributions | |
| Unit VI | Univariate Distributions: Bernoulli Distribution, Binomial Distribution, mean and variance of binomial distribution, Moments, Moments Generating Function, Additive and Multiplicative property, Recurrence relation for moments, Fitting of Binomial Distribution, Poisson Distribution, Poisson Distribution as a limiting case of Binomial Distribution, mean | |

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| | and variance of Poisson distribution, Moments, Moment Generating Function, Additive and Reproductive property, Recurrence relation for moments, fitting of Poisson Distribution. |
| Unit VII | Discreet Distribution: Geometric Distribution, mean and variance, moment generating function of geometric distribution, Negative Binomial Distribution, Moment Generating Function, Mean and Variance, Recurrence formulae for negative Binomial Distribution, Poisson Distribution as a limiting case of Negative Binomial Distribution, Hyper Geometric Distribution, Mean and Variance, Recurrence relation for Hyper Geometric distribution.. |
| Unit VIII | Normal Distribution: Normal Distribution and its parameters, Standard Normal Distribution, Moments, Moments Generating Function, Area Property, properties of normal curve, Standard Scores, Advantages and Characteristics of Z Scores |
| Unit IX | Continuous Distribution: Uniform Distribution, Moment Generating Function, Distribution Function, Moments of Uniform Distribution, Exponential Distribution, Moments, Moment Generating Function, Lack of Memory Property |
| Unit X | Sampling Distribution: Sampling distribution of a statistic, Parameter, Derivation of χ^2 , t, F, z distributions, Beta, Gamma, Chauchy densities. |
| Block 4 | Basic Principles of Statistical Inference |
| Unit XI | Estimation: Point Estimation, properties of a good estimator, Consistency, Unbiasedness, Efficiency, Sufficiency, Confidence Interval Estimation. |
| Unit XII | Method of Estimation: Procedures of Estimation, Method of Moments, method of Maximum Likelihood, Method of Scoring, Properties of Estimators. |
| Unit XIII | Testing of Hypothesis: Statistical Hypothesis, Simple and Composite Hypothesis, Critical Region, Two kinds of Error, One-tailed and Two-tailed tests, Test of Significance, Most Powerful Test, Uniformly Most Powerful Test . |
| Block 5 | Test of Significance |
| Unit XIV | Exact Tests and Fisher's transformations: Tests of Significance based on Chi-Square Distribution, Tests of Significance based on t – Distribution, Tests of Significance based on F – Distribution, Tests of Significance based on Fisher's Z - Distribution. |
| Unit XV | Large Sample Tests: Testing Significance of Mean, Testing Equality of Means, Testing Significance of Proportion, Testing Equality of Proportions, Testing Significance of Standard Deviation, Testing Equality of Standard Deviation |
| Unit XVI | Non-Parametric Tests: Non Parametric Tests, Sign Test, Wilcoxon Signed- Rank Test, Mann- Whitney U-Test, Run Test. |

Suggested Text Book Readings:

- Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997): Statistics: A Beginner's Text, Vol. II, New Age International (P) Ltd.
- Edward P.J., Ford J.S. and Lin (1974): Probability for Statistical Decision-Making, Prentice Hall.
- Goon A.M., Gupta M.K., Das Gupta.B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
- Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
- Cooke, Cramer and Clarke (): Basic Statistical Computing, Chapman and Hall.
- David S (1996): Elementary Probability, Oxford Press.
- Hoel P.G (1971): Introduction to Mathematical Statistics, Asia Publishing House.
- Meyer P.L (1970): Introductory Probability and Statistical applications. Addison Wesley.
- Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
- Hodges J.L and Lehman E.L (1964): Basic Concepts of Probability and Statistics, Holden Day.
- Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
- Rohatgi V.K (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons.
- Snedecor G.W and Cochran W. G. (1967): Statistical Methods. Iowa State University Press.

This course can be opted as an elective by the students of following subjects:

U.G/P.G. in Mathematics, Data Science, Computer Science, Agricultural Sciences, all Life Sciences and Social Sciences subjects students etc

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Learner can join this for their own knowledge:

1. <https://onlinecourses.nptel.ac.in/noc>, Probability and Random Processes, Prof Rohit Sinha and Prof. Ribhu

2. <https://onlinecourses.nptel.ac.in/noc>, Non-parametric Statistical Inference, Prof. Niladri Chatterjee

Electronic media and other digital components in the curriculum:

Choose any one or more than one:(Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)

| S. No. | Course Code | Title | Uploaded Date & link |
|---------------|--------------------------------------|---|--|
| 1. | UGSTAT – 102 Block – I, Unit – II | Probability Distribution and Statistical Inference, Probability Theory, Conditional Probability | uploaded on 20.09.2021 , https://youtu.be/7P-dvJIEs1g |
| 2. | UGSTAT – 102 Block – I, Unit – I | Probability Distribution and Statistical Inference, Probability Theory, Random Experiments and Probability | uploaded on 23.09.2021 , https://youtu.be/hr0frb7K-9c |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: I | Semester: II |
| Subject: Statistics | | |
| Course Code: UGSTAT-102NP | | Course Title: <i>Practical and Viva voce</i> |
| Course Objectives: The main objective of this course is to develop a skill to: understand the practical methods and tests related to estimation of real-life data. | | |
| Course Outcomes: CO1: Learner should able to solve the numerical problems related with Probability theory. CO2: Learner should able to solve the numerical problems related with distributions. CO3: Learner should able to solve the numerical problems related with sampling distributions. CO4: Learner should able to solve the numerical problems related with Non parametric tests. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| <i>Practical based on UGSTAT-102N</i> | | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: II | Semester: III |
| Subject: Statistics | | |
| Course Code: UGSTAT -103 (N) | Course Title: <i>Sampling Theory and Design of Experiments</i> | |
| Course Objectives: To understand the concept of sampling distributions and their applications in statistical inference. To understand the process of hypothesis testing. To have a clear understanding of when to apply various tests of hypothesis about population parameters using sample statistics and draw appropriate conclusions from the analysis. To learn how the mathematical ideas of Statistics carry over into the world of applications. Drawing inference about the unknown population parameters based on random samples. Validating our estimation/ inference about the population using hypothesis testing. To provide tools and techniques for selecting a sample of elements from a target population keeping in mind the objectives to be fulfilled and nature of population. To obtain estimator of the population parameter on the basis of selected sample and study its properties. To understand the knowledge about the principles of design of experiments, linear models and also CRD, RBD and LSD. | | |
| Course Outcomes: | | |
| CO1: This course gives the concept of population, census and statistic, types of survey, sampling and Sampling over complete enumeration .Simple Random Sampling with and without replacement, Stratified sampling, Systematic Sampling. | | |
| CO2: Under this course learner will able to understand the knowledge of auxiliary variable, Ratio and Regression Method of estimation, Cluster sampling, Two Stage Sampling, Two Phase Sampling and also Multi Stage Sampling, Non Sampling errors: Response Errors and Non Response Errors. | | |
| CO3: Learner will able to understand the Analysis of Variance (ANOVA), and linear model. | | |
| CO4: Learner will able to understand concept about the Design of Experiments, CRD, RBD and LSD. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Samplings Theory - I | |
| Unit I | Simple Random Sampling: Advantages of Sampling over Complete Enumeration, Sampling and Non Sampling Errors, Probability or Random Sampling, Bias of an Estimator, Measures of Sampling Error, Simple Random Sampling Without Replacement (SRSWOR) . | |
| Unit II | Stratified Random Sampling: Introduction, Reasons & Advantages of Stratification, Some theorems. | |
| Unit III | Allocation of Sample Size and Systematic Sampling: Introduction, Equal Allocation, Proportional Allocation, Variance of Stratified Mean under Proportional Allocation, Optimum Allocation, Variance of Stratified Mean under Neyman Allocation, Relationship Among Three Variances, Impact of Arbitrary Allocation, Practical difficulties in Implementing NeymanAllocation, Systematic Random Sampling. | |
| Block 2 | Sampling Theory - II | |
| Unit IV | Ratio and Regression Methods of Estimation: Introduction, Ratio and Regression Estimators, Approximate Variances of the Ratio Estimators | |
| Unit V | Cluster and Two Stage Sampling: Cluster Sampling (Equal Cluster- Size), Estimation of Mean with SRS at both Stages, Relative Efficiency of Cluster Sampling, Two Stage Sampling, Estimation of Mean, Optimum Allocation when Cost Fixed and when Variance Fixed, Two-Phase (Double) Sampling for Stratification, Estimation of Mean, Difference between Multistage Sampling and Two Phase Sampling. | |
| Unit VI | Non- Sampling Errors: Response Error and Non Response Errors: Introduction, Errors in Sampling, Sampling Errors, Non Sampling Errors, Response Errors, Sources of Non Sampling Errors, Method of Minimizing Non- Response Errors. | |
| Block 3 | Design and Analysis of Experiments | |
| Unit VII | Analysis of Variance, Design of Experiment and Completely Block Design: Analysis of Variance, Linear Models and Analysis of Variance, Design of Experiment, Basic Principles of | |

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| | Design of Experiments, Completely Randomized Design. |
| Unit VIII | Randomized Block Design and Latin square Design: Randomized Block Design, Efficiency of RBD, Missing Plot Technique, Latin Square Design, and Efficiency of LSD |
| Unit IX | Factorial Experiment: Definition, 2^2 and 2^3 factorial experiments with its ANOVA table |
| Suggested Text Book Readings: | |
| <ul style="list-style-type: none"> • Cochran W.G and Cox G.M (1957): Experimental Designs, John Wiley and Sons. • Das M.N and Giri (1986): Design and Analysis of Experiments, Springer Verlag • Murthy M. N (1967): Sampling Theory and Methods, Statistical Publishing Society, Calcutta. • Sampath S. (2000): Sampling Theory and Methods, Narosa Publishing House. • Sukhatme B. V (1984): Sample Survey methods and Its Applications, Indian Society of Agricultural Statistics. • Des Raj (2000): Sample Survey Theory, Narosa Publishing House. • Goon A. M., Gupta M. K., Das Gupta. B. (1986): Fundamentals of Statistics, Vol. II, World Press, Calcutta. • Kempthorne O. (1965): The Design and Analysis of Experiments, Wiley Eastern. | |
| This course can be opted as an elective by the students of following subjects: | |
| U.G/P.G. in Agricultural Sciences, all Life Sciences and Social Sciences subjects students etc | |
| Suggested equivalent online courses (MOOCs) for credit transfer:NA | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: II | Semester: III |
| Subject: Statistics | | |
| Course Code: UGSTAT-103 (N)(P) | | Course Title: <i>Practical and Viva voce</i> |
| Course Objectives: The main objective of this course is to develop a skill to: understand the practical methods and tests related to estimation of real-life data. | | |
| Course Outcomes: CO1: Learner should able to solve the numerical problems related with Simple random sampling theory. CO2: Learner should able to solve the numerical problems related with stratified sampling. CO3: Learner should able to solve the numerical problems related with systematic sampling. CO4: Learner should able to solve the numerical problems related with cluster sampling.etc CO5: Learner should able to solve the numerical problems related with CRD, RBD and LSD. CO6: Learner should able to solve the numerical problems related with one way and two way analysis etc | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| <i>Practical based on UGSTAT-103(N)</i> | | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: II | Semester: IV |
| Subject: Statistics | | |
| Course Code: <i>UGSTAT -104(N)</i> | Course Title: <i>Applied Statistics</i> | |
| Course Objectives: | | |
| Course Outcomes: | | |
| CO1: This course gives the complete knowledge about the Index number, Price Index number, Cost Index number, criterion of a good index number. | | |
| CO2: Under this course, learner will able to understand the knowledge about the Time Series Analysis, its utility, component, mathematical models, determination of trends and seasonal indices. | | |
| CO3: Learner will able to understand about the concept of Demography, vital statistics, concept of fertility, mortality with their measurements and also knowledge of life table and measures of reproductively. | | |
| CO4: Learner will also persist the knowledge about Statistical Quality Control, control charts for variables, control charts for attributes and also gain the knowledge of principles of acceptance sampling.etc | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Index Numbers | |
| Unit I | Index Number: General Theory: Definition & Construction of an Index number, Price Relatives, Quantity or Volume Relatives, Value Relatives, Link & Chain Relatives, Problem involved in computation of an Index Number . | |
| Unit II | Index Numbers: Important Formulae: Introduction, Calculation of Index Number, Laspeyre's, Paasche's, Marshall- Edgeworth's, fisher's formulae, other indices, Quantity Index, Criteria of good Index Number | |
| Unit III | Consumer Price Index Number: Introduction, Construction & Computation of Consumer Price Index Number (CPI), Steps in construction of CPI, Use & Limitations of CPI, Base Shifting of Index Numbers, Splicing of Index Number Series, Deflating the Index Number, Index of Industrial Production | |
| Block 2 | Time Series Analysis | |
| Unit IV | Time Series: Introduction, Utility of Time Series Analysis, Component of Time Series, Mathematical Models for Time Series Analysis. | |
| Unit V | Determination of Trends: Introduction, Graphic Method, Method of Semi Averages, Method of Curve Fitting by the Principle of Least Squares, Method of Moving Averages (when Period is Even & Odd) | |
| Unit VI | Determination of Seasonal Indices: Introduction, Measurement of Seasonal Indices, Method of Simple Averages, Ratio to Trend Method, Ratio to Moving Average Method, Method of Link Relatives | |
| Block 3 | Demography | |
| Unit VII | Sources of Demographic Data : Introduction, Demography & Vital Statistics, Sources of Demographic Data, Errors in Data Collection, Evaluation & its Adjustments, Rates & Ratios | |
| Unit VIII | Measures of Mortality: Introduction, Measures of Mortality, CDR, SDR, StDR, MMR, IMR. | |
| Unit IX | Measures of Fertility : Introduction, Measures of Fertility, CBR, GFR, ASFR, TFR. | |
| Unit X | Life Tables: Introduction, Description & Construction of Complete Life Table, Uses of a Life Table. | |
| Unit XI | Measures of Reproductively: Introduction, GRR, NRR. | |
| Block 3 | Statistical Quality Control | |

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| Unit XII | Introduction of Statistical Quality Control : Introduction, Advantages of Quality Control, Quality Characteristics, Basic Principles & Operating Characteristics of Control Charts, Choice of Control Limits, Sample Size & Sample Frequency, Rational Subgroups, Analysis of Pattern on Control Charts, Rate of Detection of Change in Average Level |
| Unit XIII | Control Charts for Variables: Introduction, Control Charts for Mean, Control Charts for Range, Control Charts for Standard Deviation |
| Unit XIV | Control Charts for Attributes: Introduction, Control Charts for Fraction Defectives, Control Charts for Number of Defectives, Control Charts for Number of Defects |
| Unit XV | Principles of Acceptance Sampling: Introduction, AQL, LTPD, Producer's Risk, Consumer's Risk, OC Function, AOQ, Average Total Inspection, Average Sample Number, Single Sampling Plan, Double Sampling Plan, Sampling Inspection by Variables |
| Suggested Text Book Readings: | |
| <ul style="list-style-type: none"> • Croxton F.E and Cowden D.J. (1969) : Applied General Statistics, Prentice Hall of India. • Goon A.M., Gupta M. K., Das Gupta. B. (1986): Fundamentals of Statistics, Vol. II, World Press, Calcutta. • Guide to Current Indian Official Statistics: Central Statistical Organization, Govt. of India, New Delhi. • Saluja M. P () Indian Official statistical Systems, Statistical Publishing Society, Calcutta. • Srivatava O.S (1983): A Textbook of Demography, Vikas Publishing. • Gupta and Mukhopadhyay P.P () Applied Statistics, Central Book Agency. • Pressat R (1978) : STATISTICAL Demography, Methuen and Co. Ltd. | |
| This course can be opted as an elective by the students of following subjects: | |
| U.G/P.G. in Commerce, Business studies, population studies, economics, all Life Sciences and Social Sciences subjects students etc | |
| Suggested equivalent online courses (MOOCs) for credit transfer:NA | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the Concerned Course. | | |
| Programme: B.Sc./B.A. | Year: II | Semester: IV |
| Subject: Statistics | | |
| Course Code: <i>UGSTAT-104NP</i> | | Course Title: <i>Practical and Viva voce</i> |
| Course Objectives: The main objective of this course is to develop a skill to: understand the practical methods and tests related to estimation of real-life data. | | |
| Course Outcomes: CO1: Learner should able to solve the numerical problems related with Index number. CO2: Learner should able to solve the numerical problems related with Time series analysis. CO3: Learner should able to solve the numerical problems related with Demography. CO4: Learner should able to solve the numerical problems related with Statistical Quality Control. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| <i>Practical based on UGSTAT-104N</i> | | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: III | Semester: V |
| Subject: Statistics | | |
| Course Code: UGSTAT -105 (N) | Course Title: <i>Advance Statistical Inference</i> | |
| Course Objectives: Study of theoretical concepts of Point Estimation & Cramer Rao Inequality, Sufficiency & Factorization Theorem, Complete Sufficient Statistics & Rao Blackwell Theorem, Complete Sufficient Statistics, MP & UMP Tests, Neyman- Pearson Lemma, Likelihood Ratio Test & Their Uses, Shortest Unbiased Confidence Intervals. | | |
| Course Outcomes: | | |
| CO1: Under this course learner will able to understand about the concept of statistical inference, point estimation, cramer rao inequality and MVUE. | | |
| CO2: Learner will able to understand about the Sufficiency and factorization theorem, rao Blackwell theorem and invariance property. | | |
| CO3: This course also discuss about the minimum variance unbiased estimation, completeness, lehmann Scheffe theorem and Neyman Pearson Lemma. | | |
| CO4: Learner should also able to understand about the Neyman- Pearson Lemma, Likelihood Ratio Test & Their Uses, Testing of Means of Normal Population, Confidence Interval & Confidence Coefficient, Neyman's Principle of Shortest Confidence Interval, Unbiased Confidence Interval and Shortest Unbiased Confidence Interval. | | |
| Credits: 2 | Type of Course: Discipline Centric Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi should be framed block wise/unit wise; No of blocks and units may change) | | |
| Block 1 | Point Estimation | |
| Unit I | Introduction to Statistical Inference: Introduction, Parameter & Statistic, Parametric & Non-Parametric Methods, Likelihood Function of Sample Values, Sampling Distribution, Standard Error of the Statistic | |
| Unit II | Point Estimation & Cramer Rao Inequality: Introduction, Point Estimation, Properties of Estimators, Unbiasedness, Consistency, Efficiency, MVUE, C-R Inequality | |
| Unit III | Sufficiency & Factorization Theorem: Introduction, Sufficiency, Neyman- Fisher Factorization Theorem, Koopman's form of the Distribution, Invariance Property of Sufficient Statistics. | |
| Unit IV | Complete Sufficient Statistics & Rao Blackwell Theorem: Introduction, Complete Family of Distributions, Rao-Blackwell Theorem | |
| Block 2 | MVU Estimation | |
| Unit V | MUV Estimators : Introduction, Minimum Variance Unbiased Estimation, Some Theorems on MVUE | |
| Unit VI | Complete Sufficient Statistics: Introduction, Sufficient Statistic & Completeness, Lehmann- Scheffe Theorem, Construction of UMVUE | |
| Block 3 | Testing of Hypothesis - I | |
| Unit VII | Preliminary Concepts in Testing: Introduction, Types of Hypothesis, Types of Error, Critical Region, Power Function. | |
| Unit VIII | MP & UMP Tests : Introduction, Most Powerful Test, Uniformly Most Powerful Test | |
| Block 4 | Testing of Hypothesis -II | |
| Unit IX | Neyman- Pearson Lemma, Likelihood Ratio Test & Their Uses : | |

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| | Introduction, Neyman-Pearson Lemma, Likelihood Ratio Test. |
| Unit X | Testing of Means of Normal Population : Introduction, One Sample Problem, Two Sample Problem |
| Unit XI | Interval Estimation : Introduction, Confidence Interval & Confidence Coefficient, C.I. For Sample Mean from a Normal Population, C.I. for differences of Means From Two Normal Population. |
| Unit XII | Shortest & Shortest Unbiased Confidence Intervals : Introduction, Intervals of Shortest Length, Neyman's Principle of Shortest Confidence Interval, Unbiased Confidence Interval, Shortest Unbiased Confidence Interval, Case of Discreet Random Variables. |

Suggested Text Book Readings:

- Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997): Statistics: A Beginner's Text, Vol. II, New Age International (P) Ltd.
- Edward P.J., Ford J.S. and Lin (1974): Probability for Statistical Decision-Making, Prentice Hall.
- Goon A.M., Gupta M.K., Das Gupta.B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
- Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
- Cooke, Cramer and Clarke (): Basic Statistical Computing, Chapman and Hall.
- David S (1996): Elementary Probability, Oxford Press.
- Hoel P.G (1971): Introduction to Mathematical Statistics, Asia Publishing House.
- Meyer P.L (1970): Introductory Probability and Statistical applications. Addison Wesley.
- Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
- Hodges J.L and Lehman E.L (1964): Basic Concepts of Probability and Statistics, Holden Day.
- Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
- Rohatgi V.K (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons.
- Snedecor G.W and Cochran W. G. (1967): Statistical Methods. Iowa State University Press.

This course can be opted as an elective by the students of following subjects:

U.G/P.G. in Mathematics, Data Science, Computer Science subjects students etc

Suggested equivalent online courses (MOOCs) for credit transfer: NA

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: III | Semester: V |
| Subject: Statistics | | |
| Course Code: <i>DECSTAT -106 (N)</i> | Course Title: <i>Basic Knowledge of Statistical Software</i> | |
| Course Objectives: To introduce some advanced statistical computing techniques to extract information, visualization and knowledge about various industries. To learn the principles and methods of data analysis. To provide a basic understanding of methods of analyzing data from different fields. To learn R software. The main objective of this course is to allow the learners to learn the advanced techniques of modeling real data from diverse discipline | | |
| Course Outcomes: | | |
| CO1: Learner should able to understand about the concept and practical hands on about statistical software. | | |
| CO2: Understand about SPSS, Stata with statistical applications. | | |
| CO3: Understand about R and R commander with statistical applications.. | | |
| CO4: Understand about Matlab and Latex etc.. | | |
| Credits: 2 | Type of Course: Discipline Centric Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Statistics with MS Office | |
| Unit I | MS Office and its components: About Statistical Softwares, its features and the steps for data analysis with related softwares Introduction to system software and application software, word processing software – Microsoft office Word, spread sheet software – Microsoft office excel, presentation software – Microsoft office Power Point (Interface of all the three application software, file handling, editing, formatting and final output). Excel as data base software: cell referencing, concept of list, data sorting and filtering, manipulation of data, naming of cells | |
| Unit II | Computation with MS Excel: Functions specifically Numeric/Mathematical functions, Statistical Functions, Logical Functions, lookup functions, Statistical Analysis using Excel – Descriptive Statistics, Curve fitting, correlation and regression analysis, graphs | |
| Block 2 | Statistical Computation with R | |
| Unit III | Basics of R: Basics of R, R Studio and R-Commander, creation of data files. Import Export of Data files, Transformation of Data. | |
| Unit IV | Statistical Analysis with R: Statistical Analysis using R – Descriptive Statistics, Curve fitting, correlation and regression analysis, graphs. | |
| Unit V | Testing of Hypothesis with R: Testing of hypothesis using R. | |
| Suggested Text Book Readings: | | |
| <ul style="list-style-type: none"> • Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997): Statistics: A Beginner's Text, Vol. II, New Age International (P) Ltd. • Edward P.J., Ford J.S. and Lin (1974): Probability for Statistical Decision-Making, Prentice Hall. • Goon A.M., Gupta M.K., Das Gupta.B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta. • Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill. • Cooke, Cramer and Clarke (): Basic Statistical Computing, Chapman and Hall. • David S (1996): Elementary Probability, Oxford Press. • Hoel P.G (1971): Introduction to Mathematical Statistics, Asia Publishing House. • Meyer P.L (1970): Introductory Probability and Statistical applications. Addison Wesley. • Freund J.E (2001): Mathematical Statistics, Prentice Hall of India. • Hodges J.L and Lehman E.L (1964): Basic Concepts of Probability and Statistics, Holden Day. • Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill. • Rohatgi V.K (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons. | | |

- Snedecor G.W and Cochran W. G. (1967): Statistical Methods. Iowa State University Press.

This course can be opted as an elective by the students of following subjects:

U.G/P.G. in Mathematics, Data Science, Computer Science, Agricultural Sciences, all Life Sciences and Social Sciences subjects students etc

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Learner can join this for their own knowledge:

1. <https://onlinecourses.nptel.ac.in/noc>, Descriptive Statistics With R Software, Prof. Prashant Jha
2. <https://onlinecourses.nptel.ac.in/noc>, Foundations of R Software, Prof. Shalabh
3. <https://onlinecourses.nptel.ac.in/noc>, Probability –I with Examples Using R, Prof Siva Athreya.

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: III | Semester: V |
| Subject: Statistics | | |
| Course Code: <i>DECSTAT-107(N)(P)</i> | | Course Title: <i>Practical and Viva voce</i> |
| Course Objectives: The main objective of this course is to develop a skill to: understand the practical methods and tests related to estimation of real-life data. | | |
| Course Outcomes: | | |
| CO1: Learner should able to solve the numerical problems related with Statistical Inference. | | |
| CO2: Learner should able to solve the numerical problems related based on descriptive statistics with R. | | |
| CO3: Learner should able to solve the numerical problems related with Applied Statistics with R. | | |
| CO4: Learner should able to solve the numerical problems related with official statistics with R. | | |
| Credits: 2 | Type of Course: Discipline Centric Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Practical work based on DCESTAT-105 (N) and DCESTAT-106 (N) | | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: III | Semester: VI |
| Subject: Statistics | | |
| Course Code: <i>DECSTAT -108 (N)</i> | Course Title: <i>Official Statistics</i> | |
| Course Objectives: To understand the concept of all theories and their practical knowledge. This program will gives a complete knowledge about the official statistics. To understand the concept of all theories and their practical knowledge. This program will give a complete knowledge about the audit sampling, audit risk, official and Bio statistics. | | |
| Course Outcomes: | | |
| CO1: Learner will able to understand the knowledge about official statistics, Statistical Methods for Total Quality Management, Quality Systems, ISO 9000 standards, QS 9000 standards. Concept of six-sigma. | | |
| CO2: Learner will understand concepts of population and sample need for sampling, census and sample surveys, basic concepts in sampling and designing of large scale surveys, non-sampling errors, randomized response technique (Warner's model only). | | |
| CO3: Learner have a concept of need for design of experiments, fundamental principles of design of experiments., Factorial Experiments, 2n, 32 factorial experiments, illustrations, main effects and interactions, confounding and illustrations. | | |
| CO4: This course persist the knowledge about statistical audit sampling, its advantage in audit, risk of statistical sampling, attributes vs variable sampling, audit hypothesis, testing of hypothesis, monetary unit sampling, risk based analysis, concept of alpha and beta risk, concept of tolerable misstatement. | | |
| Credits: 2 | | Type of Course: Discipline Centric Elective |
| Max. Marks: 100 | | Min. Passing Marks: 36 |
| Block 1 | Official Statistics | |
| Unit I | Basics of Official Statistics: About the official Statistics, Use of Statistics in different offices, Census, National Sample Survey Office, Sample Survey Organization, Birth and Death Registration. etc Introduction to Indian and International statistical systems. Role, function and activities of Central and State statistical organizations. Organization of large scale sample surveys. Role of National Sample Survey Organization. General and special data dissemination systems. | |
| Unit II | Application of Areas and Tools: Population growth in developed and developing countries, evaluation of performance of family welfare programmes, projections of labour force and manpower. Scope and content of population census of India. System of collection of Agricultural Statistics. Crop forecasting and estimation, productivity, fragmentation of holdings, support prices, buffer stocks, impact of irrigation projects. Statistics related to industries, foreign trade and balance of payment, cost of living, inflation, educational and other social statistics. | |
| Unit III | Statistical System and Functions of Various Agencies: Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations. Principal publications containing data on the topics such as population, agriculture, industry, trade, prices, labour and employment, transport and communications, banking and finance. Various official agencies responsible for data collection and their main functions. | |
| Block 2 | Statistical Methods for Total Quality Management | |
| Unit IV | Objectives and Basics of TQM: Quality Systems, ISO 9000 standards, QS 9000 standards. Concept of six-sigma and the Define-Measure-Analyse-Improve-Control Approach. Precision and accuracy in measurement systems. Estimation of Measurement Uncertainty. Total Quality Management | |
| Unit V | Methodologies of TQM: Process Analysis and Optimization. Quality at Design stage, | |

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| | Quality Function Deployment, Failure Mode and Effect Analysis, Conjoint Analysis. System, parameter and tolerance designs. Planning and analysis of fractional factorial experiments. Basic ideas of response surface methodology and contour plots |
| Unit VI | Process Quality and Capability Analysis: Quality in manufacturing, control charts for attribute and variable characteristics, process adjustments based on control chart evidences. Process capability and performance indices. Evolutionary operations. Measuring customer satisfaction, American Customer Satisfaction Index Model. |
| Suggested Text Book Readings: | |
| <ul style="list-style-type: none"> • Guide to current Indian Official Statistics. Central Statistical Organisation, Govt. of India, New Delhi. • Saluja, M.P. () : Indian official statistical systems. Statistical Publishing Society, Calcutta. | |
| This course can be opted as an elective by the students of following subjects: | |
| U.G/P.G. in Business & Commerce, all Life Sciences and Social Sciences subjects students etc | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | |
| Programme: B.Sc./B.A. | Year: III |
| Subject: Statistics | |
| Course Code: DECSTAT-109(N) | Course Title: <i>Operation Research</i> |
| Course Objectives: The main aim of this course is to develop the fundamental knowledge and understanding of theories and techniques of solving operations research problems in linear programming, inventory, simulation, queuing and reliability theory. To understand the knowledge about Operation Research, Graphical Method to Solve LPP, Simplex Method of Solving LPP, Duality Problem in LPP, Transportation Problem & Assignment Problem, Theory of Games, Dominance Rule, Equivalence of Rectangular Games with Linear Programming. | |
| Course Outcomes: | |
| CO1: Learner should able to under about the operation research, linear programming problem (LPP), graphical and simplex method for solving LPP. | |
| CO2: Learner should able to know about duality problem, transportation problem and also assignment problem. | |
| CO3: Under this course, learner should able to understand the concept about the game theory, dominance rule, linear programming | |
| CO4: Understand discrete event simulation and decision analysis with inclusion of modeling based on random events involving uncertainties and Able to know the inventory, queuing and replacement models with their real life applications. | |
| Credits: 2 | Type of Course: Discipline Centric Elective |
| Max. Marks: 100 | Min. Passing Marks: 36 |
| Block 1 | Formulation of Linear Programming Problems |
| Unit I | Introduction to Operation Research: Introduction, Phases of OR Problem, Operation Research Modeling Approach, Defining the Problem & Gathering Data, Formulating a Mathematical Models, Deriving Solution from the Model Introduction to Linear Programming, Formulation of a Linear Programming Problem with examples. |
| Unit II | Graphical Method top Solve LPP: Introduction, Graphical Solution to Linear Programming Problem. |
| Block 2 | Simplex Method of Solving LPP |
| Unit III | Simplex Method: Introduction, Principle of Simplex Method, Simplex Method with Several Decision Variables, Two Phase & M-Method, Multiple, Unbounded Solution & Infeasible Problems, Sensitivity Analysis. |
| Unit IV | Duality Problem in LPP: Introduction, Dual Linear Programming Problem, Formulation of a Dual Problem with example. |
| Block 3 | Transportation Problem & Assignment Problem |
| Unit V | Representation of Transportation Problem (Non-Generated & Balanced Cases only) & Assignment Problem as Linear Programming Problem: Introduction of T.P. & A.P., Transportation Problem as LPP, Non-Degenerate Transportation Problem, Balanced Transportation Problem, Assignment Problem &LPP, Balanced Assignment Problem. |

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| Unit VI | Different Methods of Finding Initial Feasible Solution of a Transportation Problem (T.P., MODI Method of Finding Optimal Solution of a T.P.) : Introduction, Basic Feasible Solution of a Transportation Problem, Modified Distribution Method (MODI), Vogel's Approximation Method (VAM), Maximization in a Transportation Problem |
| Unit VII | Solution of Assignment Problem With using Hungarian Method : Introduction, Solution of an Assignment Problem, Hungarian Method, Maximization in an Assignment Problem. |
| Block 4 | Theory of Games |
| Unit VIII | Basic Concepts of Game Theory : Introduction, A Game, Pure & Mixed Strategies, Two- Person Zero- Sum Game, Pay-Off Matrix, Games without Saddle Point and Mixed Strategies, Methods of Solving Game Problems. |
| Unit IX | Dominance Rule, Equivalence of Rectangular Games with Linear Programming: Introduction, Rectangular Games without Saddle Point, Dominance Property of reducing the Size of the Game, Solution Methods of Games without Saddle Point, Equivalence of Rectangular Games with Linear Programming |
| Suggested Text Book Readings: | |
| <ul style="list-style-type: none"> • Taha H.A. (1982) Operational Research: An Introduction; Macmillan. • Hillier F.S. and Lieberman G.J. (1962) Introduction to Operations Research; Holden Day. • Kanti Swarup, Gupta,P.K. and Singh,M.M.. (1985) Operations Research; Sultan Chand & Sons. • Philips D.T.,Ravindran A. and Solberg J.() Operations Research, Principles and Practice. • Churchman C.W., Ackoff R.L. and Arnoff E.L. (1957) Introduction to Operations Research; John Wiley. • Hadley G. (1964) Non-linear and Dynamic programming; • Addison Wesley Murthy K.G. (1976) Linear and Combinatorial Programming; • John Wiley Kleinrock L. (1975) Queueing Systems, vol. 1, Theory; • John Wiley Saaty T.L. (1961) Elements of Queueing Theory with Applications; McGraw Hill • Hadley G. and Whitin T.M. (1963) Analysis of Inventory Systems; Prentice Hall • Starr M.K. and Miller D.W. (1962) Inventory Control-Theory and Practice; Prentice Hall • Mckinsey J.C.C. (1952) Introduction to the Theory of Games; McGraw Hill • Wagner H.M. (1973) Principles of O.R. with Applications to Managerial Decisions; Prentice Hall • Gross, D. Harris,C.M. (1974) Fundamentals of Queueing Theory; John Wiley | |
| This course can be opted as an elective by the students of following subjects: | |
| P.G. in computer science, Data science, Mathematics, MBA and engineering students etc. | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |
| Learner can join this for their own knowledge: https://onlinecourses.nptel.ac.in/noc, Operations Research, Prof. Kusumdeep | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: III | Semester: VI |
| Subject: Statistics | | |
| Course Code: <i>DECSTAT-110(N)(P)</i> | | Course Title: <i>Practical and Viva voce</i> |
| Course Objectives: The main objective of this course is to develop a skill to: understand the practical methods and tests related to estimation of real-life data. | | |
| Course Outcomes: | | |
| CO1: Learner should able to solve the numerical problems related with Operation research. | | |
| CO2: Learner should able to solve the numerical problems related based on descriptive statistics. | | |
| CO3: Learner should able to solve the numerical problems related with Applied Statistics. | | |
| CO4: Learner should able to solve the numerical problems related with official statistics. | | |
| Credits: 2 | Type of Course: Discipline Centric Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Practical work based on DCESTAT-108 (N) and DCESTAT-109 (N) | | |

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| Course prerequisites: For the study of the said course, the learner must fulfill all the eligibility criteria prescribed by the university for the concerned course. | | |
| Programme: B.Sc./B.A. | Year: III | Semester: VI |
| Subject: Statistics | | |
| Course Code: SBSSTAT -04 (N) | Course Title: <i>Numerical Methods & Basic Computer Knowledge</i> | |
| Course Objectives: To study the Numerical Analysis, this is the study of algorithms that use numerical approximation for the problems of mathematical analysis and also the basic knowledge of the computers. To define, design and model; To analyze; To identify the real life applications of stochastic processes. To study various Operational Research Techniques and Models. | | |
| Course Outcomes: | | |
| CO1: This course provides the knowledge of finite differences, interpolation with equal and unequal intervals, Lagrange's Interpolation. | | |
| CO2: Under this course learner will able to understand about the Central Differences, Inverse Interpolation, Numerical Differentiation and also Numerical Integration. | | |
| CO3: Learners also learn about the introduction and history of computers, generations of computers. It gives the knowledge about the hardware and system software.. | | |
| CO4: This course also provides the knowledge about the basic computer programming, concept of algorithm, flow charts and also programming languages.. | | |
| Credits: 4 | | Type of Course: Skill Development |
| Max. Marks: 100 | | Min. Passing Marks: 36 |
| Block 1 | Solutions of Non-Linear Equations in one Variable | |
| Unit I | Basic Properties of Equations: Review of Calculus, Round off Error, Truncation Error, Some properties of equations, Iteration Methods for finding the roots (zero's) of an equation. Convergence Criterion, Initial Approximation to a Root, Bisection Method | |
| Unit II | Solutions of Non-Linear Equations: Fixed Point Iteration Method, Chord Methods for Finding Roots- Regula Falsi Method, Newton Raphson Method. Order of convergence | |
| Block 2 | Finite Differences | |
| Unit III | Finite Differences: Forward Difference Operator, Difference Table, The Operator E, The Operator D, Backward Differences, Factorial Polynomial, Central Differences, Mean Operator. | |
| Unit IV | Interpolation with Equal Intervals: Introduction, Missing Values, Newton- Gregory Forward & Backward Interpolation Formula | |
| Unit V | Interpolation with Un-Equal Intervals: Introduction, Missing Values, Properties of Divided Differences, Newton's Divided Difference Interpolating Polynomial, Error of the interpolation Polynomial Divided Differences and Derivatives | |
| Unit VI | Lagrange's Interpolation: Introduction, Lagrange's Interpolating Polynomial, General Error term or Remainder Term, Linear Interpolation, error in Linear Interpolation | |
| Block 3 | Central Differences | |
| Unit V | Central Difference Interpolation Formulae: Introduction, Gauss Forward & Backward Formulae, Stirling's Formula, Bessel's Formula, Bessel's Formula for halves | |
| Unit VI | Inverse Interpolation: Inverse Interpolation by Lagrange's method, method of Successive Approximation, Method of Reversion of Series | |
| Unit VII | Numerical Differentiation: Introduction, Numerical Differential for Equal Intervals, Numerical Differential for Un-Equal Intervals, Approximation Formulae for the Derivative of a Function. | |
| Unit VIII | Numerical Integration: Introduction, Trapezoidal Rule, Simpson's One-Third Rule, Simpson's Three-Eighth Rule, Waddle's Rule, Euler-Maculerian Formula. | |
| Block 4 | Solution of Differential Equations | |

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| Unit IX | Numerical Solution of Ordinary Differential Equations-I: (first order) by Picard's Iteration Method, Euler's Method, Runge- Kutta Methods- 4 th Order |
| Unit X | Numerical Solution of Ordinary Differential Equations-II: (second order and simultaneous) by Picard's Iteration Method, Euler's Method, Runge- Kutta Methods- 4 th Order. |
| Block 5 | Computer |
| Unit XI | Introduction to Computer : Introduction, Characteristics of computer, Historical Evaluation of Computer, Generation of Computers, Classification of computers. |
| Unit XII | Hardware: Introduction, CPU, Memory Organization, Input-Output Devices |
| Unit XIII | System Software: Introduction, System Software, File Commands, Editing, Commands, Disk Management Commands, Number System |
| Block 3 | Basics of Computer Programming |
| Unit XIV | Algorithm & Flow Charts : Introduction, Algorithm, Flow Charts |
| Unit XV | Programming Language: Introduction, Machine Language, Assembly Language & Assembler, High Level Language, Object Oriented Programming, Programming Language Generation |
| Suggested Text Book Readings: | |
| <ul style="list-style-type: none"> • Guide to current Indian Official Statistics. Central Statistical Organisation, Govt. of India, New Delhi. • Saluja, M.P. () : Indian official statistical systems. Statistical Publishing Society, Calcutta. | |
| This course can be opted as an elective by the students of following subjects: | |
| U.G/P.G. in Business & Commerce, all Life Sciences and Social Sciences subjects students etc | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

Year-2023-2024
Syllabus of B.Sc. Programme: [Subject Name: Zoology]
In accordance with NEP-2020

| Year | Sem. | Course Code | Paper Title | Theory/Practical | Max. Marks. | Credits | |
|---------------------------|------|---|---|--|-------------|-----------|---|
| 1 | I | UGZY-101 (N) | Animal Physiology | Theory | 100 | 2 | |
| | | UGZY-101 (N)(P) | Practical Work | Practical Work | 100 | 2 | |
| | II | UGZY-102 (N) | Diversity of Animal Life | Theory | 100 | 2 | |
| | | UGZY-102 (N)(P) | Practical Work | Practical Work | 100 | 2 | |
| | | Skill Enhancement Course | | | | | |
| | | SBSZY-02(N) | Fundamental of Animal Behavior | | | 4 | |
| 2 | III | UGZY-103 (N) | Genetic and Cell Biology | Theory | 100 | 2 | |
| | | UGZY-103(N) (P) | Practical Work | Practical Work | 100 | 2 | |
| | IV | UGZY-104 (N) | Hemichordata and Chordata | Theory | 100 | 2 | |
| | | UGZY-104 (N)(P) | Practical Work | Practical Work | 100 | 2 | |
| 3 | V | Discipline Centric Elective Course | | | | | |
| | | DCEZY-105(N) | Animal Distribution and ecology | Theory | 100 | 2 | |
| | | DCEZY-106 (N) | Taxonomy and Evolution | Theory | 100 | 2 | |
| | | DCEZY-107 (N)(P) | Practical Work | Practical Work | 100 | 2 | |
| | | Skill Enhancement Course | | | | | |
| | | | SBSZY-03(N) | Economic Zoology and environmental biology | Theory | 100 | 4 |
| | VI | Discipline Centric Elective Course | | | | | |
| | | DCEZY-108 (N) | Developmental Biology | Theory | 100 | 2 | |
| | | DCEZY-109 (N) | Molecular Biology and Genetic Engineering | Theory | 100 | 2 | |
| DCEZY-110 (N) (P) | | Practical Work | Practical Work | 100 | 2 | | |
| Total Marks/Credit | | | | | 1500 | 36 | |

B.Sc.: Subject: Zoology

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: I |
| Subject: Zoology | | |
| Course Code: UGZY-101 (N) | Course Title: Animal Physiology | |
| Course Objectives- The course aim to develop, to knowledge about the structure and functions of various organs in our body. | | |
| Course Outcomes: (CO): | | |
| <ul style="list-style-type: none"> • Animal physiology is comprehensive subject that gives in depth knowledge of various physiological processes of the animal kingdom. • Students gain knowledge about the comparative physiological concepts of nutrition, digestion, respiration and physiological concept of excretion, metabolism and osmoregulation. • Students feel confident in teaching physiology as well as executive research projects. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Physiology I | |
| Unit I | Physiology of Digestion <ul style="list-style-type: none"> • Nutrition – Carbohydrates, Lipids, Proteins, Vitamins and Minerals • Feeding Mechanism • Digestive Tract and process of Digestion • Digestive Enzymes, its Regulation and Control • GIT System • Absorption of products of Digestion | |
| Unit II | Physiology of Respiration <ul style="list-style-type: none"> • Respiratory System • Modes of Respiration • Structural Organization of Lungs and other Respiratory Structures • Process of Gaseous Exchange • Hemoglobin, • Respiratory Gases and its Transport • Regulation of Respiration | |
| Unit III | Circulatory System <ul style="list-style-type: none"> • General plan of Circulatory Systems (Circulation) • Structure of Mammalian Heart • Excitation of Heart • Cardiac Output • Blood Vessels, Arteries, Veins and Capillaries • Blood Flow • Lymphatic System • Haemostatic Mechanisms | |
| Unit IV | Excretory System <ul style="list-style-type: none"> • Nitrogen Excretion with Formation of Ammonia • Ammonotelic, Ureotelic ,Urecotelic Animals • Glomerular Filtration • Reabsorption and Secretion in Renal Tubules • Function and Regulation of Vertebrate Kidney | |
| Block 2 | Physiology II | |
| Unit V | Osmoregulation <ul style="list-style-type: none"> • Functional Principles of Osmoregulation and membrane permeability | |

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| | <ul style="list-style-type: none"> • Problems of Osmoregulation • Osmoregulation in Aqueous (Fresh, Marine) and Terrestrial Environment |
| Unit VI | <p>Nervous System</p> <ul style="list-style-type: none"> • Nervous System and Nerve Cells • Nerve Impulse, Action Potential • Conduction of Nerve Impulse • Synaptic Transmission, Chemical Synaptic Transmission, Post Synaptic Potential • Neurotransmitters • Neural Circuits |
| Unit VII | <p>Muscular System</p> <ul style="list-style-type: none"> • Structure of Vertebrate Skeletal Muscle • Mechanism and Control of Muscle Contraction • Initiation of Muscle Contraction • Cardiac and Smooth Muscle |
| Unit VIII | <p>Endocrine system</p> <ul style="list-style-type: none"> • Hormonal Control Mechanism • Chemical Nature, Synthesis and Storage of Hormones • Secretion of Hormones • Steroid • Thyroid and Peptide Hormones • Neuroendocrine Connection • Hypothalamus and Pituitary • Regulation of Hormones • Pheromones |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Knut Schmidt-Nielsen: Animal physiology 2. Philip C. Withers: Comparative Animal Physiology 3. Christopher D. Moyes and Patricia M. Schulte: Principles of Animal Physiology 4. Ian Kay: Introduction to Animal Physiology 5. Thomas Mills: A text book of animal physiology | |
| <p>This course can be opted as an elective by the students of following subjects: NA</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: NA</p> | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)</p> | |
| <p>Name of electronic media</p> <p>https://youtu.be/d2ab1v7yIBU https://youtu.be/h1PcmyJusQw https://youtu.be/iVV1SXjv7nE https://youtu.be/UAu36gcSNtQ https://youtu.be/E8ns1b0o1s e-SLM</p> | <p>Year of incorporation: 2021-22</p> |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: II |
| Subject: Zoology | | |
| Course Code: UGZY-102 (N) | Course Title: Diversity of Animal Life | |
| Course Objectives- Students will be able to identify and understand the basics of animal biology with a comparative knowledge on the organization of various animals group. | | |
| Course Outcomes:(CO): | | |
| <ul style="list-style-type: none"> • Provides students with an in-depth knowledge of diversity of animal life and their systematic position. • To make them aware of the economic importance of some classes. • To make the students observe the diversity in non chordates. | | |
| Credits: 02 | | Type of Course: Core |
| Max. Marks: 100 | | Min. Passing Marks: 36 |
| Block 1 | Comparative Forms and Functions-I | |
| Unit I | General characters & Classification of Protozoa <ul style="list-style-type: none"> • Locomotory Organelles • Locomotion in Protozoa. • Viruses- a Border Line Case between Living and Non Living things. • Acellular and Cellular Organisms • Prokaryotes and Eukaryotes • Biology of Flagellated Protozoans, Amoeboid Protozoans, Spore Forming Protozoans, Ciliated Protozoans and Parasitic Protozoans | |
| Unit II | Body Organization & Characteristic of Metazoa <ul style="list-style-type: none"> • Symmetry: Asymmetrical, Spherical, Radial, Biradial, Bilateral • Development patterns – Cleavage, Fate of Blastopore and Germ Layers • Body Cavity – Pseudocoelom and Coelom • Origin and Evolution of Metazoa • Syncytial theory, Colonial Theory, Polyphyletic Theory | |
| Unit III | General characters and classification of Porifera, Cnidaria, Ctenophora, Platyhelminthes, Nematoda | |
| Unit IV | General characters and classification of Phylum Annelida, Arthropoda, Mollusca <ul style="list-style-type: none"> • Torsion and Detorsion in mollusca. • Echinodermata- Laval forms in Echinodermata | |
| Block 2 | Comparative Forms and Functions-II | |
| Unit V | Comparative form and Functions : <ul style="list-style-type: none"> • Locomotion : Significance of Hydraulic Pressure in Locomotion, Locomotion in Coelenterates, Flatworms, Nematoda, Annelida & Arthropoda • Mollusca – Foot in mollusca as a Creeping and Crawling organ, burrowing Organ , Leaping organ and Swimming organ • Ambulance system in Echinodermata • Feeding and Digestion in Sponges, Coelenterates • Structure and function of Protonephridia , Metanephridia, Malpighian Tubules and Coelomoducts of Molluscs | |
| Unit VI | Respiratory , Circulatory and Nervous system <ul style="list-style-type: none"> • Respiratory System – Respiratory organs, Process of Respiration , Respiratory Pigments • Circulatory System – Open and closed type of Circulatory System • Organisation of Nervous System – Nerve Cell , Neuroglia , Ganglia • Nervous System in Platyhelminthes , Annelida , Arthropoda and Mollusca | |
| Block 3 | Adaption and Behavioral Pattern | |

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| Unit VII | Reproductive system <ul style="list-style-type: none"> • Reproductive System – Formation of Special Reproductive Unit • Asexual Reproduction – The Gemmules, Regeneration, Autotomy and Regeneration • Epitoky, Polarity and Regeneration • Prevalence and its Significance • Sexual Reproduction and its Patterns. Sexual Dimorphism, The Reproductive Organs • Mating and Fertilization, Ovipary , Vivipary , Ovovivipary , Hermaphroditism • Parthenogenesis and Metagenesis |
| Unit VIII | Adaptive Radiation <ul style="list-style-type: none"> • Colonial forms among Protozoans and Metazoans • Adaptive Radiations in Annelida , Arthropoda and Mollusca • Flight in Insects , Migration in Insects |
| Unit IX | Behavioural patterns <ul style="list-style-type: none"> • Social organization in insects – Advantage and disadvantage of Social Behavior • Kinds of Honey Bees , Production of Honey, Composition of Honey, Honey Production in India • Industrial Products – Silk , Lac, Bees Wax, Pearl, Sponge , Dyes and Pigments |
| Unit X | Harmful and beneficial Non-Chordates <ul style="list-style-type: none"> • Parasitic Platyhelminthes – Nematoda • Parasitic Nematoda • Economic importance of Arthropods : in agriculture, soil fertility, pollination, pest management, food chain, scavenger |
| Suggested Text Book Readings: <ol style="list-style-type: none"> 1. Barnes et al (2009), The Invertebrates: A synthesis, Wiley Backwell 17 2. Hunter; Life of Invertebrates (1979, Collier Macmillan) 3. Marshall: Parker & Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan) 4. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press) 5. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill 6. Thomas C. Chung. General Parasitology. Hardcourt Brace and Co. Ltd., Asia, New Delhi. 7. Bisht. D.S. <i>Apiculture</i>, ICAR Publication. | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |
| Electronic media and other digital components in the curriculum: Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media e-SLM | Year of incorporation: 2021-22 |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: III |
| Subject: Zoology | | |
| Course Code: SBSZY-02 (N) | Course Title: Fundamental of Animal Behavior | |
| Course Objectives- To understand the natural behavioral of various animals. Knowledge the difference between innate and learned behavioural. | | |
| Course Outcomes (CO): | | |
| <ul style="list-style-type: none"> • By the completion of this course, students will be expected to gain a comprehensive understanding of the behavior of animals. • To describe innate Taxes, Reflexes, Instincts and Motivation, Kinesis. • To describe the social behavior and parental care in fish and amphibia. • Understand types of animal behavior and there importance to the organisms. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Fundamental of Animal Behavior – I | |
| Unit I | General Survey of Various Kinds of Animal Behavior <ul style="list-style-type: none"> • General Survey of Various Kinds of Animal Behavior, Types of Innate Behavior - Taxes, Reflexes, Instincts and Motivation, Kinesis. | |
| Unit II | Types of Behavior <ul style="list-style-type: none"> • Types of Learned Behavior Habituation, Imprinting, Conditioned Reflexes, Trial and Error, Latent Learning, Reasoning. | |
| Unit III | Introduction and Basic Mechanism of Behavior <ul style="list-style-type: none"> • Introduction and Basic Mechanism of Behavior- Role of Nervous System, Hormones, Pheromones and Genetics in Behavior, Difficulties in Studying Behavior Study of Human Behavior | |
| Unit IV | Social Behavior in Insects <ul style="list-style-type: none"> • Social Behavior in Insects, Social structure and functioning of Bees and Termites. | |
| Block 2 | Fundamental of Animal Behavior - II | |
| Unit V | Parental Care in Fishes and Amphibia <ul style="list-style-type: none"> • Parental Care in Fishes and Amphibia, Maternal Vs Paternal care | |
| Unit VI | Nest Building <ul style="list-style-type: none"> • Nest Building, Nesting and Brooding Behavior in Birds | |
| Unit VII | Migration in Fishes and Birds <ul style="list-style-type: none"> • Migration in Fishes and Birds- physiological and behavioral changes. Cost and benefits of migration. | |
| Unit VIII | Biological Clock <ul style="list-style-type: none"> • Biological Clock, Colouration, Mimicry, Adaptation and anti-predator behavior. | |
| Suggested Text Book Readings: | | |
| <ol style="list-style-type: none"> 1. Animal behavior by Reena Mathur 2. The marvels of Animal Behaviour, A publication of National Geographic Society, Washington, DC, USA. 3. Wildlife Wealth of India (Resources and Management), Edited By T.C. Mojurpuria. Published and Distributed By: Tecpress Service, Bangkok, Thailand. 4. Wildlife in India, By V.B. Saharia, Natraj Publishers, Dehradun. 5. Indian Wildllife, Edited By Samuel Israel and Toby Sinclair. Directed and Designed By Hans Johannes Hoefler, Singapore. 6. Animal behaviour (ethology) by V.K. Agrawal. 7. Animal Social Behaviour, By James F Wittenberger Duxbury Press, Boston, USA. 8. Animal Behaviour: An Evolutionary Approach, By John Alcock. Sinaver Associates, Inc, USA. 9. Sociology, By Edward O. Wilson. The Bellknap Press, USA. | | |
| This course can be opted as an elective by the students of following subjects: NA | | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | | |
| Electronic media and other digital components in the curriculum: | | |
| Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | | |
| Name of electronic media e-SLM | Year of incorporation: 2021-22 | |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: III |
| Subject: Zoology | | |
| Course Code: UGZY-103 (N) | Course Title: Genetics and Cell Biology | |
| Course Objectives- Students can understand the structure and functions of cell organelles. To understand the cellular components underlying the process of cell division in both somatic and germ cell. | | |
| Course Outcomes (CO): | | |
| <ul style="list-style-type: none"> • Structural and functional aspects of basic unit of life i.e. cell concepts. • Concepts behind genetic disorder, gene mutations, various causes associated with inborn errors of metabolism. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Genetics | |
| Unit I | Molecular basis of genetic information <ul style="list-style-type: none"> • Genetic Variation, Molecular basis of genetic information • Human Chromosomes and Human Chromosomal Abnormalities • Sex Linkage and Determination in Drosophila and Man • Sex Chromatin Bodies • Dosage Compensation and Lyon's hypothesis | |
| Unit II | Blood group, DNA and RNA <ul style="list-style-type: none"> • Blood group and haemoglobin, Genetics in Man Inborn Errors of Metabolism in Man • DNA and RNA structure • Harchey chase experiment • Replication of DNA – Messelson and Stahl's Experiment | |
| Unit III | DNA Polymerase and In Vitro DNA Synthesis, Transcription, Genetic Code, Gene Cloning Experiment <ul style="list-style-type: none"> • DNA Polymerase and in Vitro DNA synthesis • Transcription • Genetic Code • Gene Cloning Experiment | |
| Block 2 | Cell Biology | |
| Unit IV | Cell Biology & Microscopy <ul style="list-style-type: none"> • Definition and history of Cell Biology • Microscopy – Light Microscopy and Electron Microscopy (Fundamental of TEM and SEM) • Principle of Fixation, Staining and Autoradiography | |
| Unit V | Plasma Membrane, Nucleus and Cell cycle <ul style="list-style-type: none"> • Cell Cycle – Mitosis and Meiosis , Nucleus , Nuclear Membrane and Nucleolus • Structure and Function of Plasma Membrane (Passive Transport and Active Transport) | |
| Unit VI | ENDOPLASMIC RETICULUM, RIBOSOMES <ul style="list-style-type: none"> • Endoplasmic Reticulum – Morphology, Ultrastructure • Types of Endoplasmic Reticulum <ul style="list-style-type: none"> □ Smooth ER and Rough ER • Origin of ER | |

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| | <ul style="list-style-type: none"> • Function of ER • Ribosomes – Occurrence and Distribution • Types Of Ribosomes <ul style="list-style-type: none"> □ 70s Ribosomes □ 80s Ribosomes • Structure of Ribosomes • Dissociation and Reconstitution of Ribosomes |
| Unit VII | <p>Golgi body & Lysosomes</p> <ul style="list-style-type: none"> • Golgi Body – Occurrence , Distribution , Morphology , Chemical Composition , Origin and Function • Lysosomes – Chemical Composition , Lysosomal Enzymes , Lysosomal Membrane • Kinds of Lysosomes – Primary and Secondary Lysosomes • Origin and Function of Lysosomes • Lysosomes and Disease |
| Unit VIII | <p>Mitochondria</p> <ul style="list-style-type: none"> • Origin of Mitochondria • Mitochondria – Morphology, Chemical Composition • Function of Mitochondria • Mitochondria as Semi Autonomous Organelles |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. John Morrow: Eukaryotic Cell Genetics 2. Gunter Ed Obe: Cytogenetics: Basic & Applied Aspects 3. Frederic Hecht: Textbook of cytogenetics 4. H C MacGregor: Introduction to Animal Cytogenetics 5. Barbara Hamkalo : Molecular Cytogenetics. 6. Cell Biology And Genetics (Hindi) 2/e PB....Gupta P K (Hindi) rastogi Publications 7. Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0066-1 Sunil D Purohit & Gotam K Kukda, Apex Publishing House 8. Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House 9. Padaprajanan (Hindi) Hardcover – 1 January 2016 by Chandra Prakash Shukl (Author) Pointer Publishers, Jaipur | |
| <p>This course can be opted as an elective by the students of following subjects: NA</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: NA</p> | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation: 2021-22</p> |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: IV |
| Subject: Zoology | | |
| Course Code: UGZY-104 (N) | Course Title: HEMICHORDATES & CHORDATES | |
| Course Objectives- To understand different categories of chordates. To understand general characters of chordates and affinities of hemichordates and chordates. To understand the comparative anatomy of chordates. | | |
| Course Outcomes: (CO): | | |
| <ul style="list-style-type: none"> • Imparts conceptual knowledge of vertebrates • Classify phylum protochordata to mammalia. • Understanding of origin and salient features of Ostracodrms to Actinopterygii, adaptive radiation of amphibian, reptiles, birds and mammals. • To make the student observe the diversity in chordates and their systematic position. • To make them aware the economic importance of some classes. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | HEMICHORDATES & CHORDATES | |
| Unit I | Hemichordata and Cephalochordata General Characters of Hemichordata and Affinities of Balanoglossus Classification and Detailed Study (Habits, Morphology, Anatomy and Physiology) of Branchiostoma | |
| Unit II | UROCHORDATA Classification and Detailed Study (Habits, Morphology, Anatomy, Physiology and Post Embryonic Development) of Herdmania | |
| Unit III | FISH , Amphibia & Reptilia Classification and Detailed Study (Habits, Morphology, Anatomy and Physiology) of Scoliodon General Characters and Classification of Amphibia and reptilian up to Order with examples | |
| Unit IV | General Characters and Classification of Aves Up To Order With Examples, Flying Adaptations In Birds | |
| Block 2 | Functional Anatomy of Chordates | |
| Unit V | Comparative Anatomy of vertebrates Histology , Comparative Study Of Integument And Skeleton | |
| Unit VI | Digestive system & Respiratory system Brief Account of Alimentary Canal And Digestive Glands in vertebrates Brief Account of Gills and Air Sacs, Swim Bladder | |
| Unit VII | Circulatory system & Urinogenital system Evolution of Heart And Aortic Arches in vertebrates Succession of Kidney , Evolution Of Urinogenital Ducts | |
| Unit VIII | Nervous system & Sense Organs Comparative Account Of Brain Types Of Receptors | |
| Suggested Text Book Readings: | | |
| <ol style="list-style-type: none"> 1. Harvey et al: The Vertebrate Life (2006) 2. Kenneth V. Kardong (2015) Vertebrates: Comarative Anatomy, Function, Evolution McGraw Hill 3. Parker and Haswell: Textbook of Zoology, Vol. II (1978, ELBS) 4. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan) 5. Young: The life of vertebrates (3rd ed 2006, ELBS/Oxford) | | |
| This course can be opted as an elective by the students of following subjects: NA | | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | | |
| Electronic media and other digital components in the curriculum: Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | | |
| Name of electronic media: e-SLM | | Year of incorporation: 2021-22 |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: V |
| Subject: Zoology | | |
| Course Code: DCEZY-105 (N) | Course Title: Animal Distribution and Ecology | |
| Course Objectives- Students will be able to distribution of fauna in different realms interaction branches of ecology and various kinds of animals adaptations. | | |
| Course Outcomes:(CO): | | |
| <ul style="list-style-type: none"> • Knowledge about branches of ecology and animal distribution. • Knowledge of eras and evolution of species. • Understand the concept of environment, ecology and ecosystem • Structure and organization of ecosystem with biotic and abiotic component. • Energy flow and nutrient cycle in ecosystem and various kinds of animal adaptations. • Community, population and role of ecology in human welfare. | | |
| Credits: 02 | Type of Course: Core (√) /Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Animal distribution | |
| Unit I | Geological and Geographical <ul style="list-style-type: none"> • Animal Distribution – Geological and Geographical Distribution of Animals , with their Characteristic Fauna | |
| Unit II | Fossils, Barriers and Dispersal | |
| Block 2 | Ecology – I | |
| Unit III | Branches and significance of Ecology <ul style="list-style-type: none"> • Ecology – Definition, Branches of Ecology , Significance of Ecology For Man • Growth of Animal Ecology, • Desert Ecology • Pollution Ecology | |
| Unit IV | Atmosphere – Hydrosphere & Lithosphere <ul style="list-style-type: none"> • Various Zone of Atmosphere • Hydrosphere (Water) – Physical and Chemical Properties Of Water • Effect of Factor of Aquatic Environment On Aquatic Organisms • Lithosphere (Soil) – Process of Soil Formation • Soil Types, Morphology of Soil • Physical and chemical, Properties of Soil • Soil Fauna and Flora | |
| Unit V | Ecological Environmental Factors <ul style="list-style-type: none"> • Ecological Environment, Factors (Biotic and abiote) and Limiting Factors • Component of Ecosystem , Tolerance Range And Limiting Factor , Tropic Level | |
| Block 3 | Ecology – II | |
| Unit VI | Ecological Pyramids & Biogeochemical Cycle <ul style="list-style-type: none"> • Ecological Pyramids • Energy Flow • Food Chain and Food Web • Biogeochemical Cycle | |
| Unit VII | Population Ecology | |

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| | <ul style="list-style-type: none"> ● Population Dynamics – Density , Natality , Mortality , Age Distribution , Population Distribution ● Population Growth – Factors Affecting Biotic Potential , Carrying Capacity ● Population Regulation |
| Unit VIII | Adaptation <ul style="list-style-type: none"> ● Adaptation of Animals In Deserts and Fresh Water |
| Unit IX | Wildlife Conservation <ul style="list-style-type: none"> ● Wildlife Conservation – Defining Wildlife , Treats to Wildlife , Measures For Conservation of Wild Life |
| Suggested Text Book Readings: <ol style="list-style-type: none"> 1. Clarke: Elements of Ecology 2. Eugene P. Odum: Ecology 3. Edmond Hillary: Ecology 4. Allan Frewin Jones: Environmental Biology 5. P.S. Verma and V.K. Agrawal: Environmental Biology (Principles of Ecology) 6. Environmental Biology and Phytogeography ISBN #: 978-81-301-0064-7B. L. Chaudhary, Gotam K Kukda& Jitendra Kumar Joshi 7. Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders 8. Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications 9. Ambasht, R.S. & Ambasht, N.K. A Text Book of Plant Ecology, Latest Ed., CBS Publication & Distributors 10. Mani, M.S. Bio-Geography of India, Latest Ed., Springer-Verlag. | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |
| Electronic media and other digital components in the curriculum: Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: e-SLM | Year of incorporation: 2021-22 |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: V |
| Subject: Zoology | | |
| Course Code: DCEZY-106 (N) | Course Title: Taxonomy and Evolution | |
| Course Objectives- This paper to introducing the learner for the salient features of Taxonomy and Evolution. | | |
| Course Outcomes:(CO): | | |
| <ul style="list-style-type: none"> • To give a through understanding in the functional principles of systematic in which the animals are, to classify according to their characters and international rules of nomenclature. • Introduction of Elementary statistics • Understanding of origin of life. | | |
| Credits: 02 | | Type of Course: Core |
| Max. Marks: 100 | | Min. Passing Marks: 36 |
| Block 1 | Taxonomy and Evolution – I | |
| Unit I | Taxonomy and biological species concept <ul style="list-style-type: none"> • Principle of Systematics and Taxonomy • Biological Species Concept • Taxonomy practices | |
| Unit II | Evidences of evolution and comparative anatomy <ul style="list-style-type: none"> • Evidences of evolution from classification (taxonomy), • Comparative anatomy, connecting link, homology, analogy and vestigial organ | |
| Unit III | Evidences of evolution from comparative embryology, physiology and biochemistry <ul style="list-style-type: none"> • Evidences of evolution from comparative embryology, • comparative physiology and biochemistry | |
| Block 2 | Taxonomy and Evolution – II | |
| Unit IV | Classification and population taxonomy <ul style="list-style-type: none"> • Objectives of classification, Theories of classification, grouping and ranking, diversity of individuals, principle of hierachy, population taxonomy, information retrieval | |
| Unit V | Modern concept in taxonomy <ul style="list-style-type: none"> • Taxonomic and non-taxonomic attributes, morden concepts in taxonomy. | |
| Unit VI | International code of Zoological nomenclature <ul style="list-style-type: none"> • Definitions, Uses and application of international code of zoological nomenclature | |
| Unit VII | Elementary Statistics <ul style="list-style-type: none"> • Elementary statistics, Mean, Median and Mode, Measures of dispersion variation, Standard deviation) | |
| Unit VIII | Origin of Life, Mutation, Migrations, Isolation <ul style="list-style-type: none"> • Origin of life, synthetic theory of evolution, selection , mutation, migration, genetic drit, mimicry isolation and speciation | |
| Suggested Text Book Readings: <ol style="list-style-type: none"> 1. Verma A.: Principles of Animal taxonomy 2. Futuyama, D.J. Evolution 3. Lull, R.S. Organic Evolution. 4. Organic evolution by A.K. Berry. 5. Richard E. Blackwelder: Taxonomy: a Text and Reference book. | | |
| This course can be opted as an elective by the students of following subjects: NA | | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | | |
| Electronic media and other digital components in the curriculum: Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | | |
| Name of electronic media: e-SLM | | Year of incorporation: 2021-22 |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: V |
| Subject: Zoology | | |
| Course Code: SBSZY-03 | Course Title: Economic Zoology and environmental biology | |
| Course Objectives- The main objectives of the course is to make learner aware of economic important of various invertebrates and scope and methodology of aquaculture. | | |
| Course Outcomes:(CO): | | |
| <ul style="list-style-type: none"> • Economic uses of various animal products. • Understand morphology, life cycle and economic important protozoa, platyhelminthes aschelminthes and Arthropods. • Understands concepts of fisheries, fishing tools and site selection. • Aquaculture system, induced breeding techniques, post harvesting techniques. | | |
| Credits: 02 | Type of Course: Core (√) /Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Economic Zoology | |
| Unit I | Protozoa <ul style="list-style-type: none"> • Protozoan Parasitic Diseases Of Man And Domestic Animals With Special Reference To Zoonotic Significance Of Entamoeba histolytica Plasmodium • Protozoa And Soil Fertility | |
| Unit II | PLATYHELMINTHES & ASCHELMINTHES <ul style="list-style-type: none"> • Life Cycle and Zoonotic Significance of Diphyllbothrium latum • Life Cycle and Zoonotic Significance of Dracunculus medinensis | |
| Unit III | Arthropoda <ul style="list-style-type: none"> • Life Cycle and Zoonotic Significance of Representation Tick And Mite • Beneficial and Harmful Insects | |
| Unit IV | Plant and stored grain pest and role of insecticides in their control <ul style="list-style-type: none"> • Interrelationship of mosquito with Malaria, Yellow fever, Dengue, Encephalitis and Dermatobia, their presentation and control • Biological control of insect pests | |
| Block 2 | Environmental Biology | |
| Unit V | Aquaculture <ul style="list-style-type: none"> • Its Basic Concepts , Management and Economics(Including Pearl Fishery) | |
| Unit VI | Air Pollution <ul style="list-style-type: none"> • Nature of Pollutants , Their Sources and Effects On Humans , Plants And Animals And Their Control | |
| Unit VII | Water Pollution& Soil Pollution <ul style="list-style-type: none"> • Sources , Consequences And Control • Sources , Nature And Harmful Effects | |
| Unit VIII | Environmental Health <ul style="list-style-type: none"> • Animal In Relation To Human Health • Water In Relation To Human Disease • Urbanisation Stress And Health • Behaviour Patterns Of Health And Disease | |
| Suggested Text Book Readings: | | |
| <ol style="list-style-type: none"> 1. Harvey et al: The Vertebrate Life (2006) 2. Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS) 3. Romer and Parsons: The Vertebrates Body (6th ed 1986, CBS Publishing Japan) 4. Brusca and Brusca (2016) Invertebrates, Sinauer. 5. Bisht. D.S. Apiculture, Oxford and IBH, New Delhi. 6. Boyd, C.E. & Tucker. C.S., Pond aquaculture water quality management. | | |

7. Pedigo, L.P. (2002), Entomology and Pest Management, Prentice Hall.
8. Ranganathan L.S., Vermicomposting technology-soil health to human health.
9. Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5th edition. The wildlife Society, Allen Press.

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Electronic media and other digital components in the curriculum:
 Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)

Name of electronic media: e-SLM

Year of incorporation:
2021-22

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: VI |
| Subject: Zoology | | |
| Course Code: DCEZY-108 (N) | Course Title: Development Biology | |
| Course Objectives- The main objective of course, students are able to know various stages involved in the embryonic development. To study of process of fertilization and development of various organs. | | |
| Course Outcomes:(CO): | | |
| <ul style="list-style-type: none"> • Knowledge about development biology and organogenesis • Gain knowledge about gametogenesis, cleavage mechanisms, gastrulation and role of hormones in metamorphosis and regeneration. • Understanding of evolutionary significance of internal fertilization, neoteny etc. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Development Biology – I | |
| Unit I | Asexual reproduction (fission, budding, gemmule formation) <ul style="list-style-type: none"> • The Morphogenetic Processes And The Stages (Blastema ,Blastogenesis ,And Blastozooides), The Kinds (Fission , Budding , Gemmule Formation) And Comparion Between Blastogegesis And Embryogenesis | |
| Unit II | Sexual reproduction (spermetogenesis, oogenesis and vitellogenesis) Gametogenesis (Spermatogenesis And Oogenesis) Maturation Of Gametes : Vitellogenesis | |
| Unit III | Parthenogenesis | |
| Unit IV | Metamorphosis The Morphogenetic Processes And Cauation In Amphibians And Insects , Tissue Reactivity | |
| Block 2 | Development Biology – II | |
| Unit V | Induction process (factors controlling moultingin insects) | |
| Unit VI | Regeneration (Ability of regeneration, amphibian limb regeneration) The Morphogenetic Process In Regeneration ,Ability Of Regeneration In Different Group Of Animal , Amphibian Limb Regeneration | |
| Unit VII | Growth and Ageing Concept Of Growth , Degrowth And Cell Death , Mechanism Of Growth | |
| Unit VIII | Growth curve and its interpretation (types of cell growth, ageing) | |
| Suggested Text Book Readings: | | |
| <ol style="list-style-type: none"> 1. Essential Development Biology, Johnahan, M.W. Slack (3rd ed.), Welly Blackwell. (2012) 2. Current Topics in Development Biology: Roger A, Pedersen, Gerald P. Schatten, Elsevier. (1998) 3. Development Biology: Werner A. Moller, Springer Science & Business Media. (2012) 4. Development Biology: Michael J. F., Barresi, Scott F. Gilbert, Oxford University Press (2019) | | |
| This course can be opted as an elective by the students of following subjects: NA | | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | | |
| Electronic media and other digital components in the curriculum: Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | | |
| Name of electronic media: e-SLM | Year of incorporation: 2021-22 | |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: VI |
| Subject: Zoology | | |
| Course Code: DCEZY-109 (N) | Course Title: Molecular Biology & Genetic Engineering | |
| Course Objectives- This paper to the aimed to introduce molecular biology & genetic engineering. | | |
| Course Outcomes:(CO): | | |
| <ul style="list-style-type: none"> • Imparts the knowledge to culture animal cells in artificial media. • Use in recombinant DNA technology, genetic manipulations and in a variety of industrial processes. • Types of immunity, antigens-antibodies and their properties. • Applications of DNA technology and molecular biology for research. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Molecular Biology & Genetic Engineering – I | |
| Unit I | Prokaryotic and Eukaryotic genome <ul style="list-style-type: none"> • Eukaryotic genome and its organization, unique and repetitive DNA, recombination and chromosome mapping in bacteria and virus, Molecular basis of gene regulation in prokaryotes inducible repressible system | |
| Unit II | Concept of immunology <ul style="list-style-type: none"> • Introduction to Basic Concepts In Immunology • Components of Immune System • Principles of Innate and Adaptive Immune System • Haemopoiesis • Cells of Immune System and Organs(Primary And Secondary Lymphoid Organs)of The Immune System | |
| Unit III | Basic properties of Antigens, Immune System and disorders <ul style="list-style-type: none"> • Basic Properties of Antigens • B and T Cells • The Immune System and disease, HIV • Antigen Antibody Interactions as Tools for Research and Diagnosis | |
| Unit IV | Gene regulation in somatic cells, Antibody structure and classes <ul style="list-style-type: none"> • Gene Regulation in Heterokaryons and Somatic Cells • Somatic Hybridization And Studies In Malignancy • Structure, Classes And Functions Of Antibodies • Monoclonal Antibodies • Structure And Function Of MHC | |
| Block 2 | Molecular Biology & Genetic Engineering – II | |
| Unit V | Immune system and disease, various types of vaccines | |
| Unit VI | Scope of genetic engineering and nucleotides <ul style="list-style-type: none"> • Scope of Genetic Engineering • Restriction Enzymes And Their Uses In Gene Cloning • Nucleotide Sequencing Isolation And Ananalysis Of mRNA and cDNA Probes and Their Synthesis | |
| Unit VII | Recombinant DNA Technology <ul style="list-style-type: none"> • In Vitro Synthesis of Recombinant DNA And Gene Cloning Techniques • Non Coding Intervening Sequences Within Eukaryoticgenes • Application Of Recombinant DNA Technology • Microinjecting Gene Into Animal Oocytes , Eggs And Embryos | |
| Suggested Text Book Readings: | | |
| <ol style="list-style-type: none"> 1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004), 2. Albert et al: Molecular Biology of the cell: Garland (2002) 3. Karp: Cell and Molecular Biology: Willey (2002), Pierce B. Genetics. Freeman (2004) 4. Lewin B. Genes VIII, Pearson (2004). 5. Waston et al. Molecular Biology of the Gene. Pearson (2004) | | |

6. Thomas J, Kindit, Richard A. Goldsby, Barbara A. Osborne, Janis Kubykuby Immunology, W H Freeman (2007).
7. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition, Wiley Blackwell (2017).
8. Primrose, SB. 1995. Principles of Genome Analysis. Blackwell Science Ltd.Oxford, UK.
9. E.J. Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, Ney York.
10. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008 Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.
11. P.K. Gupta. BIOTECHNOLOGY AND GENOMICS. Rastogi Publications, 7th Reprint (1st Edition): 2016-2017.
12. A Textbook of Basic and Molecular Genetics (pb)ISBN : 9788188826193Edition : 01Year : 2018Author : Dr. Parihar P

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

Electronic media and other digital components in the curriculum:

Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)

Name of electronic media: e-SLM

Year of incorporation:
2021-22

Year-2023-2024

Syllabus of B.Sc. Programme: [Subject Name: Biochemistry]

In accordance with NEP-2020

| Year | Semester | Course Code | Title of Paper | Theory/ Practical | Credits | Max. Marks | |
|--------------------------------|----------|---|-----------------------------------|----------------------|-----------|---------------|--|
| 1 | I | UGBCH -101N | Introduction to biochemistry | Theory | 2 | 100 | |
| | | UGBCH -101(P)N | Practical Work | Practical | 2 | 100 | |
| | II | UGBCH -102N | Nutritional biochemistry | Theory | 2 | 100 | |
| | | UGBCH -102(P)N | Practical Work | Practical | 2 | 100 | |
| 2 | III | UGBCH -103N | Intermediary metabolism | Theory | 2 | 100 | |
| | | UGBCH -103(P) | Practical Work | Practical | 2 | 100 | |
| | | Skill Enhancement Course | | | | | |
| | | SBSBCH- 01N | Bio-analytical techniques | Theory | 2 | 100 | |
| | IV | UGBCH -104N | Enzymology | Theory | 2 | 100 | |
| | | UGBCH -104(P)N | Practical Work | Practical | 2 | 100 | |
| 3 | V | Discipline Centric Elective Course | | | | | |
| | | DCEBCH -105N | Microbiology | Theory | 2 | 100 | |
| | | DCEBCH -106N | Spectroscopy | Theory | 2 | 100 | |
| | | DCEBCH -107(P)N | Practical Work Based on 105 & 106 | Practical | 2 | 100 | |
| | VI | Discipline Centric Elective Course | | | | | |
| | | DCEBCH -108N | Plant biochemistry | Theory | 2 | 100 | |
| | | DCEBCH -109N | Immunology | Theory | 2 | 100 | |
| | | DCEBCH -109(P)N | Practical Work Based on 108 & 109 | Practical | 2 | 100 | |
| | | Skill Enhancement Course | | | | | |
| | | SBSBCH-04N | Clinical biochemistry | Theory | 4 | 100 | |
| Total Credit/Max. Marks | | | | | 34 | 1600 | |

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| Programme: B.Sc. | Year: First | Semester: I |
| Subject: Biochemistry | | |
| Course Code: UGBCH-101N | Course Title: Introduction to Biochemistry | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To discuss the basics of outline of biochemistry • To discuss the solvent properties of water of biochemical reactions • To discuss the protein that is the building block of living being • To discuss the basic concept of cell organelles and its role in biochemical functions | | |
| Course Outcomes: | | |
| CO 1: Able to understanding of history and scope of Biochemistry in brief. | | |
| CO 2: Learn about water properties and role of it in living beings. | | |
| CO 3: To know about cell structure and their functions | | |
| CO 4: Able to understanding the structure and functions of various cell organelles. | | |
| CO 5: Also able to understand the amino acid structure and its classification, and also know how amino acids play important role in proteins formation. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Life History and Cell Structure | |
| Unit I | Introduction to biochemistry: The origin of biochemistry and unity of life- History, scope and current prospective of biochemistry, unique properties of water, weak interactions in aqueous systems, ionization of water, buffers | |
| Unit II | Cell structure and functions Prokaryotic and eukaryotic cell, animal and plant cells, units of measurement, light microscope and electron microscope, centrifugation for subcellular fractionation. | |
| Unit III | Cell organelles: Structure and functions of cell nucleolus, Endoplasmic reticulum, Golgi complex, Lysosome, mitochondria, chloroplasts and peroxisomes. | |
| Block 2 | Amino Acids, Proteins and Carbohydrate | |
| Unit IV | Amino Acids: General introduction, classification, structure and functions of amino acids, basic properties of amino acids. | |
| Unit V | Proteins the basic molecules: Nature, classification and types of protein structure, Peptides classification and conformational structure | |
| Unit VI | Carbohydrates: General introduction, classification and structure, monosaccharides - structure of aldoses and ketoses, ring structure of sugars, formation of disaccharides, polysaccharides. | |
| Block 3 | Lipids, Nucleic Acids and Vitamins | |
| Unit VII | Lipids: | |

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| | General introduction, classification, building blocks of lipids - fatty acids, glycerol, ceramide, structure of fatty acids and their derivatives. |
| Unit VIII | Nucleic acids: Nucleotides and nucleosides-structure and properties, nitrogenous bases: purines and pyrimidines, structure of DNA and RNA. |
| Unit IX | Vitamins: Types and functions, structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021. 2. Dr J L Jain, "Fundamentals of Biochemistry" S. Chand and Company-2020. 3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular Biology" S. Chand Publication-2016. 4. Talwar and Srivastava, "Textbook of Biochemistry and Human Biology" Eastern Economy Edition, Prentice Hall, India-2002. 5. Satyanarayana U., "Biochemistry" Elsevier India,2021 | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Cell Organelles: Cell Organelles Notes.pdf (gwisd.us) 2. Carbohydrates: CARBOHYDRATES (dHINGCOLLEGEONLINE.CO.IN) 3. Amino Acids: Microsoft Word - Amino Acids Peptides Proteins Notes (srmist.edu.in) 4. Vitamins: https://www.pearsonhighered.com/assets/samplechapter/0/1/3/2/0132181630.pdf | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counseling/VirtualClasses/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: Youtube | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: First | Semester: II |
| Subject: Biochemistry | | |
| Course Code: UGBCH-102N | Course Title: Nutritional Biochemistry | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To discuss the basic elements of nutrition. • To discuss the basal metabolic rate and measurement of fuel value of foods. • To discuss the biological oxidation of foodstuff. • To discuss the basic concept of micro and macro nutrition | | |
| Course Outcomes: | | |
| CO 1: Able to know the basic concept of different nutrition and energy in brief. | | |
| CO 2: Able to understand the role of different nutrients in growth of living beings. | | |
| CO 3: Learn about cell structure and their functions. | | |
| CO 4: Learn about the concept of digestion of carbohydrates, proteins and fats. | | |
| CO 5: Also know the structure of proteins, carbohydrates and lipids. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Nutrition and oxidation of foodstuff | |
| Unit I | Elements of Nutrition: Dietary requirements of carbohydrates, lipids and proteins. Essential amino acids, essential fatty acids, Malnutrition. | |
| Unit II | Basal Metabolic Rate (BMR): Concept of BMR, factors affecting BMR, measurement of fuel value of foods. basal and resting metabolism, physical activity, energy balance. | |
| Unit III | Biological oxidation of foodstuff: Measurement of energy content of food, physiological energy value of foods, measurement of energy expenditure, factors affecting thermogenesis. | |
| Block 2 | Nutrition of carbohydrates, Proteins and Vitamins | |
| Unit IV | Dietary carbohydrate: Functions, digestion, absorption, storage and utilization of carbohydrates, hormonal regulation of blood glucose. | |
| Unit V | Proteins: Sources, functions, digestions and absorptions, essential and nonessential amino acids, antagonism, toxicity and imbalance, effects of deficiency and kwashiorkor. | |
| Unit VI | Minerals and Vitamins: Nutrition importance of dietary calcium; phosphorus; magnesium; iron; iodine; zinc and copper, requirements and deficiency diseases associated with vitamin B Complex, C A,D, E and K. | |
| Block 3 | Food and drugs integration | |
| Unit VII | Lipids and fats: | |

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| | Role of lipid in dietary supplement. Dietary fiber, role of fibre in lipid metabolism, blood glucose level and GI tract functions, role of saturated fat. Sources, functions, digestions and absorptions of fats, types of fats dietary fats, role of omega-3 fatty acids in living human body, essential and nonessential fatty acids. |
| Unit VIII | Food and drug interactions: Nutrient interactions affecting ADME of drugs, alcohol and nutrient deficiency, antidepressants, psychoactive drugs and nutrient interactions. |
| Unit IX | Nutritional status: Anthropometric measurements, biochemical assessment, reactive oxygen species (ROS), glycosylated Hb, differential diagnosis of B ₁₂ and foliate. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021. 2. Sharma D C, Nutritional Biochemistry, CBS Publications 3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular Biology)" S. Chand Publication-2016. 4. Tom Brody, Nutritional Biochemistry, Second edition, University of California at Berkely 5. Satyanarayana U., "Biochemistry" Elsevier India,2021 | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Metabolism: Instruction Metabolism 1 Medicine V1.Pdf (Umed.Wroc.Pl) 2. Bmr: Basal Metabolic Rate (Upsmfac.Org) 3. Minerals and vitamins: https://sightandlife.org/wp-content/uploads/2017/03/sal_mvlex_web.pdf 4. Food and drug interactions: https://www.omjournal.org/images/75_m_deatials_pdf_.pdf 5. Nutritional status: PowerPoint Presentation (zmchdahod.org) | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: | |
| 1. Nutritional and Clinical Biochemistry - Course (swayam2.ac.in) | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: YouTube | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: Second | Semester: III |
| Subject: Biochemistry | | |
| Course Code: UGBCH-103N | Course Title: Intermediary Metabolism | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To discuss the basic outline of bioenergetics • To discuss the concept of metabolism. • To discuss the concept of thermodynamics • To discuss the basic concept of metabolism of proteins, carbohydrates and lipids | | |
| Course Outcomes: | | |
| CO 1: Able to understanding the concept of bioenergetics and metabolism | | |
| CO 2: Know to the concept of phosphorylation, and ATP cycle | | |
| CO 3: Able to know Glycolysis and Kreb's cycle | | |
| CO 4: Learn about the structure and functions of chloroplast and mitochondria. | | |
| CO 5: Able the understand the concept of photosynthesis and photosystem I and II. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Bioenergetics and Thermodynamics | |
| Unit I | Bioenergetics: Introduction to bioenergetics, photochemical reaction in plants, chemical energy of organic substance. | |
| Unit II | Thermodynamics: Notions and laws of thermodynamics, state functions, equilibrium constant, coupled reactions, free energy charge, and application to chemical reaction. | |
| Unit III | ATP: ATP cycle and formation of ATP by phosphorylation, importance of ATP and other compounds of high energy potential. | |
| Block 2 | Metabolism of Biomolecules | |
| Unit IV | Metabolism of carbohydrates: Glycolysis, Kreb's cycle, electron transport system in mitochondria, Oxidative phosphorylation and mechanism of ATP synthesis | |
| Unit V | Metabolism of lipids; Catabolism of triglycerides, biosynthesis of cholesterol, B-oxidation of fatty acids. | |
| Unit VI | Nitrogen metabolism: Nitrogen fixation and assimilation, amino acid metabolism, the urea cycle, chlorophylls. | |
| Block 3 | Phosphorylation and Photosynthesis | |
| Unit VII | Oxidative phosphorylation: | |

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| | Mitochondria, electron transport chain-its organization and function, regulation of oxidative phosphorylation, alternative respiratory pathways in plants. |
| Unit VIII | Photophosphorylation: Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II. Photo inhibition. |
| Unit IX | Photosynthesis: Pigments of Photosynthesis, Oxygenic and anoxygenic Photosynthesis, adsorption of light by chlorophyll, Calvin cycle. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021. 2. Simmi Kharb, Intermediary Metabolism 3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular Biology)" S. Chand Publication-2016. 4. Talwar and Srivastava, "Textbook of Biochemistry and Human Biology" Eastern Economy Edition, Prentice Hall, India-2002. | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Bioenergetics: Microsoft PowerPoint - 426L4Bioen.ppt [Compatibility Mode] (unm.edu) 2. Metabolism of Biomolecules: 76633_ch07_5589.pdf (jpub.com) 3. Nitrogen metabolism: Nitrogen Metabolism (wou.edu) 4. Photophosphorylation: 5. http://ppup.ac.in/download/econtent/pdf/Photophosphorylation.pdf 6. Photosynthesis: https://www.rsb.org.uk/images/15_Photosynthesis.pdf | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: YouTube | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: Second | Semester: III |
| Subject: Biochemistry | | |
| Course Code: SBSBCH-01N | Course Title: BIO ANALYTICAL TECHNIQUES | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To discuss the basics concepts of bioanalytical techniques • To discuss the pH, buffer and biological importance • To discuss the about concept of chromatography and spectroscopy. • To discuss the basic concept of electrophoresis | | |
| Course Outcomes: | | |
| CO 1: Able to understanding the concept of normality, molarity and molality. | | |
| CO 2: Know the properties of light, optical rotation and optical rotator. | | |
| CO 3: Able to know about visible and UV spectroscopy. | | |
| CO 4: Learn the basic principle of FT-IR and NMR spectrometer. | | |
| CO 5: Discuss the principle of centrifugation and its applications. | | |
| Credits: 4 | Type of Course: Skill Enhancement Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Basics of bio-analytical techniques | |
| Unit I | Basic introductions: Basic concept of bio analytical techniques, normality, morality and molality, brief about purification, centrifugation, filtration, dialysis, homogenization | |
| Unit II | pH and buffer: Hydrogen ion concentration, Buffer- definition, types and its preparation, buffers of biological importance such as carbonate bicarbonate, phosphate and acetate. | |
| Unit III | Properties of Light: light spectra, wave length, plane polarized light, optical rotation, optical rotatory, absorbance-chromospheres, auxochrome, | |
| Block 2 | Block II- Chromatography and spectroscopy | |
| Unit IV | Chromography: Principals of partition chromatography, exchange, gel filtration chromatography, high performance liquid chromatography (HPLC). | |
| Unit V | Spectroscopy-I: Concepts of spectroscopy, Beer-Lambert's law, Visible and UV Spectroscopy, applications of colorimetry. | |
| Unit VI | Spectroscopy-II Basic principle of FT-IR and NMR spectrometer and their role in detection of organic molecules detection. | |
| Block 3 | Electrophoresis and Centrifugation | |
| Unit VII | Electrophoresis: Principles of electrophoresis, separation of proteins by PAGE and SDS-PAGE. | |
| Unit VIII | Centrifugation: Principles of centrifugation, differential centrifugation, applications of centrifugation and density gradient. | |

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| Unit IX | Microbial techniques: Isolation of bacteria, antimicrobial activity by using DISC diffusion techniques, use of different solvent system for amino acid, carbohydrate and lipid separation. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. David L. Nelson and Michael Cox, “Lehninger Principles of Biochemistry” International Edition-2021. 2. Sabari Ghosal and Anupama Sharma Awasthi, Fundamentals of Bioanalytical Techniques and Instrumentation, Second edition. 3. Abhilasha Shourie (Author), Shilpa S. Chapadgaonkar Bioanalytical Techniques 4. Sabro Ghosal a. K. Srivastava, Fundamentals of Bioanalytical Techniques and Instrumentation 5. Talwar and Srivastava, “Textbook of Biochemistry and Human Biology” Eastern Economy Edition, Prentice Hall, India-2002. <p>Suggested online link:</p> <ol style="list-style-type: none"> 1. pH and buffer: <u>pH and Buffers.ppt (csun.edu)</u> 2. Properties of Light: <u>ACL7_light.ppt (umd.edu)</u> 3. spectroscopy: <u>Spectroscopy.pdf (osti.gov)</u> 4. Chromatographic Techniques: <u>222 Chapter 4.pdf (unipune.ac.in)</u> 5. Microbiological Laboratory Techniques <u>Microbiological Laboratory Techniques (mowr.gov.in)</u> | |
| This course can be opted as an elective by the students of following subjects: NA | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer:</p> <ol style="list-style-type: none"> 1. Analytical techniques: by Dr. Moganty r. Rajeswari <u>Analytical Techniques - Course (swayam2.ac.in)</u> | |
| <p>Electronic media and other digital components in the curriculum:</p> <p>Choose any one or more than one:(Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)</p> | |
| Name of electronic media: YouTube | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: Second | Semester: IV |
| Subject: Biochemistry | | |
| Course Code: UGBCH-104N | Course Title: Enzymology | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To discuss the basics of enzymology. • To discuss the effects of various factors on enzymatic-catalyzed reactions • To discuss the enzyme cofactors and inhibition • To discuss the regulation of enzyme activity and its importance. | | |
| Course Outcomes: | | |
| CO 1: Learn the enzyme classification and kinetics | | |
| CO 2: known the reversible and irreversible inhibition | | |
| CO 3: Able to discuss the mechanism of action of chymotrypsin | | |
| CO 4: Know the enzymes used in clinical biochemistry as reagents, | | |
| CO 5: Able to discuss the principle of co-enzymes, prosthetic groups and allosteric activators | | |
| Credits: 3 | Type of Course: Core/Elective(Core) | |
| Max. Marks: 100 | Min. Passing Marks: 21 | |
| Block 1 | Enzyme classification and kinetics | |
| Unit I | Introduction to enzymes: Basic concept and classification of enzymes, enzymes as biocatalysts, effects of various factors on enzymatic-catalyzed reactions. | |
| Unit II | Enzyme cofactors and inhibition: Role cofactors, mode of action of coenzymes, principle co-enzymes, prosthetic groups, allosteric activators and inhibitors. | |
| Unit III | Enzymes kinetics: enzymes classification, concept of ES complex, Michaelis-Menten equation, KM constant. | |
| Block 2 | Enzyme action and mechanism | |
| Unit IV | Enzyme inhibition: Reversible and irreversible inhibition, competitive, non-competitive and un-competitive inhibition. | |
| Unit V | Mechanism of enzyme action: Acid-base catalysis, chemical modification of active site group; mechanism of action of chymotrypsin and lysozyme. | |
| Unit VI | Enzyme mechanism: Mechanism of action of chymotrypsin, inhibitors of enzymes - antibiotics, regulation of enzyme activity and its importance. | |
| Block 3 | Multienzyme System and its role in medicine | |
| Unit VII | Enzyme regulation: General mechanisms of enzyme regulation, inhibition, allosteric enzymes, positive and negative cooperatively with special reference to aspartate, transcarbamoylase. | |
| Unit VIII | Multienzyme System: Mechanism of enzyme action and regulation of pyruvate dehydrogenase, isoenzymes. | |

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| Unit IX | Enzymes in medicine: Enzymes used in clinical biochemistry as reagents, diagnostics and therapy, role of immobilized enzymes in industry. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. David L. Nelson and Michael Cox, “Lehninger Principles of Biochemistry” International Edition-2021. 2. Nicholas C. Price, Fundamentals Of Enzymology, 3rd Edition 3. P S Verma and V K Agarwal, “Cell Biology (Cytology, Biomolecule and Molecular Biology” S. Chand Publication-2016. 4. Talwar and Srivastava, “Textbook of Biochemistry and Human Biology” Eastern Economy Edition, Prentice Hall, India-2002. 5. Lewis Stevens and Nicholas Price, Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins <p>Suggested online link:</p> <ol style="list-style-type: none"> 1. Introduction to Enzymes: Microsoft Word - Introduction (ufsc.br) 2. Enzyme Kinetics: ENZYME KINETICS (columbia.edu) 3. Regulation of Enzyme Activity: Slide 1 (mgcub.ac.in) 4. Multienzyme Complexes: Multienzyme Complexes (mlsu.ac.in) | |
| This course can be opted as an elective by the students of following subjects: Any one | |
| Suggested equivalent online courses (MOOCs) for credit transfer: | |
| Enzymology: Enzymology - Course (swayam2.ac.in) | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than one:(Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)</p> | |
| Name of electronic media: Youtube | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: Third | Semester: V |
| Subject: Biochemistry | | |
| Course Code: DCEBCH-105N | Course Title: Microbiology | |
| Course Objectives: <ul style="list-style-type: none"> • To discuss the diversity of microbial world. • To discuss the classification of microbiology, and their nomenclature. • To discuss the genetic engineering and recombination of bacteria. • To discuss the basic concept of bacterial cell, gram positive and negative bacteria. | | |
| Course Outcomes: CO 1: Learn the history of microbial world and development in biology. CO 2: Able to know about bacteria, viruses and algae. CO 3: Know the biological nitrogen fixation and biofertilizers CO 4: Learn the structure and functions of flagella. CO 5: Able to know the role of bacteria in N, P, S and C cycle. | | |
| Credits: 2 | Type of Course: Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Microbial world their development | |
| Unit I | Diversity of Microbial world: Classification of microbiology, and their nomenclature. Whittaker's five kingdom classification systems and their utility. | |
| Unit II | Development of microbiology: Spontaneous generation vs. biogenesis, general characteristics of different groups, acellular microorganisms (Viruses, Viroids, Prions). | |
| Unit III | Isolation and Cultivation: Culture media, nutritional requirements and growth characteristics of bacteria, development of various microbiological techniques. | |
| Block 2 | Genetic engineering and Microorganism | |
| Unit IV | Genetic: Recombination of bacteria conjugation, transduction, and transformation, significance of genetic recombination in bacteria. | |
| Unit V | Bacteria: Structure of bacterial cell, gram positive and gram negative bacteria, microscopy-simple, compound, applications of bacteria and archaea in industry, environment and food. | |
| Unit VI | Viruses: General structure and classification, properties of viruses, structure and replication of poliovirus and HIV. Protozoa- General characteristics with special reference to Amoeba and Paramecium. | |
| Block 3 | Microorganism and their agriculture | |

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| Unit VII | Algae: Types and occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves. |
| Unit VIII | Fungi: General classification, occurrence, habitat of fungi, distribution, nutritional requirements, fungal cell ultra- structure, role of fungi in agriculture, environment, Industry, medicine and food. |
| Unit IX | Role of microorganism in Agriculture: Biological nitrogen fixation, microbes as bio fertilizers, role of bacteria in N, P, S, C cycle, role of bacteria in nutrient cycle |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Donald L. Pavia (Author) Introduction to Spectroscopy 2. Gauglitz, John Wiley Handbook Of Spectroscopy 2Nd Edition 4 Volume Set 3. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021. 4. Banwell (Author), Fundamentals of Molecular Spectroscopy 4th Edition 5. P. S Kalsi, Spectroscopy of Organic Compounds | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Microbial Diversity And Systematic: 1075x_Ch03_025.Qxd (Jblearning.Com) 2. Microbiological Laboratory Techniques: Microbiological Laboratory Techniques (Mowr.Gov.In) 3. Micro-Organism: Pdf (Usda.Gov) 4. Beneficial microorganisms in Agriculture: Microsoft Word - Lecture 25 Bio fertiliser.docx (eagri.org) | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: YouTube | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: Third | Semester: V |
| Subject: Biochemistry | | |
| Course Code: DCEBCH-106N | Course Title: Spectroscopy | |
| Course Objectives: <ul style="list-style-type: none"> • To discuss the basics of UV-visible and IR spectroscopy. • To discuss the fundamental law of spectroscopy, electromagnetic radiation and atomic adsorption spectroscopy. • To discuss the NMR, atomic spectroscopy and atomic emission spectroscopy • To discuss the basic concept of luminescence and electron spectroscopy. | | |
| Course Outcomes: <p>CO 1: Able to know the history spectroscopy and electromagnetic radiation in brief.</p> <p>CO 2: Able to know the principle and instrumentation of UV-Visible and applications</p> <p>CO 3: Able to know the principle of electron spectroscopy and its applications.</p> <p>CO 4: Able to know the principle of flame photometry.</p> <p>CO 5: Learn the enzymatic kinetics reactions.</p> | | |
| Credits: 2 | Type of Course: Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | UV-Visible and IR spectroscopy | |
| Unit I | Spectroscopy: Fundamental law of spectroscopy, electromagnetic radiation, origin of spectra, application of spectroscopy in biochemistry. | |
| Unit II | UV Visible spectroscopy: Principle and instrumentation of UV-Visible, Beer-Lambert law, qualitative and quantitative analysis by UV-Visible spectroscopy. Origin of spectra and electronic transition, composition of color complex, application of UV-Visible spectrometer in enzyme kinetics reaction | |
| Unit III | Spectroscopy: Theory and principle of infrared spectroscopy, components of IR spectroscopy, application of FTIR in biochemistry. | |
| Block 2 | NMR and Atomic Spectroscopy Amino Acids, Proteins and Carbohydrate | |
| Unit IV | NMR Spectroscopy: Principle of NMR spectroscopy, NMR spectra measurement, types of NMR, chemical shift, application of NMR in biochemistry | |
| Unit V | Atomic adsorption spectroscopy: Principle of adsorption spectroscopy, instrumentation and application of adsorption spectroscopy. | |
| Unit VI | Atomic Emission Spectroscopy: Principle of emission spectroscopy, Instrumentation Emission spectroscopy, principle of flame photometry | |
| Block 3 | Luminescence and Electron spectroscopy | |

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| Unit VII | ICP-atomic emission spectroscopy: Principle of plasma spectroscopy, application of adsorption spectroscopy, comparison of ICP-AES with ASS |
| Unit VIII | Luminescence spectroscopy: Luminescence and chemiluminescence, principle of fluorescence, application of Fluorimetry |
| Unit IX | Electron spectroscopy: Principle of electron spectroscopy, electron spectroscopy for chemical analysis (ESCA), chemical shift in ESCA. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021. 2. Dr J L Jain, "Fundamentals of Biochemistry" S. Chand and Company-2020. 3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular Biology" S. Chand Publication-2016. 4. Talwar and Srivastava, "Textbook of Biochemistry and Human Biology" Eastern Economy Edition, Prentice Hall, India-2002. | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Spectroscopy: Spectroscopy.pdf (osti.gov) 2. Nuclear Magnetic Resonance: Nuclear Magnetic Resonance (NMR) (brown.edu) 3. Electronic Spectroscopy: MSc Chemistry Paper-IX Unit-4.pdf (nou.ac.in) | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: Youtube | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: Third | Semester: VI |
| Subject: Biochemistry | | |
| Course Code: DCEBCH -108N | Course Title: PLANT BIOCHEMISTRY | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To discuss the plant biochemistry and electron transport system in plants. • To discuss the nitrogen metabolism and nitrogen fixation and assimilation. • To understand the carbon assimilation, respiration and plant growth regulator • To understand basic concept of hill reaction, photorespiration and photosynthesis | | |
| Course Outcomes: | | |
| CO 1: Able to know the oxidative phosphorylation | | |
| CO 2: know the concept of chlorophyll, pigments, and light harvesting complexes. | | |
| CO 3: To know cyclic and non cyclic photophosphorylation. | | |
| CO 4: Able to understanding the regulation of plant glycolysis | | |
| CO 5: Also know about abiotic and biotic stress, salinity, water stress and pathogenesis. | | |
| Credits: 2 | Type of Course: Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Electron Transport System and nitrogen metabolism | |
| Unit I | Electron Transport System in Plants: Oxidative phosphorylation, mitochondrial respiratory complexes. | |
| Unit II | Nitrogen Metabolism: Assimilation of nitrate, enzyme of nitrate reduction and their regulation and assimilation of ammonia into organic compounds. | |
| Unit III | Nitrogen fixation and assimilation: Biological nitrogen fixation by free living and in symbiotic association, structure and function of enzyme nitrogenase, nitrate assimilation. | |
| Block 2 | Photosynthetic process and carbon assimilation | |
| Unit IV | Photosynthetic process: Chlorophylls, photoperiodism, photosynthetic membranes and organelles, z scheme, light dependant reactions. Photosynthetic apparatus and pigments involved in photosynthesis, Hill reaction, generation of NADPH and ATP, light harvesting complexes. | |
| Unit V | Synthesis of photochemicals: Classification and biosynthesis of Terpenes, Lignins, Waxes and Alkaloids | |
| Unit VI | Carbon assimilation: Cyclic and non cyclic photophosphorylation, Calvin cycle, and photorespiration General introduction, classification and structure, monosaccharides - structure of aldoses and ketoses, ring structure of sugars, formation of disaccharides, polysaccharides. | |
| Block 3 | Plant stress growth regulators | |

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| Unit VII | Stress Metabolism in Plants: A biotic and biotic stress; salinity, water stress, chilling, heat, pathogenesis, heavy metals and their impact on plant growth and metabolism. |
| Unit VIII | Respiration: Regulation of plant glycolysis, regulation of plant glycolysis, translocation of metabolites across mitochondrial membrane, TCA cycle. |
| Unit IX | Plant growth regulator: Phytohormones and its effect on plant growth and development, regulation of plant morphogenetic processes by light. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. David L. Nelson and Michael Cox, “Lehninger Principles of Biochemistry” International Edition-2021. 2. Dr J L Jain, “Fundamentals of Biochemistry” S. Chand and Company-2020. 3. P S Verma and V K Agarwal, “Cell Biology (Cytology, Biomolecule and Molecular Biology” S. Chand Publication-2016. 4. Talwar and Srivastava, “Textbook of Biochemistry and Human Biology” Eastern Economy Edition, Prentice Hall, India-2002. <p>Suggested Online Link:</p> <ol style="list-style-type: none"> 1. Electron transport and oxidative phosphorylation: spring 2013 lecture 37 & 38 (purdue.edu) 2. Nitrogen metabolism: lesson-10.pdf (nios.ac.in) 3. Carbon dioxide assimilation and respiration: chapter-2-carbon-dioxide-assimilation-and-respiration-for-pdf.pdf (asps.org.au) | |
| This course can be opted as an elective by the students of following subjects: Any one | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| <p>Electronic media and other digital components in the curriculum:</p> <p>Choose any one or more than one:(Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)</p> | |
| Name of electronic media: YouTube | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: Third | Semester: VI |
| Subject: Biochemistry | | |
| Course Code: DCEBCH-109N | Course Title: Immunology | |
| Course Objectives: <ul style="list-style-type: none"> • To discuss the immunology and types of immunity. • To discuss the diversity in immune system and types of immunoglobulin's. • To discuss the generation of antibody diversity, B cell activation and theory of clonal selection. • To discuss the basic concept of disorders of immune responses and different immunoglobulin (IgG, IgM, IgA, IgD and IgE) | | |
| Course Outcomes: <p>CO 1: Able to understanding of immune system and its types.</p> <p>CO 2: Able to understanding about antigen, antibody and their interaction.</p> <p>CO 3: know about concept of autoimmunity, ELISA and T-cell receptor diversity.</p> <p>CO 4: Also understanding about AIDS and active immunity & passive immunity.</p> <p>CO 5: Brief idea about SARS, hepatitis, tolerance and hypersensitivity.</p> | | |
| Credits: 2 | Type of Course: Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Immune system | |
| Unit I | Immune system, innate and acquired immunity, definitions, non-immunological barriers, cells and soluble mediators of innate immunity, cytokines. | |
| Unit II | Antigen and Antibody: Criteria of antigenicity, haptens; classification, types and functions of antibodies, antigenic determinants of immunoglobulins | |
| Unit III | Types of immunoglobulins, generation of antibody diversity, B cell activation, theory of clonal selection, formation of plasma and memory cells. | |
| Block 2 | Diversity in Immune system | |
| Unit IV | Diversity in Immune system: Clonal selection theory, concept of antigen specific receptor, generation of antibody diversity, | |
| Unit V | Antigen-antibody: Measurement of antigen-antibody interactions, agglutination, precipitations, opsonization, gel diffusion (Ouchterlony double immune diffusion). | |
| Unit VI | Immune system and immunity: Enzyme linked immunosorbent assay (ELISA), T-Cell receptor diversity, concept of autoimmunity. | |
| Block 3 | Immune responses and Immunoglobulins | |
| Unit VII | Disorders of immune responses: Autoimmunity, acquired immunodeficiency, immune tolerance and hypersensitivity. | |
| Unit VIII | Cell mediated immunity: T-cell development, MHC locus, structure, function and distribution of MHC glycoproteins, cell mediated immune responses. | |
| Unit IX | Immunoglobulins: IgG, IgM, IgA, IgD and IgE, active immunity and passive immunity. Brief idea of AIDS, SARS and hepatitis. | |

Suggested Text Book Readings:

1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021.
2. Dr J L Jain, "Fundamentals of Biochemistry" S. Chand and Company-2020.
3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular Biology" S. Chand Publication-2016.
4. Talwar and Srivastava, "Textbook of Biochemistry and Human Biology" Eastern Economy Edition, Prentice Hall, India-2002.

Suggested online link:

1. Introduction to Immunology: [Immunology.pdf \(hmmcollege.ac.in\)](http://hmmcollege.ac.in)
2. Components of Immune system: [components of immune system \(dHINGCOLLEGEONLINE.CO.IN\)](http://dHINGCOLLEGEONLINE.CO.IN)
3. Immune System: [Immune System Handout \(Soinc.Org\)](http://Soinc.Org)
4. Antigens: [Microsoft PowerPoint - Chapter04-09 \(nau.edu\)](http://nau.edu)
5. Immunoglobulins: [Immunoglobulins.pdf \(ndvsu.org\)](http://ndvsu.org)

This course can be opted as an elective by the students of following subjects: Any one

Suggested equivalent online courses (MOOCs) for credit transfer: NO

Electronic media and other digital components in the curriculum:

Choose any one or more than one:(Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)

Name of electronic media: Youtube

Year of incorporation: 2023-24

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| Programme: B.Sc. | Year: Third | Semester: VI |
| Subject: Biochemistry | | |
| Course Code: SBSBCH-04N | Course Title: Clinical biochemistry | |
| Course Objectives: <ul style="list-style-type: none"> • To discuss the basics of clinical biochemistry and clinical enzymology. • To discuss the role and regulation of electrolyte content in body fluids • To discuss the concept disorders of carbohydrate, lipids and nitrogen metabolism. • To discuss the basic concept of blood clotting, nutrition, drugs and cancer. | | |
| Course Outcomes: CO 1: Able to understanding of electrolyte, enzymes, hormones and bone disorder. CO 2: able to know the regulation of blood sugar, glycogen, and diabetes mellitus. CO 3: Able to learn the density of lipoproteins, cholesterol, triglycerides and phospholipids in health and disease. CO 4: Define the concept of tube feeding, parenteral nutrition, drugs and alcohol CO 5: Able to known the types of cancer, multiple steps of tumor development. | | |
| Credits: 4 | Type of Course: Skill Enhancement Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Basic in clinical chemistry and Clinical Enzymology | |
| Unit I | Basic introduction: Basic concept of clinical biochemistry: A brief review of units and abbreviations used in expressing concentrations and standard solutions. | |
| Unit II | Electrolytes and acid-base balance: Role and regulation of electrolyte content in body fluids and maintenance of pH, body fluids and fluid compartments | |
| Unit III | Clinical enzymology: Enzymes and hormones, plasma enzymes, isoenzymes with examples, liver damage, bone disorder. | |
| Block 2 | Disorders of carbohydrate, lipids and Nitrogen metabolism | |
| Unit IV | Disorders of carbohydrate metabolism: Regulation of blood sugar, glycogen storage diseases, diabetes mellitus, glucose and galactose tolerance tests, sugar levels in blood. | |
| Unit V | Disorders of lipids: Low and high density lipoproteins, cholesterol, triglycerides and phospholipids in health and disease, Gaucher's and Tay-Sach's disease | |
| Unit VI | Disorders Nitrogen metabolism: Abnormalities in nitrogen metabolism: Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance. | |
| Block 3 | Nutrition, drugs and blood clotting | |
| Unit VII | Nutrition and drugs: | |

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| | Routine hospital diets, special feeding methods, tube feeding, parenteral nutrition, drugs, alcohol and toxicants |
| Unit VIII | Diagnostic Enzymes: Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays- SGPT, CPK, LDH. |
| Unit IX | Blood Clotting: Blood clotting mechanism-hemorrhagic disorders-hemophilia, thrombotic thrombocytopenic purpura, blood groups, antigen and antibodies, circulating anticoagulants. |
| Unit X | Cancer: Types of cancer, multiple steps of tumor development, cell death and apoptosis, carcinogens and cancer therapy. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" International Edition-2021. 2. Dr J L Jain, "Fundamentals of Biochemistry" S. Chand and Company-2020. 3. P S Verma and V K Agarwal, "Cell Biology (Cytology, Biomolecule and Molecular Biology" S. Chand Publication-2016. 4. Talwar and Srivastava, "Textbook of Biochemistry and Human Biology" Eastern Economy Edition, Prentice Hall, India-2002. 5. Satyanarayana U., "Biochemistry" Elsevier India,2021 | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Pathophysiology of Water and Electrolyte Metabolism: PowerPoint Presentation (bns-hungary.hu) 2. Nutrient-Drug Interactions and Food: 09361.pdf (colostate.edu) 3. HANDBOOK OF DRUG-NUTRIENT INTERACTIONS: Handbook of Drug-Nutrient Interactions, 2nd Edition (Nutrition and Health) (usp.br) 4. Enzymes of diagnostic values: L12-Enzymes-of-diagnostic-values.pdf (ndvsu.org) 5. Blood Clotting Notes: Blood Clotting Notes (murrieta.k12.ca.us) 6. Cancer: book.pdf (tmc.gov.in) | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: Youtube | Year of incorporation: 2023-24 |

Year-2023-2024
Syllabus of B.Sc. Programme: [Subject Name: Botany]
In accordance with NEP-2020

| Year | Sem. | Course Code | Paper Title | Theory/Practical | Max. Marks. | Credits | |
|---------------------------|---|------------------|---|------------------|-------------|-----------|--|
| 1 | I | UGBY-101(N) | Cytology and Genetic | Theory | 100 | 2 | |
| | I | UGBY-101(N) (P) | Practical Work | Practical Work | 100 | 2 | |
| | II | UGBY-102(N) | Plant Physiology | Theory | 100 | 2 | |
| | II | UGBY-102(N) (P) | Practical Work | Practical Work | 100 | 2 | |
| 2 | III | UGBY-103(N) | Plant Diversity-I | Theory | 100 | 2 | |
| | III | UGBY-103(N) (P) | Practical Work | Practical Work | 100 | 2 | |
| | IV | UGBY-104(N) | Plant Diversity-II | Theory | 100 | 2 | |
| | IV | UGBY-104(N) (P) | Practical Work | Practical Work | 100 | 2 | |
| | Skill Enhancement Course | | | | | | |
| IV | SBSBY-02(N) | Ecology | Theory | 100 | 4 | | |
| 3 | Discipline Centric Elective Course | | | | | | |
| | V | DCEBY -105(N) | Embryology and Morphogenesis | Theory | 100 | 2 | |
| | V | DCEBY-106(N) | Plant Pathology and Microbiology | Theory | 100 | 2 | |
| | V | DCEBY-107(N) (P) | Practical Work | Practical Work | 100 | 2 | |
| | Discipline Centric Elective Course | | | | | | |
| | VI | DCEBY-108(N) | Molecular Genetics and biotechnology | Theory | 100 | 2 | |
| | VI | DCEBY-109(N) | Paleobotany, Palynology and Economic Botany | Theory | 100 | 2 | |
| | VI | DCEBY-110(N) (P) | Practical Work | Practical Work | 100 | 2 | |
| Total Marks/Credit | | | | | 1500 | 32 | |

B.Sc.: Subject: Botany

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: I |
| Subject: Biology | | |
| Course Code: UGBY-101 (N) | Course Title: Cytology and Genetic | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> • Cell science • Eukaryotic plant cell, various cellular organelles and genetics | | |
| Course Outcomes: (CO): Knowledge of plant cell and various cellular organelles. <ul style="list-style-type: none"> • Salient features of cell division in plants cell. • Understand the Mendel's laws of Heredity. • Concept of linkage, crossing over and chromosome mapping. • Extranuclear inheritance, structure, numerical abnormalities in chromosome and their effects. • Knowledge of nature and structure of genetic material. • Structure and function of gene. | | |
| Credits: 02 | | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Cytology | |
| Unit I | Cell structure and cellular organelles-I <ul style="list-style-type: none"> • Chloroplast, Mitochondria, Ribosome, Nucleolus and Nucleus, Plasma membrane | |
| Unit II | Cell structure and cellular organelles-II <ul style="list-style-type: none"> • Endoplasmic reticulum, Golgi-body, Lysosome and chromosome. | |
| Unit III | Cell cycle, Mitosis and Meiosis | |
| Block 2 | Genetics-I | |
| Unit IV | Pre-mendelian genetics and Mendel's laws of inheritance | |
| Unit V | Linkage and crossing over | |
| Unit VI | Cytoplasmic inheritance, sex linked | |
| Block 3 | Genetics-II | |
| Unit VII | Pre-Chromosomal aberrations | |
| Unit VIII | Gene mutation and induced mutation | |
| Unit IX | Genetics in Plant improvement | |
| Suggested Text Book Readings: Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th Cell Biology And Genetics (Hindi) 2/e PB....Gupta P K (Hindi) rastogi Publications Cytogenetics, Plant Breeding, Evolution and Biostatistics ISBN #: 978-81-301-0066-1Sunil D Purohit & Gotam K Kukda, Apex Publishing House Genetics and Biotechnology Sunil D Purohit, K. Ahmed & Gotam K Kukda Apex Publishing House | | |
| This course can be opted as an elective by the students of following subjects: NA | | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | | |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: II |
| Subject: Biology | | |
| Course Code: UGBY-102 (N) | Course Title: Plant Physiology | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> Plant water relations, mineral nutrition, photosynthesis, Respiration and growth hormones | | |
| Course Outcomes (CO): <ul style="list-style-type: none"> Understand different process of plant water relation. Understand process of photosynthesis. Process of biological Nitrogen Fixation. Plant hormones and their role in physiology of plant. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Plant Physiology-I | |
| Unit I | The Concept of Diffusion, Imbibition, Osmosis and Water Potential | |
| Unit II | Absorption of Water <ul style="list-style-type: none"> Water absorbing organ, active water absorption theory and passive water absorption theory | |
| Unit III | Ascent of Sap <ul style="list-style-type: none"> Concepts, theory of ascent of sap with emphasis on cohesion theory of ascent of sap. | |
| Unit IV | Water Loss (Transpiration) <ul style="list-style-type: none"> Stomatal structure, mechanism of stomatal opening and closing, transpiration, guttation, factors controlling transpiration | |
| Block 2 | Plant Physiology-II | |
| Unit V | Mineral Nutrition <ul style="list-style-type: none"> Essential elements, macro and micro nutrient, role of essential elements, transport of ion across cell membrane , active and passive transport. | |
| Unit VI | Photosynthesis <ul style="list-style-type: none"> Basic concept, equation of photosynthesis, evidence for the existence of light and dark reaction, structure of chloroplast, discovery of two light reactions, quantum yield, red drop, Emerson enhancement effect, photo system I & II, dark reaction-the calvin cycle photorespiration and C₄ plants, CAM plant. | |
| Unit VII | Hormones <ul style="list-style-type: none"> Discovery and characteristic of plant hormones, role of auxins, giberellin, cytokinin, ethylene, abscisic acid. Flowering hormones, Phytochrome. | |
| Unit VIII | Respiration <ul style="list-style-type: none"> Aerobic and anaerobic respiration, Glycolysis, TCA cycle, Oxidative phosphorylation. | |
| Suggested Text Book Readings: Jain, V.K. Fundamental of Plant Physiology (7th ed.) 2004. S. Chand and Company. Salisbury, F.B. & Ross, C.W. Plant Physiology (4th ed.), 1992, Wadsworth Publishing Company. Panday, S.N. & Sinha, B.K. Plant Physiology (4th ed.), 2006, Vikas Publishing House Pvt. Ltd. Mukherjee, S. & Ghosh, A. Plant Physiology (2nd ed.), 2005, New Central Book Agency. Chaudhuri, D., Kar, D.K., and Halder, S.A. Handbook of Plant Biosynthetic Pathways 2008, New Central Book. Agencies. Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar. Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi. | | |
| This course can be opted as an elective by the students of following subjects: NA | | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | | |

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| <p>Electronic media and other digital components in the curriculum: Choose any one or more than one: (Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)</p> | |
| <p>Name of electronic media Video Lectures https://youtu.be/AXMZ80EePQy https://youtu.be/2W5SKKFNdk https://youtu.be/yEblrxy6mAU https://youtu.be/oElnm3y7Pzw https://youtu.be/Vcs-4Ws/2Q e-SLM</p> | <p>Year of incorporation: 2021-22</p> |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: III |
| Subject: Biology | | |
| Course Code: UGBY-103 (N) | Course Title: Plant Diversity-I | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> • Structure, reproduction and economic important of bacteria, virus and lichens. • Morphology and life cycle of important groups of algae, fungi, bryophytes and pteridophytes. | | |
| Course Outcomes:(CO): <ul style="list-style-type: none"> • Knowledge of microbes and diversity of lower plants. • Understand the diversity of plant. • Knowledge of morphology, cell structure and life cycle of various algae. • Habits, morphology, life cycle of fungi and their economic importance. | | |
| Credits: 02 | | Type of Course: Core |
| Max. Marks: 100 | | Min. Passing Marks: 36 |
| Block 1 | Plant Diversity-I | |
| Unit I | Bacteria, Virus and Lichen <ul style="list-style-type: none"> • Bacterial-Cell structure, Reproduction, Economic importance • Virus- Biological status of virus, structure of bacteriophage & TMV, replication. • Lichen- Structure and economic importance of lichen. | |
| Unit II | Algae – I <ul style="list-style-type: none"> • Morphology and life cycle of algae, unicellular form <i>chlamydomonas</i>, colonial forms <i>Volvox</i>, Filamentous form <i>Nostoc</i>, Heterotrichous forms <i>Ectocarpus</i>, Thalloid form <i>Fucus</i>, Polysiphonoid form <i>Polysiphonia</i>. | |
| Unit III | Algae – II <ul style="list-style-type: none"> • Origin and evolution of sex, classification of Algae: Criteria for classification, Economic importance of Algae, Habitats and distribution- Algae, Aquatic algae: Fresh water, Marine habitats Special Habitats; Soil and sub aerial algae. | |
| Unit IV | Fungi <ul style="list-style-type: none"> • Introduction; Habitats, morphology, nutrition and reproduction, life cycle of <i>phytophthora</i>, <i>Rhizopus</i>, <i>Puccinia</i>, <i>Cercospora</i>, Economic importance of fungi. | |
| Block 2 | Plant Diversity-I | |
| Unit V | Bryophytes-I <ul style="list-style-type: none"> • Introduction, General characteristics, adaptation to land habit, morphology, anatomy and reproduction of Hepaticosida <i>Riccia</i>, <i>Marchantia</i>, <i>Pellia</i>, Anthocerosida <i>Anthoceros</i>, <i>Bryopsida-Sphagnum</i>. | |
| Unit VI | Bryophytes-II <ul style="list-style-type: none"> • Evolution of sporophytes in bryophytes. Importance and bio-functional uses of bryophytes (Food, Medicine, Ecological Services, Industrial and Research work) | |
| Unit VII | Pteridophytes-I <ul style="list-style-type: none"> • General characteristics, and Life cycle of pteridophytes, Relationship with other groups, stellar structure and evolution, Fern as a system for experimental studies, apogamy and apospory. | |
| Unit VIII | Pteridophytes-II <ul style="list-style-type: none"> • Morphology, anatomy and life cycle of <i>Rhynia</i>, <i>Lycopodium</i>, <i>Selaginella</i>, <i>Equisetum</i>, and <i>Marsilea</i>. | |
| Suggested Text Book Readings: Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad. Rashid A (1999) An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. New Delhi. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Pteridophyta, S. Chand and Company Parihar NS (1976) Biology and Morphology of Pteridophytes. Central Book Depot. | | |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: IV |
| Subject: Biology | | |
| Course Code: UGBY-104 (N) | Course Title: Plant Diversity-II | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> Gymnosperms & life cycle of Cycas & Pinus. Various aspects of anatomy of vascular plants. System of classification and details of important dicot and monocot families. | | |
| Course Outcomes:(CO): <ul style="list-style-type: none"> Understand morphology, anatomy, life cycle and economic important genera of gymnosperm. Anatomy and secondary growth in some angiospermic plants. General information of flowering plants. Understand aims, objective and importance of taxonomy. Various system of plant classification and description of some important families. | | |
| Credits: 02 | | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Plant Diversity-II | |
| Unit I | Introduction of Gymnosperms <ul style="list-style-type: none"> Introduction, characteristic, classification and economic importance of gymnosperm. | |
| Unit II | Cycas <ul style="list-style-type: none"> Structure and reproduction (life cycle) | |
| Unit III | Pinus <ul style="list-style-type: none"> Structure and reproduction (life cycle) | |
| Block 2 | Plant Diversity-II | |
| Unit IV | Tissue system <ul style="list-style-type: none"> simple tissue, complex tissue. | |
| Unit V | Root <ul style="list-style-type: none"> Primary and secondary structure of root | |
| Unit VI | Stem <ul style="list-style-type: none"> Primary and secondary structure | |
| Unit VII | Anomalous Secondary Growth <ul style="list-style-type: none"> Anomalous secondary growth in <i>Bignonia</i> and <i>Boerhaavia</i> (dicot-stem), <i>Dracaena</i> (Monocot-stem) | |
| Block 3 | Plant Taxonomy | |
| Unit VIII | Plant Taxonomy-I <ul style="list-style-type: none"> History of Economic botany with special reference to India, Bentham and Hookers system of classification. | |
| Unit IX | Plant Taxonomy-II <ul style="list-style-type: none"> Details account of following families: Dicot-Family- Asteraceae, Ranunculaceae, Brassicaceae, Solanaceae, Malvaceae, Mimosoideae, Caesalpinioideae, Papilionoideae, Monocot-Family- Liliaceae, Orchidaceae, Poaceae | |
| Suggested Text Book Readings: Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India. Sharma OP (1990) Textbook of Pteridophyta. MacMillan India Ltd. Delhi. Vashishtha BR, Sinha AK and Kumar A (2010) Botany for Degree Students – Gymnosperms, S. Chand Bhatnagar SP (1996) Gymnosperms, New Age International Publisher. E.J.Eames . Morphology of Vascular Plants, Standard University Press. Dickinson, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their | | |

Structure, Function and Development. John Wiley and Sons, Inc.
Plant Systematics. Arun K. Pandey & Shruti Kansana. 2020. Jaya Publishing House
K. B. Anjaria, (2015)“Electronic Herbarium and Digital Database Preparation of Common Trees of Anand District, Gujarat” MRP submitted to UGC, WRO, Pune 2015 (unpublished)
Pandey, B.P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd, New Delhi.

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: V |
| Subject: Biology | | |
| Course Code: SBSBY-02(N) | Course Title: Ecology | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> Ecosystem its various aspects which educate them about environment. | | |
| Course Outcomes (CO): <ul style="list-style-type: none"> Understand the concept of environment, ecology and ecosystem. Structure and organization of ecosystem with biotic and abiotic component. Energy flow and nutrient cycle in ecosystem. Community, population and role of ecology in human welfare. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Ecology-I | |
| Unit I | Introduction To Ecology | |
| Unit II | Structure and function of Ecosystem <ul style="list-style-type: none"> Biotic and Abiotic components, Food chain, Food web, Pyramid, and Energy flow in ecosystem, Biogeochemical cycle. | |
| Unit III | Ecological Succession <ul style="list-style-type: none"> Basic concept, succession in water and land (hydrosere and xerosere) | |
| Unit IV | Pollution <ul style="list-style-type: none"> Definition, types of pollution: Air pollution, water pollution, Noise pollution, control of pollution. | |
| Block 2 | Ecology-II | |
| Unit V | Ecological Adaptations in Plants <ul style="list-style-type: none"> Hydrophytic and xerophytic adaptation. | |
| Unit VI | Edaphic Factors <ul style="list-style-type: none"> Definition and composition of soil, soil profile, soil erosion, soil conservation. | |
| Unit VII | Phytogeography <ul style="list-style-type: none"> Major plant community of world, soil, climate and vegetation of India. | |
| Unit VIII | Environmental Education | |
| Suggested Text Book Readings: Ecology And Environmental Biology by RBD Publisher Author: Bhatia - Jain - Kohli - Shrivastava - Singh – Verma Environmental Biology and Phytogeography ISBN #: 978-81-301-0064-7B. L. Chaudhary, Gotam K Kukda & Jitendra Kumar Joshi Odum, F.P. Fundamentals of Ecology, Latest Ed., Saunders Sharma, P.D. Elements of Ecology, Latest Ed., Rastogi Publications Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi. | | |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: V |
| Subject: Biology | | |
| Course Code: DCEBY-105 (N) | Course Title: Embryology and Morphogenesis | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> • Various aspects of angiosperm's embryology and phenomenon of morphogenesis in plant. | | |
| Course Outcomes (CO): <ul style="list-style-type: none"> • Knowledge about gametogenesis of anther and ovule. • Pollination, fertilization along with development of embryo and endosperm. • Understand Polyembryony, its application and morphogenesis. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Plant Embryology-I | |
| Unit I | Introduction to Embryology | |
| Unit II | Life Cycle of Angiosperm <ul style="list-style-type: none"> • Structure of flower; process of reproduction | |
| Unit III | Microsporogenesis <ul style="list-style-type: none"> • Microsporogenesis and male gametophytes; microsporangium anther wall and sporogenous tissue. Microsporogenesis-Cytokinesis, pollen tetrads. Male gametophyte- Structure of pollen grains, development of male gametophyte. | |
| Unit IV | Megasporesogenesis <ul style="list-style-type: none"> • Megaspore and female gametophyte-1. Megaspore - type of ovule, development of ovule, parts of ovule, 2. Megasporesogenesis, Female gametophyte (Embryosac) structure of embryosac and types. | |
| Block 2 | Plant Embryology-II | |
| Unit V | Pollination <ul style="list-style-type: none"> • Anther dehiscence, types of pollination, agents and types of cross pollination; artificial pollination. | |
| Unit VI | Fertilization <ul style="list-style-type: none"> • Germination of pollen grain, Growth of pollen tube, Entry of pollen tube into Ovule and Embryosac, Movement of sperm towards egg and polar nuclei. pollination and fertilization. | |
| Unit VII | Post fertilization Development <ul style="list-style-type: none"> • Endosperm- Types of endosperm, Nuclear types, Cellular types, Helobial types, Function of endosperm, morphological nature of endosperm, embryogenesis – Development of dicot and mono-cot embryo, nutrition of embryo | |
| Unit VIII | Polyembryony and Apomixis <ul style="list-style-type: none"> • Origin of polyembryony, causes of polyembryony and role of polyembryony in breeding. apomixis; Types of apomixes and its significance. | |
| Block 2 | Plant Morphogenesis and Polarity | |
| Unit IX | Morphogenesis <ul style="list-style-type: none"> • Morphogenesis and Factors Affecting Morphogenesis | |
| Unit-X | Polarity <ul style="list-style-type: none"> • Symmetry, Totipotency | |
| Suggested Text Book Readings: Bhojwani, S.S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House., Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verlag, Berlin. | | |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: V |
| Subject: Biology | | |
| Course Code: DCEBY-106 (N) | Course Title: Plant Pathology and Microbiology | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> • Scope and importance of plant pathology. • Know the prevention and control measures of plant diseases. • Life cycle of some important plant diseases. • Soil, water and dairy microbiology. | | |
| Course Outcomes (CO): <ul style="list-style-type: none"> • Introduction of plant pathology, symptoms, dissemination and various control methods for disease. • Description of some important diseases of plants. • Knowledge of water, soil and dairy microbiology. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Plant Pathology | |
| Unit I | Introduction of plant pathology | |
| Unit II | Symptoms of plant diseases caused by fungi, bacteria and virus | |
| Unit III | Control of plant diseases : various methods used for disease control | |
| Unit IV | Dissemination of pathogen, epidemiology and disease forecasting | |
| Unit V | Diseases of plant. <ul style="list-style-type: none"> • White Rust of Crucifer, wilt of arhar, damping off, Late Blight of potato, Early Blight of Potato, Black Rust of wheat, Tikka Disease of Groundnut Loose smut of wheat. | |
| Block 2 | Microbiology | |
| Unit VI | Sewage microbiology <ul style="list-style-type: none"> • What is sewage, various process of treatment of sewage. | |
| Unit VII | Soil microbiology <ul style="list-style-type: none"> • Humus, Role of microbes in various cycles: Nitrogen, Carbon, Phosphorous and sulphur in soil. | |
| Unit VIII | Dairy microbiology | |
| Suggested Text Book Readings: Microbiology Fundamental and Applications (hindi) (pb) Modern Microbiology (hindi) (hb) ISBN: 9788177543599 Edition : 1 Year : 2018 Author : Dr. Purohit SS , Dr. Singh T Publisher : Agrobios (India) “Plant pathology by R.S. Mehrotra, Tata McGraw-Hill Education” are included in reading resources list Sharma, P. D. 2012, Microbiology and Plant Pathology, Rastogi Publication Pvt Ltd., Meerut, India. Singh, R. P. 2007. Microbial Taxonomy and Culture Techniques, Kalyani Publication, New Delhi. | | |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: VI |
| Subject: Biology | | |
| Course Code: DCEBY-108 (N) | Course Title: Molecular Genetics and Biotechnology | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> • The genomic organization. • Genetic engineering. • Concept of operon its structure and regulation. • Basic protocols for plant tissue culture. | | |
| Course Outcomes (CO): <ul style="list-style-type: none"> • Understand DNA, RNA, gene expression and regulation. • Genetic engineering, biotechnology and its applications in human welfare with special reference to agriculture. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Molecular genetics- I | |
| Unit I | Nucleic acids (DNA & RNA) and Genetic Materials | |
| Unit II | Structure of DNA, Replication and Types of RNA | |
| Unit III | Gene Expression, Transcription and Translation in Prokaryotes and Eukaryotes | |
| Block 2 | Molecular genetics- II | |
| Unit IV | Gene Regulation, Operon Concept and Transposons | |
| Unit V | Recombinant DNA Technology and Transgenic Plant | |
| Unit VI | Monoclonal Antibodies, DNA Probe and DNA Fingerprinting | |
| Block 3 | Biotechnology | |
| Unit VII | Tissue Culture and Its Techniques | |
| Unit VIII | Culture of Different Tissue, Meristem Culture, Anther Culture Pollen culture, Protoplast culture and Embryo cultures. | |
| Unit IX | Applications of Biotechnology in human welfare with special reference to agriculture | |
| Suggested Text Book Readings: | | |
| Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc. | | |
| Advanced Methods In Physiology And Biochemistry (pb) ISBN : 9789381191132 Edition : 01 Year : 2016 Author : Padmanaban G , Chandrasekaran CN , Thangavelu AU , Dr. Sivakumar R , Kalimuthu N , Dr. Boominathan P , Dr. Anbarasan P, Agrobios. | | |
| Methods in Plant Biochemistry and Molecular Biology. 1997. Dashek, WV (ed.). CRC Press. | | |
| Thimmaiah, SR. 2004. Standard Methods of Biochemical Analysis. Kalyani Publishers. | | |
| Henry, RJ. 1997. Practical Application of Plant Molecular Biology. Chapman & Hall, London | | |
| M K Raxdan An Introduction to Plant Tissue Culture –; Oxfird & IBH Publishing Co.Pvt. Ltd., New Delhi | | |
| Veer Bala Rastogi (2008), Fundamentals of Molecular Biology Ane Books Pvt. Ltd | | |
| J. Nair Introduction to Genetic Engineering & Biotechnology. Jones & Bartlett Publishers, Boston, USA. | | |

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| Course prerequisites: To study this course, a student must have qualified 10+2 with Biology | | |
| Programme: B.Sc. | Year: I | Semester: VI |
| Subject: Biology | | |
| Course Code: DCEBY-109 (N) | Course Title: Paleobotany, Palynology and Economic Botany | |
| Course Objectives: The main objective of the course is to make learners aware of- <ul style="list-style-type: none"> Fossils, pollens and various plants of economic use. | | |
| Course Outcomes (CO): <ul style="list-style-type: none"> Understanding of fossils & Various technology technique used for their study. Palynology and its scope. Economic uses of various plant products. | | |
| Credits: 02 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Paleobotany and palynology | |
| Unit I | Introduction and techniques to study of fossils, Geological time scale | |
| Unit II | Kinds of fossils and reconstruction of fossil, form-genera, Organ-genera, Reconstruction of fossil. | |
| Unit III | Concept and scope of palynology: Pollen units, Pollen preparation, acetolysis method. | |
| Block 2 | Economic botany is divided into five units as under | |
| Unit IV | Spices and flavoring materials: Ginger, Turmeric, Clove, Saffron, Coriander; Botanical description, cultivation and uses. | |
| Unit V | Beverages: Tea and Coffee; Botanical description, cultivation and uses. | |
| Unit VI | Fibers: Jute, Flax, Hemp, Coir, Cotton; Botanical description, cultivation and uses. | |
| Unit VII | Forest products: Wood, Rubbers, Gum and Resines; botanical description, cultivation and uses. | |
| Unit VIII | Medicinal plants: Rauwolfia, Belladonna, Quinine, Opium, Ephedrine; botanical description, cultivation and uses. | |
| Suggested Text Book Readings: P.K.K. Nair- A textbook of Palynology. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition. Sambamurthy, AVSS & Subrahmanyam, NS (2000). Economic Botany of Crop Plants. Asiatech Publishers. New Delhi. Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi Raychudhuri, S.P., 1991. (Ed.) Recent advances in Medicinal aromatic and spice crops. Vol.1, Today& Tomorrow's printers and publishers, New Delhi. | | |

Year-2023-2024
Syllabus of B.Sc. Programme: [Subject Name: Chemistry]
In accordance with NEP-2020

| Year | Sem. | Course Code | Paper Title | Theory/Practical | Max. Marks. | Credits | |
|---|------|---------------------------------|---|------------------|-------------|-----------|--|
| 1 | I | UGCHE -101N | INORGANIC CHEMISTRY I (BASIC INORGANIC CHEMISTRY) | Theory | 100 | 2 | |
| | | UGCHE -101P(N) | Practical Work | Practical | 100 | 2 | |
| 1 | II | UGCHE -102N | ORGANIC CHEMISTRY I (BASIC ORGANIC CHEMISTRY) | Theory | 100 | 2 | |
| | | UGCHE -102P(N) | Practical Work | Practical | 100 | 2 | |
| | | Skill Enhancement Course | | | | | |
| | | SBSCHE-02N | ADVANCED ANALYTICAL TECHNIQUES | Theory | 100 | 4 | |
| 2 | III | UGCHE -103N | PHYSICAL CHEMISTRY I (BASIC PHYSICAL CHEMISTRY) | Theory | 100 | 2 | |
| | | UGCHE -103P(N) | Practical Work | Practical | 100 | 2 | |
| | | Skill Enhancement Course | | | | | |
| | | SBSCHE-01N | ORGANIC CHEMISTRY II (ADVANCE ORGANIC CHEMISTRY) | Theory | 100 | 4 | |
| 2 | IV | UGCHE -104N | INORGANIC CHEMISTRY II (ADVANCE INORGANIC CHEMISTRY) | Theory | 100 | 2 | |
| | | UGCHE -104P(N) | Practical Work | Practical | 100 | 2 | |
| Discipline Centric Elective Course | | | | | | | |
| 3 | V | DCECHE -105N | PHYSICAL CHEMISTRY II (ADVANCE PHYSICAL CHEMISTRY) | Theory | 100 | 2 | |
| | | DCECHE -106N | INORGANIC CHEMISTRY III (SELECTED TOPICS IN INORGANIC CHEMISTRY) | Theory | 100 | 2 | |
| | | DCECHE -107P(N) | Practical Work | Practical | 100 | 2 | |
| Discipline Centric Elective Course | | | | | | | |
| 3 | VI | DCECHE -108N | ORGANIC CHEMISTRY III (SELECTED TOPICS IN ORGANIC CHEMISTRY) | Theory | 100 | 2 | |
| | | DCECHE -109N | PHYSICAL CHEMISTRY III (SELECTED TOPICS IN PHYSICAL CHEMISTRY) | Theory | 100 | 2 | |
| | | DCECHE -110P(N) | Practical Work | Practical | 100 | 2 | |
| Total Marks/Credit | | | | | 1600 | 32 | |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: 10+2 with Chemistry | | |
| Programme: B.Sc. | Year: 1 | Semester: I |
| Subject: Chemistry | | |
| Course Code: UGCHE -101N | Course Title: INORGANIC CHEMISTRY I (BASIC INORGANIC CHEMISTRY) | |
| Course Objectives: | | |
| To provide knowledge about structure of atoms and associated important rules, importance of chemistry of elements, bonding and properties of any compound/material. Several parameters associated with elements, Solid state chemistry and chemistry of elements belonging to s-block, noble gases and main group. | | |
| Course Outcomes: | | |
| CO-1 Structure of atoms and associated important rules, importance of chemistry of elements. | | |
| CO-2 Ionic, covalent and non-covalent bonding which always play pivotal role in deciding the chemistry and properties of any compound/material. | | |
| CO-3 Periodic properties of elements and several parameters associated with elements | | |
| CO-4 Solid state chemistry which forms the basis of the development of targeted crystalline solids inculcating varied defects which induces variety of materials properties viz. piezoelectricity. | | |
| CO-5 Chemistry of elements belonging to s-block, noble gases and main group. | | |
| Credits: 2 | | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| | Atomic Structure | |
| Unit I | Historical concepts of atomic structure. Idea of de-Broglie's matter waves, Heisenberg's uncertainty principle, significance of ψ and ψ^2 , Schrodinger's wave equation for H atom; Radial and angular wave functions: quantum numbers and shapes of s, p, d and f orbitals; Aufbau and Pauli Exclusion Principle. Variation of orbital energies with atomic number and energy level diagram; Long form of periodic table based on electronic configuration. | |
| Unit II | Periodic properties of elements | |
| | Types of radii (Covalent, Crystal and Van der Waal); Electron affinity and its variation; Ionisation potential, Factors affecting the magnitude of I.P., Concept of effective nuclear charge and shielding effect (Calculation of Screening constant with Slater's rules.); Electronegativity (Pauling, Mulliken and Allred Rochow scale) and its variation. | |
| Unit III | Chemical Bonding | |
| | (i) Ionic Bonding: Conditions favouring the ionic bond, radius ratio and structure of ionic solids. Concept of lattice energy and Born-Haber cycle, Polarisation of ions and Fajan's rules. | |
| | (ii) Covalent and brief idea of other bonds: Concept of directed valence bond theory (VBT) and hybrid orbital description (sp , sp^2 , sp^3 , sp^3d and sp^3d^2) using simple illustrations, determination of the shapes of molecules and ions viz. NH_3 , H_2O , H_3O^+ , SF_4 , ClF_3 , ICl_2^- and I_3^- by VSEPR concept, Concept of maximum covalency. Odd electron bond, three centre bond. MO Theory, homonuclear (H_2 , H_2^+ , B_2 , N_2 , O_2 , Cl_2) and heteronuclear (CN, CO and | |

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| | <p>(NO) diatomic molecules, bond strength, and bond energy, percent ionic character from dipole moment and electronegativity. Multicenter bonding in electron deficient molecules.</p> <p>(iii) Weak Interactions: Hydrogen bonding (Inter and Intra Molecular), Vander Waals forces.</p> <p>(iv) Metallic Bond: Theories of bonding in metals; Free electron, VB and Band theories.</p> |
| Block 2 | |
| Unit IV | <p>General Studies of s block elements</p> <p>Comparative study, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls; Chemical reactivity of alkali and earth alkaline metals; Uses of s-block elements and their compounds (Li, Na and K only), Organometallic compounds of Li, Na, K, Be and Mg. Polyether complexes (Crown ether complexes) of alkali metals; Extraction and isolation of Li, Be and Ra from their minerals.</p> |
| Unit V | <p>General Studies of p- block elements</p> <p>Group wise discussion with respect to electronic configuration, ionisation potential, electron affinity, electronegativity, atomic and ionic radii, oxidation states, catenation and inert pair effect (wherever applicable). Preparation, properties and structures of diborane, borazine, hydrazine, interhalogens and polyhalides and fluorides of xenon. Structure and basicities of oxyacids of B, P and S. Structural features of hydrides, halides, oxides and oxyacids.</p> |
| Unit VI | <p>Oxidation and Reduction</p> <p>Electrode potential, electrochemical series and its applications. EMF diagrams and their utility. Principle involved in the extraction of the elements.</p> |
| <p>Suggested Text Book Readings:</p> <p>Text Books (Theory Courses):</p> <p>(a) Concise Inorganic Chemistry, J.D. Lee, Blackwell Science Ltd.</p> <p>(b) Inorganic Chemistry, Puri, Sharma, Kalia and Kaushal.</p> <p>(c) Pradeep's Inorganic Chemistry, K.K. Bhasin, Pradeep Publication.</p> <p>(d) Chemistry for degree students, R. L. Madan</p> <p>Reference Books:</p> <p>(a) Inorganic Chemistry, J.E.Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.</p> <p>(b) Inorganic Chemistry, D.E.Shriver, P W. Atkins and C.H.L. Langford, Oxford.</p> <p>(c) Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.</p> <p>(d) Concepts of Models of Inorganic Chemistry, B.Douglas, D.McDaniel and J Alexander, John Wiley.</p> <p>(e) Inorganic Chemistry, W.W. Porterfield, Addison - Wesley.</p> <p>(f) Inorganic Chemistry, A.G. Sharpe, ELBS</p> <p>(g) Inorganic Chemistry, G.L. Meissler and D.A. Tarr, Prentice-Hall.</p> <p>Suggested online links:</p> <p>http://heecontent.upsdc.gov.in/Home.aspx</p> <p>https://nptel.ac.in/courses/104/106/104106096/</p> <p>https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm</p> <p>https://nptel.ac.in/courses/104/103/104103071/#</p> | |
| <p>Electronic media and other digital components in the curriculum:</p> <p>Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| Name of electronic media: e-SLM | Year of incorporation: 2020 |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year: 1 | Semester: 1 |
| Subject: Chemistry | | |
| Course Code: UGCHE 101P(N) | Course Title: UGCHE-LAB-WORK-I | |
| Course Objectives: To understand basic knowledge and skills about laboratory methods and tests related to estimation of metals ions and estimation of acids and alkali. | | |
| Course Outcomes: CO-1 Upon completion of this course the students will have the knowledge and skills to: understand the laboratory methods and tests related to estimation of metals ions and estimation of acids and alkali contents in commercial products. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | General – Principle and working of Chemical balance. Calibration of fractional weights and thermometer. | |
| Unit II | Inorganic Chemistry Qualitative analysis of an inorganic mixture containing five radicals out of the following preferably by semi-micro technique (including insoluble substances): NH ₄ ⁺ , Na ⁺ , K ⁺ , Mg ⁺⁺ , Ca ⁺⁺ , Sr ⁺⁺ , Ba ⁺⁺ , Zn ⁺⁺ , Mn ⁺⁺ , Ni ⁺⁺ , Co ⁺⁺ , Al ⁺⁺⁺ , Fe ⁺⁺⁺ , Cr ⁺⁺⁺ , Cu ⁺⁺ , Bi ⁺⁺ , Hg ⁺ , Hg ⁺⁺ , Cd ⁺⁺ , As ⁺⁺⁺ , Sb ⁺⁺⁺ , Sn ⁺⁺ , Pb ⁺ , Pb ⁺⁺ , Ag ⁺ , CO ₃ ²⁻ , NO ₂ ⁻ , S ²⁻ , SO ₃ ²⁻ , SO ₄ ²⁻ , F ⁻ , Cl ⁻ , Br ⁻ , NO ₃ ⁻ , CH ₃ COO ⁻ , Borate, Oxalate, and Phosphate. | |
| Suggested Text Book Readings: 1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009. 2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5. 3. Harris, D.C . Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016. 4. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Edition Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University Suggestive digital platforms web links https://www.labster.com/chemistry-virtual-labs/ https://www.vlab.co.in/broad-area-chemical-sciences http://chemcollective.org/vlabs | | |
| This course can be opted as an elective by the students of following subjects: | | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents | | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 | |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: 10+2 Chemistry as subject | | |
| Programme: B.Sc. | Year: 1 | Semester: 2 |
| Subject: Chemistry | | |
| Course Code: UGCHE-102N | Course Title: ORGANIC CHEMISTRY I (BASIC ORGANIC CHEMISTRY) | |
| Course Objectives: <ul style="list-style-type: none"> • To understand different organic compounds with respect to the functional groups and basics of chemical reactions. • To understand different principles of organic chemistry and predict outcomes and derive mechanism of various types of organic reactions. • To understand the concept of Aromaticity of benzenoids & nonbenzenoids. The preparation, reactivity and structure of aromatic compounds. • To learn the preparations, reactivity & stereochemistry of SN¹ & SN² reactions of Halogen compounds. | | |
| Course Outcomes: CO-1 Understand different organic compounds with respect to the functional group and thus capable to name the organic compounds as per IUPAC nomenclature. CO-2 Understand the basics of chemical reactions i.e. Substrate and Reagent, types of Reagents, Electrophilic and Nucleophilic Homolytic and heterolytic fission. Electron mobility, Inductive effect etc. CO-3 Recognize and draw constitutional isomers, stereoisomers, including enantiomers and diastereomers, racemic mixture and meso compounds. CO-4. Understand fundamental principles of organic chemistry and predict outcomes and derive mechanism of various types of organic reactions. CO-5 Understand various types of reactive intermediates and factors affecting their stability CO-6 Understand the nomenclature, synthesis, isomerism and physical properties of alkanes and cycloalkanes. CO-7 Understand the concept of Aromaticity of benzenoids & nonbenzenoids. The preparation, reactivity and structure of aromatic compounds. CO-8 Learn the preparations, reactivity & stereochemistry of SN ¹ & SN ² reactions of Halogen compounds. | | |
| Credits: 2 | | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | Structure and Bonding Atomic orbitals, hybridization, orbital representation of methane, ethane, ethyne and benzene. Polarity of bonds: Inductive, resonance and steric effects hyperconjugation, and their influence on acidity and basicity of organic compounds. Homolysis and Heterolysis; Concept of Carbocation, Carbanion and Free radicals. | |
| Unit II | Mechanism of Organic Reactions and Reaction Intermediates Curved arrow notation, drawing electron movements with allows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents – electrophiles and nucleophiles, Types of organic reactions, Energy considerations. | |

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| | Reactive intermediates – Carbocations, carbanions, free radicals, carbenes, arynes and nitrenes (with examples). Assigning formal charges on intermediates and other ionic species. Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereochemical studies). |
| Unit III | Alkanes and Cycloalkanes IUPAC nomenclature of branched and unbranched alkanes, the alkyl group, classification of carbon atom in alkanes, Isomerism in alkanes, sources methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey-House reaction and decarboxylation of carboxylic acids), physical properties and chemical reactions of alkanes. Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity. |
| Block 2 | |
| Unit IV | Stereochemistry of Organic Compounds Concept of isomerism. Types of isomerism. Optical isomerism – elements of symmetry, molecular chirality, enantiomers, stereogenic center, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centers, diastereomers, threo and erythro diastereomers, meso compounds, resolution of enantiomers, inversion, retention and racemization. Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature. Geometric isomerism – determination of configuration of geometric isomers. E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds. Conformational isomerism -- conformational analysis of ethane and n-butane; conformations of cyclohexane, axial and equatorial bonds, conformation of mono substituted cyclohexane derivatives. Newman projection and Sawhorse formulae, Fischer and flying wedge formulae. Difference between configuration and conformation. |
| Unit V | Alkenes, Cycloalkenes, Dienes and Alkynes Nomenclature of alkenes, methods of formation, mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. The Saytzeff rule, Hofmann elimination, physical properties and relative stabilities of alkenes. Chemical reactions of alkenes – mechanism involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with KMnO ₄ . Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene. Methods of formation, conformation and chemical reactions of cycloalkenes. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization, Chemical reaction – 1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition reactions, hydroboration-oxidation, metal-ammonia reductions, oxidation and polymerization. |
| Unit VI | Arenes and Aromaticity Nomenclature of benzene derivatives. The aryl group. Aromatic nucleus and side chain. Structure of benzene: molecular formula and Kekulé structure. Stability and |

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| | carbon-carbon bond lengths of benzene, resonance structure, MO picture. Aromaticity: the Huckel rule, aromatic ions. Aromatic electrophilic substitution – general pattern of the mechanism, role of σ and π complexes. Mechanism of nitration, halogenation, sulphonation, mercuration and Friedel-Crafts reaction. Energy profile diagrams. Activating and deactivating substituents, orientation and ortho/para ratio. Side chain reactions of benzene derivatives. Birch reduction. Methods of formation and chemical reactions of alhylbenzenes, alkynylbenzenes and biphenyl. |
| Unit VII | Alkyl and Aryl Halides Nomenclature and classes of alkyl halides, methods of formation, chemical reactions. Mechanisms of nucleophilic substitution reactions of alkyl halides, SN2 and SN1 reactions with energy profile diagrams. Polyhalogen compounds: chloroform, carbon tetrachloride. Methods of formation of aryl halides, nuclear and side chain reactions. The addition-elimination and the elimination-addition mechanisms of nucleophilic aromatic substitution reactions. Relative reactivities of alkyl halides vs allyl, vinyl and aryl halides. Synthesis and uses of DDT and BHC. |
| Suggested Text Book Readings: Text Books (Theory Courses): (a) Organic Chemistry, Vol. I, I.L. Finar, Pearson Education. (b) Organic Chemistry, M.K. Jain, Shoban Lal & Co. (c) Pradeep's Organic Chemistry, S.N. Dhawan, Pradeep Publication. Reference Books: (a) Organic Chemistry, Morrison and Boyd, Prentice Hall. (b) Organic Chemistry, L.G. Wade Jr. Prentice Hall. (c) Fundamentals of Organic Chemistry Solomons, John Wiley. (d) Organic Chemistry, Vol. I, II, III S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International) (e) Organic Chemistry, F.A. Carey, McGraw-Hill Inc. (f) Introduction to Organic Chemistry, Streitwiesser, Hathcock and Kosover, Macmillan. Suggested online links: http://heecontent.upsdc.gov.in/Home.aspx https://nptel.ac.in/courses/104/105/104105124/ https://nptel.ac.in/courses/103/106/105106204/ https://nptel.ac.in/courses/104/105/104105034/ https://nptel.ac.in/courses/104/103/104103121/ https://nptel.ac.in/courses/104/102/104102016/ https://nptel.ac.in/courses/104/106/104106106/ https://nptel.ac.in/courses/104/105/104105120/ | |
| This course can be opted as an elective by the students of following subjects: | |
| Suggested equivalent online courses (MOOCs) for credit transfer: 1. Mechanisms in Organic Chemistry, Prof. Nandita Madhavan, NPTEL, https://onlinecourses.nptel.ac.in/noc22_cy42/preview | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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|---|---|------------|
| Course prerequisites: 10+2 Chemistry as subject | | |
| Programme: B.Sc. | Year:1 | Semester:2 |
| Subject: Chemistry | | |
| Course Code: UGCHE 102P (N) | Course Title: UGCHE-LAB-WORK-II | |
| Course Objectives: This course will provide basic qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules. Upon successful completion of this course students may get job opportunities in food, beverage and pharmaceutical industries. | | |
| Course Outcomes: CO1- Preparation of organic compounds CO2- Crystallization and determination of melting points. | | |
| Credits:2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | Organic Chemistry-I (a) Preparation of organic compounds: 1. Acetanilide 2. p-bromoacetanilide 3. picrates | |
| Unit II | Organic Chemistry-II (b) Crystallization and determination of melting point. 1. Phthalic acid from hot water (using fluted filter paper and stemless funnel) 2. Acetanilide from boiling water 3. Naphthalene from ethanol 4. Benzoic acid from water | |
| Suggested Text Book Readings: 1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. <i>Practical Organic Chemistry, 5th Ed.</i> , Pearson (2012). 2. Mann, F.G. & Saunders, B.C. <i>Practical Organic Chemistry</i> , Pearson Education. 3. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla. 4. Vogel, A.I. <i>A Textbook of Quantitative Analysis</i> , ELBS. 1986 5. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. <i>Vogel's Textbook of Practical Organic Chemistry</i> , ELBS. 6. Ahluwalia, V.K. & Aggarwal, R. <i>Comprehensive Practical Organic Chemistry</i> , Universities Press 7. Cooper, T.G. <i>Tool of Biochemistry</i> . Wiley-Blackwell (1977). 8. Wilson, K. & Walker, J. <i>Practical Biochemistry</i> . Cambridge University Press (2009). 9. Varley, H., Gowenlock, A.H & Bell, M.: <i>Practical Clinical Biochemistry</i> , Heinemann, | | |
| Suggestive digital platforms web links 1. https://www.labster.com/chemistry-virtual-labs/ 2. https://www.vlab.co.in/broad-area-chemical-sciences 3. http://chemcollective.org/vlabs | | |
| This course can be opted as an elective by the students of following subjects: | | |
| Suggested equivalent online courses (MOOCs) for credit transfer: | | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents | | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 | |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: 10+2 Chemistry as subject | | |
| Programme: B.Sc. | Year:1 | Semester:2 |
| Subject: Chemistry | | |
| Course Code: SBSCHE -02N | Course Title: ADVANCED ANALYTICAL TECHNIQUES | |
| Course Objectives: | | |
| To gain basics about analytical chemistry plays an enormous role in our society, such as in drug manufacturing, process control in industry, environmental monitoring, medical diagnostics, food production, and forensic surveys. It is also of great importance in different research areas. | | |
| Course Outcomes: | | |
| CO1- Students will be able to explore Analytical chemistry is a science that is directed towards creating new knowledge so that chemical analysis can be improved to respond to increasing or new demands. | | |
| CO2- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology. | | |
| CO3- Students will be able to function as a member of an interdisciplinary problem solving team. | | |
| CO4- Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems | | |
| CO5- Students will gain an understanding of how to determine the structure of organic molecules using IR and NMR spectroscopic techniques | | |
| CO6- To develop basic skills required for purification, solvent extraction, TLC and column chromatography | | |
| Credits: 4 | Type of Course: Core | |
| Category of Course | Value-added / employability/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | Statistical Analysis Definition of terms mean and median, precision, standard deviation, relative standard deviation, accuracy, absolute error, types of error in experimental data, determinate (systematic), indeterminate (or random) and gross, sources of errors and effects upon the analytical results, methods for reporting analytical data, statistical evaluation of data, indeterminate errors, uses of statistics. | |
| Unit II | Volumetric analysis General principles of acid – base titration, precipitation titration, oxidation-reduction titration, iodimetry and iodometry, complexometric titrations, use of EDTA for the determination of Ca ²⁺ and Mg ²⁺ and hardness of water, types of EDTA titrations, metal ion indicators. | |
| Unit III | Gravimetric analysis Precipitation from homogeneous medium, purity of precipitates, co-precipitation, post-precipitation, washing and ignition of precipitates, contamination and their removal. | |
| Block 2 | | |
| Unit IV | Separation techniques Principle, technique and analytical applications of the following: (a) Solvent extraction (b) Chromatography (Paper, Thin Layer, Column and HPLC) (c) Ion exchange | |
| Unit V | Nano Chemistry | |

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| | <p>Nanomaterials – An Introduction, Size Effects, Defining Nanodimensional Materials, Potential Uses for Nanodimensional Materials, The General Methods Available for the Synthesis of Nanodimensional Materials, Precipitative Methods, Reactive Methods in High Boiling Point Solvents, Hydrothermal and Solvothermal Methods, Gas-Phase Synthesis of Semiconductor Nanoparticles, Synthesis in a Structured Medium, The Suitability of Such Methods for Scaling, Conclusions and Perspectives on the Future, Oxide Nanoparticles, Nanotubes and Nanowires. Study of different characterization tools (XRD, TEM, SEM, AFM, etc.) for Nanomaterials.</p> |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Alberty, R A, Physical Chemistry, 4th edition Wiley Eastern Ltd, 2001. 2. Atkins, P W, the elements of physical chemistry, Oxford, 1991 3. Barrow, G .M, International student Edition .McGraw Hill, McGraw-Hill, 1973. 4. Cotton, F.A, Wilkinson, G and Gaus, P. L, Basic Inorganic Chemistry, 3rd Edition, Wiley 1995 5. Lee, J.D, Concise Inorganic Chemistry 4th Edition ELBS, 1977 6. Clayden, J., Greeves, N., Warren, S., <i>Organic Chemistry</i>, Second edition, Oxford University Press 2012. 7. Silverstein, R. M., Bassler, G. C., Morrill, T. C. <i>Spectrometric Identification of Organic Compounds</i>, John Wiley and Sons, INC, Fifth edition. 8. Pavia, D. L. <i>et al. Introduction to Spectroscopy</i>, 5th Ed. Cengage Learning India Ed. 9. Willard, H.H. <i>et al.: Instrumental Methods of Analysis</i>, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988. 10. Christian, G.D. <i>Analytical Chemistry</i>, 6th Ed. John Wiley & Sons, New York, 2004. 11. Harris, D.C.: <i>Exploring Chemical Analysis</i>, 9th Ed. New York, W.H. Freeman, 2016. 12. Khopkar, S.M. <i>Basic Concepts of Analytical Chemistry</i>. New Age International Publisher, 2009. | |
| <p>This course can be opted as an elective by the students of following subjects:</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer:</p> <ol style="list-style-type: none"> 1. Analytical Chemistry, Prof. Debashis Ray, https://onlinecourses.nptel.ac.in/noc22_cy61/preview 2. Spectroscopic Techniques for Pharmaceutical and Biopharmaceutical Industries, Prof. Shashank Deep, https://onlinecourses.nptel.ac.in/noc22_cy54/preview | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation: 2021</p> |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year:2 | Semester:3 |
| Subject: Chemistry | | |
| Course Code: UGCHE -103N | Course Title: PHYSICAL CHEMISTRY I (BASIC PHYSICAL CHEMISTRY) | |
| Course Objectives: To get basic knowledge about computers and mathematical functions and understanding of gaseous state, critical phenomenon, liquid state, solid state, colloidal state and liquid crystals. | | |
| Course Outcomes: CO-1- Students would gain knowledge regarding the basic of computers and mathematical concepts of log, permutation and combination, differential and integration of some relevant functions. CO-2- Student would gain understanding of gaseous state, critical phenomenon, liquid state, solid state, colloidal state and liquid crystals. CO-3- It would help students recognize the importance of chemical kinetics and catalysis. | | |
| Credits:2 | Type of Course: Core | |
| Category of Course | Value-added / employability/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| | Mathematical Concepts and Computers Unit 1: Mathematical Concepts and Computers (A) Mathematical Concepts Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like $f(x)$, e^x , x^n , $\sin x$, $\log x$; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions; permutations and combinations, Factorials, Probability and Regrrations. (B) Computers General introduction to computers, different components of a computer, hardware and software, input-output devices; binary numbers and arithmetic; introduction to computer languages. Programming, operating systems. Use and application of different software in the Chemistry. | |
| Unit I | | |
| Unit II | Gaseous and Liquid States (A) Gaseous States Postulates of kinetic theory of gases, deviation from ideal behaviour, van der Waals equation of state. Critical Phenomena : PV isotherms of real gases, continuity of states, the isotherms of van der Waals equation, relationship between critical constants and van der Waals constants, the law of corresponding states, reduced equation of state. Molecular Velocities : Root mean square, average and most probable velocities. Qualitative discussion of the Maxwell's distribution of molecular velocities, collision number, mean free path and collision diameter. Liquefaction of gases. (B) Liquid State Intermolecular forces, structure of liquids (a qualitative description). Structural differences between solids, liquids and gases. | |

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| | Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic, smectic and cholesteric phases and applications. |
| Unit III | <p>Solid State Definition of space lattice and unit cell.</p> <p>Laws of crystallography: (i) Law of constancy of interfacial angles (ii) Law of rationality of indices (iii) Law of symmetry - Symmetry elements in crystals.</p> <p>X-ray diffraction: Derivation of Bragg's equation. Determination of crystal structure of NaCl, CsCl and KCl. A brief introduction to point defects in crystals, semiconductors, superconductors and nanomaterials (only qualitative idea).</p> |
| Block 2 | |
| Unit IV | <p>Thermodynamics – I Definition of terms: system, surroundings, open system, isolated system, intensive and extensive properties, State and path functions and their differentials, reversible and irreversible processes, Concept of heat and work. <i>First Law of Thermodynamics:</i> Concepts of internal energy and enthalpy, heat capacities at constant volume and constant pressure and their relationship. Calculation of w, q, dU & dH for the expansion of ideal gases under isothermal and adiabatic conditions for a reversible process. <i>Thermochemistry :</i> standard state, standard enthalpy of formation- Hess's Law of constant heat summation and its applications, heat of reaction at constant pressure and at constant volume, Bond dissociation energy and its calculation from thermochemical data, Kirchhoff's equation.</p> |
| Unit V | <p>Electrochemistry – I and Solution Electrical transport - conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Activity and activity coefficient. Transport number, definition and determination by Hittorf method and moving boundary method.</p> <p>Solution Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.</p> |
| Unit VI | <p>Chemical Kinetics and Catalysis Rate of a reaction- factors influencing the rate of a reaction such as concentration, temperature, pressure, solvent, light and catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions - zero order, first order, second order, pseudo order, half life and mean life. Determination of the order of reaction - differential method, method of integration, method of half life</p> |

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| | <p>period and isolation method. Radioactive decay as a first order phenomenon. Experimental methods for the studies of chemical kinetics.</p> <p>Theories of chemical kinetics: Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy, Simple collision theory based on hard sphere model, transition state theory (equilibrium hypothesis). Expression for the rate constant based on equilibrium constant and thermodynamic aspects.</p> <p>Catalysis: Characteristics of catalyzed reactions, classification of catalysis, Industrial catalysts and enzyme kinetics.</p> |
| <p>Suggested Text Book Readings:</p> <p>Text Books (Theory Courses):</p> <ol style="list-style-type: none"> Physical Chemistry, Puri Sharma & Pathania. Pradeep Physical Chemistry, Khetrapal, Pradeep Publication. Computers and Common Sense, R. Hunt and Shelly, Prentice Hall. <p>Reference Books:</p> <ol style="list-style-type: none"> Physical Chemistry. G.M. Barrow. International Student Edition, McGrawHill Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd. The Elements of Physical Chemistry, P.W. Atkins, Oxford. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd. Basic Programming with Application, V.K. Jain, Tata McGraw Hill. Physical Chemistry, Glasstone <p>Suggestive digital platforms web links</p> <ol style="list-style-type: none"> https://www.coursera.org/courses?query=chemistry&languages=en https://www.mooc-list.com/tags/physical-chemistry https://www.coursera.org/learn/physical-chemistry https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2017/ http://heecontent.upsdc.gov.in/Home.aspx https://nptel.ac.in/courses/104/108/104108078/ https://nptel.ac.in/courses/104/108/104108124/ https://nptel.ac.in/courses/104/106/104106122/ | |
| <p>This course can be opted as an elective by the students of following subjects:</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer:</p> <ol style="list-style-type: none"> Chemical Crystallography, Prof. Angshuman Roy Choudhury, https://onlinecourses.nptel.ac.in/noc22_cv48/preview | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation: 2021</p> |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year:2 | Semester:4 |
| Subject: Chemistry | | |
| Course Code: UGCHE -104N | Course Title: INORGANIC CHEMISTRY II (ADVANCE INORGANIC CHEMISTRY) | |
| Course Objectives: <ul style="list-style-type: none"> • To give basic knowledge about Chemistry of transition and inner-transition elements. • To give basic knowledge about Concepts of coordination chemistry and their applications • To give basic knowledge about Importance and different chemical aspects of non-aqueous solvents | | |
| Course Outcomes: CO-1 Chemistry of transition and inner-transition elements. These insights are important as they help in the rational selection of the cations of these elements for tailor-made syntheses of newer complexes CO-2 Concepts of coordination chemistry and their applications CO-3 Importance of different acid-base concepts which forms the basis of rational ligand designing and coordination complex formation for specific bioinorganic, materials and optoelectronic applications. CO-4 Importance and different chemical aspects of non-aqueous solvents which now-a-days are gaining importance in varied targeted syntheses of drugs and materials for technological applications | | |
| Credits:2 | | Type of Course: Core |
| Category of Course | | value-added / employability/ |
| Max. Marks: 100 | | Min. Passing Marks: 36 |
| Block 1 | | |
| Unit I | Molecular Symmetry Symmetry Elements, Symmetry Operations and Point groups of different compounds. Character Tables of H ₂ O and NH ₃ . | |
| Unit II | Chemistry of Transition Elements Position in periodic table, electronic configuration, General Characteristics, viz., atomic and ionic radii, variable oxidation states, ability to form complexes, formation of coloured ions and catalytic behaviour. General comparative treatment of 4d and 5d (Zr/Hf, Nb/Ta, Mo/W) elements with their 3d analogues with respect to ionic radii, oxidation states and magnetic properties. | |
| Unit III | Coordination Compounds (i) Definition of ligand: Classification with respect to denticity. (Examples of mono- to hexadentate ligands). (ii) IUPAC-Nomenclature of Transition Metal complexes. (iii) Werner's postulates, Sidgwick's effective atomic number concept and limitations, Valence Bond Theory of coordination compounds, Stereochemistry of coordination numbers two, four, five and six with examples of hybrid orbital participation in the following : | |

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| | <p>[Ag(NH₃)₂]⁺, [Ag(CN)₂]⁻, [Ni(CN)₄]ⁿ⁻ (n=2 and 4), [Cu(NH₃)₄]²⁺, [Zn(NH₃)₄]²⁺, [MnO₄]⁻, [Fe(CN)₆]ⁿ⁻ (n=3 and 4), [FeF₆]³⁻, [Fe(H₂O)₆]³⁺, [Fe(C₂O₄)₃]³⁻, [Co(NH₃)₆]³⁺, [Co(en)₃]³⁺, [Ni(NH₃)₆]²⁺, [PbCl₆]²⁻</p> <p>(iv) Stability Constant of Transition Metal complexes and Chelate effect</p> <p>(v) Various types of isomerism, viz., hydrate, ionisation, linkage, polymerization and coordination position. Stereoisomerism in C.N.-4 and C.N.-6 (only ML₄L'₂ and ML₃L'₃ complexes).</p> |
| Block 2 | |
| Unit IV | <p>Chemistry of Lanthanides and Actinides</p> <p>i. Electronic Configuration, ii. Atomic, Ionic radii and Lanthanide Contraction. iii. Ionisation energy , iv. Calculation of magnetic moments and correlation with experimental data (specially for lanthanides), v. Colour and spectral behaviour, vi. Oxidation states and their stability, vii. Ability to form complexes and examples of complexes of different coordination numbers. viii. Occurrence and principle of separation of lanthanides. ix. Chemistry of separation of Np, Pu and Am from U and x. One synthesis each of Np to Lr.</p> |
| Unit V | <p>Chemistry of Nobel Gases</p> <p>Properties, Occurrence, Isolations and Applications. Chemistry of Noble Gases, Compounds of Xenon & Krypton and their reactions. Clathrates.</p> |
| Unit VI | <p>Acid - Base and Non-aqueous solvents</p> <p>Acid - Base concept -Lewis concept, Concept and classification of hard and soft acids and bases. Applications of HSAB principle.</p> <p>Non-aqueous solvents-Classification and characteristic properties of solvents. Types of chemical reactions occurring in liquid ammonia (NH₃) and liquid sulphur dioxide (SO₂).</p> |
| <p>Suggested Text Book Readings:</p> <p>Text Books (Theory Courses):</p> <p>a. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science Ltd. b. Inorganic Chemistry, Puri, Sharma, Kalia and Kaushal. c. Pradeep's Inorganic Chemistry, K.K. Bhasin, Pradeep Publication. d. Chemistry for degree students, R. L. Madan</p> <p>Reference Books:</p> <p>a. Inorganic Chemistry, J.E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd. b. Inorganic Chemistry, D.E. Shriver, P W. Atkins and C.H.L. Langford, Oxford. c. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley. d. Concepts of Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and J Alexander, John Wiley. e. Inorganic Chemistry, W.W. Porterfield, Addison - Wesley. f. Inorganic Chemistry, A.G. Sharpe, ELBS g. Inorganic Chemistry, G.L. Meissler and D.A. Tarr, Prentice-Hall.</p> | |

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| <p>Suggested online links: http://heecontent.upsdc.gov.in/Home.aspx https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm https://nptel.ac.in/courses/104/103/104103071/# https://swayam.gov.in/</p> | |
| <p>This course can be opted as an elective by the students of following subjects:</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: Attempt all courses</p> <ol style="list-style-type: none"> 1. Symmetry and Group Theory , Prof. Anindya Datta NPTEL , https://onlinecourses.nptel.ac.in/noc22_cy40/preview 2. Transition Metal Organometallic Chemistry: Principles To Applications , Prof. P. Ghosh , NPTEL https://onlinecourses.nptel.ac.in/noc22_cy39/preview 3. Advanced Transition Metal , Prof. M S Balakrishna , NPTEL https://onlinecourses.nptel.ac.in/noc22_cy60/preview 4. Chemistry of d-block elements, Quantum Chemistry and Spectroscopy, Dr. Niraj Upadhyay , Dr. Harisingh Gour Vishwavidyalaya, Sagar https://onlinecourses.swayam2.ac.in/cec22_cy05/preview | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than:(Electronic Media: Audio/Video Lectures, Online Counselling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)</p> | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year:2 | Semester:3 |
| Subject: Chemistry | | |
| Course Code: SBSCHE-01N | Course Title: ORGANIC CHEMISTRY II (ADVANCE ORGANIC CHEMISTRY) | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To provide knowledge about preparation and chemical reactions of Alcohols and Epoxides - Alcohols Dihydric alcohols: (Ethylene Glycol) • To provide basic knowledge about the order of reactivity of different carboxylic acid derivatives and the reactivity of different carboxylic acid derivatives. • To provide knowledge about mechanism of named reactions of carbonyl compounds and condensation reactions as well as their use in food and pharmaceuticals. | | |
| Course Outcomes: | | |
| CO-1 The preparation and chemical reactions of Alcohols and Epoxides - Alcohols Dihydric alcohols: (Ethylene Glycol) | | |
| CO-2 Understanding the order of reactivity of different carboxylic acid derivatives and the reactivity of different carboxylic acid derivatives. | | |
| CO-3 Able to recognize structures of acid halides, esters, amides, acid anhydrides. | | |
| CO-4 Able to write down structure of phenol and phenoxide ion and chemical reactions of phenols. | | |
| CO-5 Know the mechanism of named reactions of carbonyl compounds and condensation reactions as well as their use in food and pharmaceuticals. | | |
| Credits:4 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | Electromagnetic Absorption Spectra Electromagnetic Radiations, Electromagnetic spectrum and absorption of radiations. The Absorption Laws. UV-Visible spectrophotometer, formation of Absorption Band. Chromatophore Concept, Calculation of Absorption Maximum. Infra Red Spectroscopy Fundamental and Applications. | |
| Unit II | Alcohols and Phenols Classification and nomenclature. Monohydric alcohols – nomenclature, methods of formation by reduction of aldehydes, Ketones, Carboxylic acids and Esters, Hydrogen bonding, Acidic nature, Reactions of alcohols. Dihydric alcohols – nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc) ₄ and HIO ₄] and pinacolo-pinacolone rearrangement. Trihydric alcohols – nomenclature and methods of formation, chemical reactions of glycerol. Phenols Nomenclature, structure and bonding, Preparation of phenols, physical properties and acidic character. Comparative acidic strengths of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols – electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries | |

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| | rearrangement, Claisen rearrangement, Gatterman synthesis, Hauben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction. |
| Unit III | <p>Ethers and Epoxide</p> <p>Ethers Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions – cleavage and autoxidation, Ziesel's method. Williamson's synthesis, formation and cleavage of oxonium salts, elementary idea about crown ethers.</p> <p>Epoxides Synthesis of epoxides, Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.</p> |
| Block 2 | |
| Unit IV | <p>Aldehydes and Ketones Nomenclature and structure of the carbonyl groups, synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitrites and from carboxylic acids. Physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villiger oxidation of Ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, LiAlH_4 and NaBH_4 reductions. Halogenation of enolizable ketones. An introduction to α,β unsaturated aldehydes and ketones.</p> |
| Unit V | <p>Carboxylic Acids and Derivatives Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction, Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids, Mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids, Hydroxy acids: malic, tartaric and citric acids. Methods of formation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids: methods of formation and effect of heat and dehydrating agents.</p> <p>Carboxylic Acid Derivatives Structure and nomenclature of acid chlorides, esters, amides(urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution Preparation of carboxylic acid derivatives, chemical reactions. Mechanisms of esterification and hydrolysis (acidic and basic).</p> |
| Unit VI | <p>Organic Compounds of Nitrogen Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media. Picric acid. Halonitroarenes: reactivity, Structure and nomenclature of amines, physical properties. Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural</p> |

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| | <p>features effecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitrites), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction. Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.</p> |
| <p>Suggested Text Book Readings:</p> <p>a) Organic Chemistry, Morrison and Boyd, Prentice Hall. b) Organic Chemistry, L.G. Wade Jr. Prentice Hall c) Fundamentals of Organic Chemistry Solomons, John Wiley. d) Organic Chemistry, Vol. I, II, III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley Eastern Ltd. (New Age International). e) Organic Chemistry, F.A. Carey, McGraw-Hill Inc. f) Introduction to Organic Chemistry, Streitwiesser, Hathcock and Kosover, Macmillan. g) Organic Chemistry, Vol. I, II, I.L. Finar h) Spectrometric Identification of organic compounds. Robert M. Silverstein, Clayton G. Bassler, Terence C. Morrill, John Wiley.</p> <p>Suggested online links: http://heecontent.upsdc.gov.in/Home.aspx https://nptel.ac.in/courses/104/105/104105124/ https://nptel.ac.in/courses/103/106/105106204/ https://nptel.ac.in/courses/104/105/104105034/ https://nptel.ac.in/courses/104/103/104103121/ https://nptel.ac.in/courses/104/102/104102016/ https://nptel.ac.in/courses/104/106/104106106/ https://nptel.ac.in/courses/104/105/104105120/</p> | |
| <p>This course can be opted as an elective by the students of following subjects:</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer:</p> <ol style="list-style-type: none"> 1. Organic Chemistry-1, Dr. B. S. Balaji, Jawaharlal Nehru University, https://onlinecourses.swayam2.ac.in/cec22_cy06/preview 2. Reagents In Organic Synthesis, Prof. Subhas Chandra Pan, https://onlinecourses.nptel.ac.in/noc22_cy55/preview 3. Introductory Organic Chemistry II, Prof. Neeraja Dashaputre/Prof. Harinath Chakrapani, https://onlinecourses.nptel.ac.in/noc22_cy46/preview | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation: 2021</p> |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year: 3 | Semester:5 |
| Subject: Chemistry | | |
| Course Code: DCECHE -105N | Course Title: PHYSICAL CHEMISTRY II (ADVANCE PHYSICAL CHEMISTRY) | |
| Course Objectives: To understand basic knowledge about first law and second law of thermodynamics, thermochemistry, entropy enthalpy etc. | | |
| Course Outcomes: CO-1- After the completion of the semester, student will acquire knowledge of first law and second law of thermodynamics, thermochemistry, entropy enthalpy etc. CO-2- It will also make them familiar with conductance, equivalent conductance, Kohlrausch's law, Ostwald dilution law, Deby-Huckel Onsagar equation, e.m.f. of cell, types of cell, liquid junction potential, pH and pka, Henderson- Hazel equation etc. | | |
| Credits: 2 | Type of Course: Core | |
| Category of Course(Please mention category of course; It may have more than one option) | employability/ skill development/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | <p>Chemical Equilibrium and Phase Equilibrium Equilibrium constant and free energy. Thermodynamic derivation of law of mass action. Le Chatelier's principle.</p> <p>Phase Equilibrium Statement and meaning of the terms - phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component system - water, Sulphur and Helium. First and second order phase transitions. Phase equilibria of two component systems - solid-liquid equilibria, simple eutectic - Pb-Ag system, desilverisation of lead, Systems involving compound formation with a congruent melting point (Mg-Zn) and an incongruent melting point (CuSO₄-H₂O). Nernst distribution law and its thermodynamic derivation</p> | |
| Unit II | <p>Thermodynamics –II <i>Second law of thermodynamics: concept of entropy</i>, entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical process. Gibbs and Helmholtz functions; Criteria for thermodynamic equilibrium and spontaneity in term of changes in entropy, Gibbs and Helmholtz functions. Concept of chemical potential.</p> | |
| Unit III | <p>Electrochemistry – II Types of reversible electrodes - gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode-reference</p> | |

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| | <p>electrodes-standard electrode potential, sign conventions, electrochemical series and its significance.</p> <p>Electrolytic and Galvanic cells - reversible and irreversible cells, conventional representation of electrochemical cells.</p> <p>EMF of a cell and its measurements. Computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K).</p> <p>Concentration cell with and without transport, liquid junction potential, application of concentration cells, valency of ions, solubility product and activity coefficient, potentiometric titrations.</p> <p>Definition of pH and pKa determination of pH using hydrogen, quinhydrone and glass electrodes, by potentiometric methods.</p> <p>Buffers - mechanism of buffer action, Henderson-Hassel equation. Hydrolysis of salts.</p> <p>Electrochemical corrosion and its prevention.</p> |
| Block 2 | |
| Unit IV | <p>Colloidal State and Macromolecules</p> <p>Definition of colloids and classification of colloids. Donnan membrane theory and its application. Electrokinetic Potential (Zeta potential).</p> <p>Solids in liquids (sols): properties - kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.</p> <p>Liquids in liquids (emulsions): types of emulsions, preparation, Emulsifier.</p> <p>Liquids in solids (gels): classification, preparation and properties, inhibition, general applications of colloids.</p> <p>Macromolecules : Determination of molecular weight of macromolecules by osmotic pressure and viscosity methods. Concepts of micelles and critical micelle concentrations.</p> <p>A brief introduction to conducting and light emitting polymers.</p> |
| Unit V | <p>Surface Phenomenon</p> <p>Surface Chemistry</p> <p>Adsorption, difference between Physical adsorption and chemisorption, Adsorption isotherms - Langmuir adsorption isotherm and Freundlich adsorption isotherm, Gibbs adsorption equation, BET equation, Determination of surface area.</p> |
| Unit VI | <p>Physical Properties and Chemical Constitution</p> <p>Molar volume, Parachor Molar refraction and Polarisation, Dipolemoment, Debye equation (derivation not required) and Clausius-Mosotti equation.</p> |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> Physical Chemistry. G.M. Barrow. International Student Edition, McGraw Hill. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd. The Elements of Physical Chemistry, P.W. Atkins, Oxford. Physical Chemistry Through problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd. Graduate physical Chemistry, Volume I-III By L.R. Sharma and M.S. Pathania Principles of Physical Chemistry by B.R. Puri, L.P Sharma and M.S. Pathania, Vishal publication, Jalandhar. <p>Suggestive digital platforms web links</p> <ol style="list-style-type: none"> https://www.coursera.org/courses?query=chemistry&languages=en https://www.mooc-list.com/tags/physical-chemistry https://www.coursera.org/learn/physical-chemistry | |

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| <p>4. https://ocw.mit.edu/courses/chemistry/5-61-physical-chemistry-fall-2017/ 5. http://heecontent.upsdc.gov.in/Home.aspx 6. https://nptel.ac.in/courses/104/108/104108078/ 7. https://nptel.ac.in/courses/104/108/104108124/ 8. https://nptel.ac.in/courses/104/106/104106122/</p> | |
| <p>This course can be opted as an elective by the students of following subjects:</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer:</p> <ol style="list-style-type: none"> 1. Chemistry and Physics of Surfaces and Interfaces, Prof. Thiruvancheril G. Gopakumar, NPTEL, https://onlinecourses.nptel.ac.in/noc22_cv57/preview 2. Introduction to Chemical Thermodynamics and Kinetics, Prof. Arijit Kumar De, NPTEL, https://onlinecourses.nptel.ac.in/noc22_cv58/preview | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/Other electronic and digital contents</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation: 2021</p> |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year:3 | Semester:5 |
| Subject: Chemistry | | |
| Course Code: DCECHE -106 | Course Title: INORGANIC CHEMISTRY III (SELECTED TOPICS IN INORGANIC CHEMISTRY) | |
| Course Objectives: <ul style="list-style-type: none"> • To provide basic knowledge about chemistry of transition and inner-transition elements, Concepts of coordination chemistry and their applications • To provide basic knowledge about importance of different acid-base concepts. | | |
| Course Outcomes: <p>CO-1 Chemistry of transition and inner-transition elements. These insights are important as they help in the rational selection of the cations of these elements for tailor-made syntheses of newer complexes</p> <p>CO-2 Concepts of coordination chemistry and their applications</p> <p>CO-3 Importance of different acid-base concepts which forms the basis of rational ligand designing and coordination complex formation for specific bioinorganic, materials and optoelectronic applications.</p> <p>CO-4 Importance and different chemical aspects of non-aqueous solvents which now-a-days are gaining importance in varied targeted syntheses of drugs and materials for technological applications</p> | | |
| Credits: 2 | | Type of Course: Elective |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | <p>Metal-ligand Bonding in Transition Metal Complexes Limitations of valence bond theory, an elementary idea of crystal field theory, Crystal Field Stabilization Energy (CFSE), crystal field splitting in octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.</p> <p>Thermodynamic and Kinetic Aspects of Metal Complexes A brief outline of thermodynamic stability of metal complexes and factors affecting the stability, substitution reactions of square planar complexes and trans effect.</p> | |
| Unit II | <p>Magnetic and Electronic spectra of Transition Metal Complexes</p> <p>(a) Electronic spectra of Transition Metal Complexes Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel-energy level diagram for d^1 and d^9 states, discussion of the electronic spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex ion.</p> <p>(b) Magnetic Properties of Transition Metal Complexes Types of magnetic behavior, methods of determining magnetic susceptibility, spin-only formula. L-S coupling, correlation of μ_s and μ_{eff} values, orbital contribution to magnetic moments, application of magnetic moment data for 3d-metal complexes.</p> | |
| Unit III | <p>Organometallic Chemistry Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and catalytic applications of alkyls and aryls of Li, Al, Hg, Sn.</p> | |
| Block 2 | | |

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| Unit IV | <p>Metal Carbonyls and Nitrosyls</p> <p>(a) Metal Carbonyls : Ligand behaviour of CO, General methods of preparation, 18 electron rule, nature of bonding (Synergic effect) in the mononuclear carbonyls, Representation of structures of the binary carbonyls of all nuclearities of V, Cr, Mn, Fe, Co and Ni.</p> <p>(b) Metal Nitrosyls : Ligand behaviour of NO (NO^+, NO^- and bridging NO), preparation and structures of nitrosyls of Cr, Fe and Ru; carbonyl nitrosyls and cyano nitrosyls</p> |
| Unit V | <p>Inorganic Polymers Silicones and Phosphazenes</p> <p>Silicons and phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.</p> |
| Unit VI | <p>Inorganic Biochemistry</p> <p>Essential and trace elements in biological processes, metalloporphyrins with special reference to oxygen carriers hemoglobin chemistry and myoglobin. Vitamin B-12, Nitrogenase and Chlorophyll structure and applications. Biological role of alkali and alkaline earth metal ions with special reference to Na^+, K^+ and Ca^{2+}.</p> |
| Unit VII | <p>Environmental Chemistry and Green Chemistry</p> <p>(a) Environmental Chemistry :The earth's atmosphere and its components, Lapse rate, Types of pollutants and their sources (in water, Air and Soil). Green house effect and global warming. Acid rains, Ozone layer (Importance and its protection).</p> <p>(b) Green Chemistry</p> <p>Principles and concept of green chemistry, atom economic and noneconomic reactions, reducing toxicity, a few examples of environmental friendly reactions and reaction media.</p> |
| Unit VIII | <p>Metal and Metallurgy</p> <p>General principles of extraction and purification of metals. Occurrence and isolation of elements, Extraction and isolation of Metals (Y, La, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, Re, Fe, Co, Ni and platinum) from their minerals.</p> |
| <p>Suggested Text Book Readings:</p> <p>a. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science Ltd.</p> <p>b. Inorganic Chemistry, Puri, Sharma, Kalia and Kaushal.</p> <p>c. Pradeep's Inorganic Chemistry, K.K. Bhasin, Pradeep Publication.</p> <p>d. Chemistry for degree students, R. L. Madan</p> <p>Reference Books:</p> <p>a. Inorganic Chemistry, J.E. Huheey, Ellen A. Keiter, Richard L. Keiter, Addison Wesley Longman (Singapore) Pvt. Ltd.</p> <p>b. Inorganic Chemistry, D.E. Shriver, P W. Atkins and C.H.L. Langford, Oxford.</p> <p>c. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.</p> <p>d. Concepts of Models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and J Alexander, John Wiley.</p> <p>e. Inorganic Chemistry, W.W. Porterfield, Addison - Wesley.</p> <p>f. Inorganic Chemistry, A.G. Sharpe, ELBS</p> <p>g. Inorganic Chemistry, G.L. Meissler and D.A. Tarr, Prentice-Hall.</p> <p>Suggestive digital platforms web links: https://swayam.gov.in/</p> | |

<https://www.coursera.org/learn/physical-chemistry>
<https://www.mooc-list.com/tags/physical-chemistry>
<https://www.openlearning.com/courses/introduction-to-physical-chemistry/>
<https://www.my-mooc.com/en/categorie/chemistry>
https://onlinecourses.swayam2.ac.in/nce19_sc15/preview
<https://www.coursera.org/browse/physical-science-and-engineering/chemistry>

This course can be opted as an elective by the students of following subjects:

Suggested equivalent online courses (MOOCs) for credit transfer:

Electronic media and other digital components in the curriculum:

Choose any one or more than:e-SLM/Other electronic and digital contents

Name of electronic media: e-SLM

Year of incorporation: 2022

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year:3 | Semester:6 |
| Subject: Chemistry | | |
| Course Code: DCECHE -108 | Course Title: ORGANIC CHEMISTRY III (SELECTED TOPICS IN ORGANIC CHEMISTRY) | |
| <p>Course Objectives: This course will provide basic qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules. Upon successful completion of this course students may get job opportunities in food, beverage and pharmaceutical industries.</p> | | |
| <p>Course Outcomes: CO1: To gain knowledge about qualitative and quantitative experimental knowledge of biomolecules such as carbohydrates, proteins, amino acids, nucleic acids drug molecules. CO2: To provide knowledge about Organometallic Compounds, Sulphur Containing Compounds and NMR Spectroscopy.</p> | | |
| Credits: 2 | | Type of Course: Elective |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | <p>NMR (PMR) Spectroscopy Proton magnetic resonance (¹H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of ¹H NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone. Problems pertaining to the structures elucidation of simple organic compounds using UV, IR and ¹H NMR spectroscopic techniques.</p> | |
| Unit II | <p>Organometallic Compounds Organomagnesium compounds: the Grignard reagents, formation, structure and Chemical reactions. Organozinc compounds: formation and chemical reactions. Organolithium compounds: formation and chemical reactions.</p> | |
| Unit III | <p>Sulphur Containing Compounds Nomenclature, structural formation, Methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides & Sulphaguamide.</p> | |
| Block 2 | | |
| Unit IV | <p>Amino Acids, Peptides, Proteins and Nucleic Acids Classification, structure and stereochemistry of amino acids. Acid-base behaviour, Isoelectric point and electrophoresis, Preparation and reactions of α-amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins, Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure, Protein denaturation/renaturation. Nucleic acids: Introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.</p> | |
| Unit V | <p>Active Methylene Group</p> | |

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| | Preparation and synthetic applications of ethyl acetoacetate and diethyl malonate, Tautomerism. |
| Unit VI | Carbohydrates Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers, Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. Structures of ribose and deoxyribose. An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination. |
| Unit VII | Problem based on Spectroscopy (UV-Vis., IR and PMR) |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012). 2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education. 3. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla. 4. Vogel, A.I. A Textbook of Quantitative Analysis, ELBS. 1986 5. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, ELBS. 6. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press 7. Cooper, T.G. Tool of Biochemistry. Wiley-Blackwell (1977). 8. Wilson, K. & Walker, J. Practical Biochemistry. Cambridge University Press (2009). 9. Varley, H., Gowenlock, A.H & Bell, M.: Practical Clinical Biochemistry, Heinemann, | |
| Suggestive digital platforms web links | |
| <ol style="list-style-type: none"> 1. https://www.labster.com/chemistry-virtual-labs/ 2. https://www.vlab.co.in/broad-area-chemical-sciences 3. http://chemcollective.org/vlabs | |
| This course can be opted as an elective by the students of following subjects: | |
| Suggested equivalent online courses (MOOCs) for credit transfer: Attempt all courses | |
| <ol style="list-style-type: none"> 1. Application of Spectroscopic Methods in Molecular Structure Determination, Prof. S. Sankararaman, https://onlinecourses.nptel.ac.in/noc22_cy45/preview 2. NMR spectroscopy, Prof. R. V Hosur, https://onlinecourses.nptel.ac.in/noc22_cy59/preview 3. Organic Chemistry In Biology, Prof. Amit Basak, https://onlinecourses.nptel.ac.in/noc22_cy62/preview | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: e-SLM/ Other electronic and digital contents | |
| Name of electronic media: 2022 | Year of incorporation: 2022 |

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year:3 | Semester:6 |
| Subject: Chemistry | | |
| Course Code: DCECHE -109 | Course Title: PHYSICAL CHEMISTRY III (SELECTED TOPICS IN PHYSICAL CHEMISTRY) | |
| <p>Course Objectives:</p> <ul style="list-style-type: none"> • To provide knowledge about Quantum mechanics as well as of spectroscopy with comprehensive understanding of valence bond model and molecular orbital model. • To provide knowledge about Ultraviolet absorption spectroscopy, Vibrational, Rotational and Electronic Spectroscopy, Infrared spectroscopy and Bioenergetics | | |
| <p>Course Outcomes:</p> <p>CO-1 Quantum mechanics as well as of spectroscopy. They will have comprehensive understanding of valence bond model and molecular orbital model.</p> <p>CO-2 Ultraviolet absorption spectroscopy, Beer Lambert Law, types of electronic transitions and the effect of conjugation and concept of chromophore and auxochrome.</p> <p>CO-3 Vibrational, Rotational and Electronic Spectroscopy of simple molecule.</p> <p>CO-4 Infrared spectroscopy in which characteristic absorptions of various functional groups.</p> <p>CO-5 Bioenergetics-Gibbs and Helmholtz energies with special emphasis on biological applications</p> | | |
| Credits:2 | | Type of Course: Core |
| Category of Course | | value-added / employability |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi should be framed block wise/unit wise; No of blocks and units may change) | | |
| Block 1 | | |
| | Elementary Quantum Mechanics | |
| Unit I | Black-body radiation, Planck's radiation law, photoelectric effect, heat capacity of solids, Bohr's model of hydrogen atom (no derivation) and its defects, Compton effect. de Broglie's hypothesis, the Heisenberg's uncertainty principle, Hamiltonian operator. Statement of the Born- Oppenheimer approximation, degrees of freedom. | |
| Unit II | Molecular Statistics | |
| | The Boltzmann distribution. Maxwell distribution law for distribution of molecular speeds. The Maxwell-Boltzmann distribution law for the distribution of molecular energies. The partition functions. Thermodynamic quantities from partition functions. The Sackur-Tetrode equation for molar entropy of monatomic gases. Rotational and vibrational partition functions. The characteristic temperature. The calculation of Gibbs free energy changes and equilibrium constant in terms of partition functions. | |
| Unit III | Laws of Photochemistry | |
| | Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry: Grothus – Drapper law, Stark – Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, nonradiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions – energy transfer processes (simple examples). | |

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| Block 2 | |
| Unit IV | <p>Vibrational, Rotational and Electronic Spectroscopy</p> <p>Rotational Spectrum: Diatomic molecules: Energy levels of a rigid rotor (semi-classical principles), selection rules, spectral intensity, distribution using population distribution (Maxwell-Boltzmann distribution) determination of bond length, qualitative description of non-rigid rotor, isotope effect.</p> <p>Vibrational Spectrum: <i>Infrared spectrum:</i> Energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of different functional groups.</p> <p>Raman Spectrum: Concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules.</p> <p>Electronic Spectrum: Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative description of selection rules and Franck-Condon principle.</p> <p>Qualitative description of σ, π- and n M.O., their energy levels and the respective transitions.</p> |
| Unit V | <p>Nuclear Chemistry</p> <p>Nuclear reactions: Bethe notation, types of nuclear reactions (n, p, α, d and γ), conservation of quantities (mass-energy and linear momentum) in nuclear reactions, reaction cross-section, compound nucleus theory and nuclear reactions. Nuclear fission: the process, fragments, mass distribution, and fission energy. Nuclear reactor: the natural uranium reactor, classification of reactors, breeder reactor. Nuclear fusion and stellar energy.</p> <p>Radiation chemistry: Elementary ideas of radiation chemistry, radiolysis of water and aqueous solutions, unit of radiation chemical yield (G-value), radiation dosimetry (Fricke's dosimeter), units of radiation energy (Rad, Gray, Rontgen, RBE, Rcm, Sievert).</p> |
| Unit VI | <p>Bioenergetics</p> <p>Gibbs and Helmholtz energies with special emphasis on biological applications: study of energy transformations in living systems (bioenergetics): standard state in biochemistry, ATP-the currency of energy, Glycolysis, limitation of applicability of thermodynamics in biology.</p> |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Skoog .D.A., West. D.M and Holler .F.J., "Analytical Chemistry: An Introduction", 7th edition, Saunders college publishing, Philadelphia,(2010). 2. Larry Hargis.G" Analytical Chemistry: Principles and Techniques" Pearson©(1988) <p>Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University</p> <p>Suggestive digital platforms web links</p> <ol style="list-style-type: none"> 1. https://www.labster.com/chemistry-virtual-labs/ 2. https://www.vlab.co.in/broad-area-chemical-sciences 3. http://chemcollective.org/vlabs | |
| <p>This course can be opted as an elective by the students of following subjects:</p> | |

Suggested equivalent online courses (MOOCs) for credit transfer:

1. Quantum Chemistry of Atoms and Molecules, Prof. Anindya Datta, https://onlinecourses.nptel.ac.in/noc22_cv41/preview

Electronic media and other digital components in the curriculum:

Choose any one or more than:e-SLM/ Other electronic and digital contents

Name of electronic media: e-SLM

Year of incorporation: 2022

Syllabus for [B.Sc.]: Subject: [Chemistry]

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| Course prerequisites: Chemistry in 10+2 Level | | |
| Programme: B.Sc. | Year:3 | Semester: 6 th |
| Subject: Chemistry | | |
| Course Code: SBSCH-02N | Course Title: ADVANCED ANALYTICAL TECHNIQUES | |
| Course Objectives: <ul style="list-style-type: none"> • To provide knowledge about Statistical Analysis <ul style="list-style-type: none"> • To provide basic knowledge about Volumetric analysis, Gravimetric analysis and Separation techniques. • To provide basic knowledge about Nano Chemistry. | | |
| Course Outcomes: CO1: To gain knowledge about Statistical Analysis CO2: To gain basic knowledge about Volumetric analysis, Gravimetric analysis and Separation techniques and about basic knowledge of Nano Chemistry. | | |
| Credits:4 | Type of Course: Core | |
| Category of Course | value-added / employability/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi should be framed block wise/unit wise; No of blocks and units may change) | | |
| Block 1 | | |
| Unit I | BLOCK-1 Unit 1: Statistical Analysis Definition of terms mean and median, precision, standard deviation, relative standard deviation, accuracy, absolute error, types of error in experimental data, determinate (systematic), indeterminate (or random) and gross, sources of errors and effects upon the analytical results, methods for reporting analytical data, statistical evaluation of data, indeterminate errors, uses of statistics. | |
| Unit II | Unit 2: Volumetric analysis General principles of acid – base titration, precipitation titration, oxidation-reduction titration, iodimetry and iodometry, complexometric titrations, use of EDTA for the determination of Ca ²⁺ and Mg ²⁺ and hardness of water, types of EDTA titrations, metal ion indicators. | |
| Unit III | Unit 3: Gravimetric analysis Precipitation from homogeneous medium, purity of precipitates, co-precipitation, post- precipitation, washing and ignition of precipitates, contamination and their removal. | |
| Block 2 | | |
| Unit IV | Unit 4: Separation techniques Principle, technique and analytical applications of the following: (a) Solvent extraction (b) Chromatography (Paper, Thin Layer, Column and HPLC) (c) Ion exchange | |

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| Unit V | <p>Unit 5: Nano Chemistry</p> <p>Nanomaterials – An Introduction, Size Effects, Defining Nanodimensional Materials, Potential Uses for Nanodimensional Materials, The General Methods Available for the Synthesis of Nanodimensional Materials, Precipitative Methods, Reactive Methods in High Boiling Point Solvents, Hydrothermal and Solvothermal Methods, Gas-Phase Synthesis of Semiconductor Nanoparticles, Synthesis in a Structured Medium, The Suitability of Such Methods for Scaling, Conclusions and Perspectives on the Future, Oxide Nanoparticles, Nanotubes and Nanowires. Study of different characterization tools (XRD, TEM, SEM, AFM, etc.) for Nanomaterials.</p> |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Skoog .D.A., West. D.M and Holler .F.J., “Analytical Chemistry: An Introduction”, 7th edition, Saunders college publishing, Philadelphia,(2010). 2. Larry Hargis.G” Analytical Chemistry: Principles and Techniques” Pearson©(1988) <p>Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University</p> <p>Suggestive digital platforms web links</p> <ol style="list-style-type: none"> 1. https://www.labster.com/chemistry-virtual-labs/ 2. https://www.vlab.co.in/broad-area-chemical-sciences 3. http://chemcollective.org/vlabs | |
| <p>This course can be opted as an elective by the students of following subjects:</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: NA</p> | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than:e-SLM/ / Other electronic and digital contents</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation 2022</p> |

Year-2023-2024
Syllabus of B.Sc. Programme: [Subject Name: Computer Science]
In accordance with NEP-2020

| Year | Semester | Course Code | Title of Paper | Credits | Max. Marks | |
|--------------------------------|-----------|---|--|-----------|-------------|--|
| 1 | I | UGCS -101N | Computer Fundamental & PC Software | 2 | 100 | |
| | | UGCS -101(P)N | Practical Work | 2 | 100 | |
| | II | UGCS -102N | C Programming | 2 | 100 | |
| | | UGCS -102(P)N | Practical Work | 2 | 100 | |
| | | Skill Enhancement Course | | | | |
| | SBSCS-02N | Python Programming | 4 | 100 | | |
| 2 | III | UGCS -103N | Data Structures | 2 | 100 | |
| | | UGCS -103(P)N | Practical Work | 2 | 100 | |
| | | Skill Enhancement Course | | | | |
| | | SBSCS-01N | Discrete Mathematics | 4 | 100 | |
| | IV | UGCS -104N | Introduction to Database Management System | 2 | 100 | |
| | | UGCS -104(P)N | Practical Work | 2 | 100 | |
| 3 | V | Discipline Centric Elective Course | | | | |
| | | DCECS -105N | Computer Network | 2 | 100 | |
| | | DCECS -106N | Operating System | 2 | 100 | |
| | | DCECS -107(P)N | Practical Work based on 106 | 2 | 100 | |
| | VI | Discipline Centric Elective Course | | | | |
| | | DCECS -108N | C++ and Object Oriented Programming | 2 | 100 | |
| | | DCECS -109N | Software Engineering | 2 | 100 | |
| | | DCECS -110(P)N | Practical Work based on 108 | 2 | 100 | |
| Total Credit/Max. Marks | | | | 36 | 1600 | |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 1 | Semester: I |
| Subject: Computer science | | |
| Course Code: UGCS -101N | Course Title: Computer Fundamental & PC Software | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To demonstrate the knowledge of the basic structure, components, features and generations of computers. • To describe the concept of computer languages, language translators and construct algorithms to solve problems using programming concepts. • To Compare and contrast features, functioning & types of operating system and computer networks. • To demonstrate architecture, functioning & services of the Internet and basics of multimedia. • To illustrate the emerging trends and technologies in the field of Information Technology. | | |
| Course Outcomes: | | |
| CO-1 Demonstrate the knowledge of the basic structure, components, features and generations of computers. | | |
| CO-2 Describe the concept of computer languages, language translators and construct algorithms to solve problems using programming concepts. | | |
| CO-3 Compare and contrast features, functioning & types of operating system and computer networks. | | |
| CO-4 Demonstrate architecture, functioning & services of the Internet and basics of multimedia | | |
| CO-5 Illustrate the emerging trends and technologies in the field of Information Technology. | | |
| Credits: 2 | | Type of Course: Core |
| Max. Marks: 100 | | Min. Passing Marks: 36 |
| Block 1 | | |
| Unit I | Computer Basics: Algorithms, A Simple Model of a Computer, Characteristics of Computers, Problem-solving Using Computers. Data Representation: Representation of Characters in computers, Representation of Integers, Representation of Fractions, Hexadecimal Representation of Numbers, Decimal to Binary Conversion, Error-detecting codes. Input & Output Devices: Description of Computer Input Units, Other Input Methods, Computer Output Units (Printers, Plotters) Operating Systems: History and Evolution. Main functions of OS Multitasking, Multiprocessing. Time Sharing, Real Time OS with Examples Database Management System: Purpose and Organization of Database, Introduction to Data Models. | |
| Unit II | Disk operating system(DOS): Introduction, history & versions of DOS, DOS basics- Physical structure of disk, drive name, FAT, file & directory structure and naming rules, booting process, DOS system files, DOS commands- internal & external,. | |
| Unit III | Windows Operating System: Windows concepts. Features, Windows Structure, Desktop, Taskbar, Start Menu, My Computer, Recycle Bin, Windows Accessories- Calculator, Notepad, Paint, Wordpad, Character Map, Windows Explorer, Entertainment, Managing Hardware & Software- Installation of Hardware & Software, Using Scanner, System Tools, Communication, Sharing Information between programs | |
| Block 2 | | |
| Unit IV | Word Processing- MS-Word Features, Creating, Saving and Opening Documents in Word, Interface, Toolbars, Ruler, Menus, Keyboard Shortcut, Editing, Previewing, Printing,& Formatting a Document, | |

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| | Advanced Features of MS Word, Find & Replace, Using Thesaurus, Using Auto-Multiple Functions, Mail Merge, Handling Graphics, Tables & Charts, Converting a word document into various formats like- Text, Rich. Text format, Word perfect, HTML etc. |
| Unit V | Worksheet- MS-Excel: Worksheet basics, creating worksheet, entering into worksheet, heading information, data, text, dates, alphanumeric values, saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Keyboard shortcuts, Working with single and multiple workbook, working with formulae & cell referencing, Auto sum, Coping formulae, Absolute & relative addressing, Worksheet with ranges, formatting of worksheet, Previewing & Printing worksheet, Graphs and charts. Database, Creating and Using macros, multiple worksheets- concepts, creating and using. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Fundamental of Computers – By V.Rajaraman, B.P.B. Publications 2. Fundamental of Computers – By P.K. Sinha 3. Microsoft Office 2007 Bible – John Walkenbach, HerbTyson, Faithe Wempen, CaryN. Prague, Michael R.groh, PeterG. Aitken, and Lisa a. Bucki -Wiley India Pvt. Ltd 4. Discovering the Internet: Complete - Shelly Cashman 4th Edition - Course Technology | |
| Reference Books: | |
| <ol style="list-style-type: none"> 1. Introduction to Information Technology - Alexis Leon, Mathews Leon, and Leena Leon, Vijay Nicole Imprints Pvt. Ltd., 2013. 2. Office 2007 – By Shelly, Cengage Publication | |
| Suggested online links: https://www.pearsoned.co.in/prc/book/anita-goel-computer-fundamentals-1e-1/9788131733097 | |
| Electronic media and other digital components in the curriculum: | |
| Name of electronic media: e-SLM | Year of incorporation: 2020 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 1 | Semester: 1 |
| Subject: Computer science | | |
| Course Code: UGCs 101P(N) | Course Title: Practical -WORK | |
| Course Objectives: <ul style="list-style-type: none"> • To understand the fundamental concept of computer. • To understand the basics concept of communication and network. • To explore various features of MS-Word and its applications. • To develop understanding of MS-Excel. To design the presentation using MS-power Point. To understand the fundamental concept of database and working with MS-Access | | |
| Course Outcomes: CO1. Understand the basic component of computers, software and Hardware. CO2. Acquire knowledge about MS-Word and different formatting styles used in that. CO3. Acquire knowledge about MS-Excel and different techniques used in that. CO4. Acquire knowledge about MS-Power Point and formatting styles used in that. CO5. Acquire knowledge about MS-Access and different techniques such as creating form, writing queries used in that. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Suggestive Practical List | | |
| <ul style="list-style-type: none"> • Learn and Understand the basic component of computers, software and Hardware. • Do practice on MS-Word and different formatting styles used in that. • Do practice onMS-Excel and different techniques used in that. • Do practice on MS-Power Point and formatting styles used in that. • Do practice and Acquire knowledge about MS-Access and different techniques such as creating form, writing queries used in that. | | |
| Suggested Text Book Readings: 1. Fundamental of Computers – By V.Rajaraman, B.P.B. Publications 2. Fundamental of Computers – By P.K. Sinha 3. Microsoft Office 2007 Bible – John Walkenbach, HerbTyson, FaitheWempen, caryN.Prague, MichaelR.groh, PeterG.Aitken, and Lisa a.Bucki -Wiley India pvt.ltd 4. Discovering the Internet: Complete - Shelly Cashman 4th Edition - Course Technology | | |
| Reference Books: 1. Introduction to Information Technology - Alexis Leon, Mathews Leon, and Leena Leon, Vijay Nicole Imprints Pvt. Ltd., 2013. 2. Office 2007 – By Shelly, Cengage Publication | | |
| Electronic media and other digital components in the curriculum: | | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 | |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme:B.Sc. | Year:1 | Semester:2 |
| Subject: Computer science | | |
| Course Code: UGCS-102N | Course Title: C Programming | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To describe & understand the problem solving techniques. • To understand the concept of basic terminology used in C programming. • To develop programs in C language by writing, compiling and debugging. • To develop programs involving simple statements, conditional statements, iterative statements, array, strings, functions, recursion, structure and union. • To differentiate between call by value and call by reference, acquire skills of using dynamic memory allocations, use of pointers and basic operations on a file.. | | |
| Course Outcomes: | | |
| CO1. Describe the functional components and fundamental concepts of a digital computer system including number systems. | | |
| CO2. Construct flowchart and write algorithms for solving basic problem | | |
| CO3. Write 'C' programs that incorporate use of variables, operators and expressions along with data types. | | |
| CO4. Write simple programs using the basic elements like control statements, functions, arrays and strings. | | |
| CO5. Write advanced programs using the concepts of pointers, structures, unions and enumerated data types. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Introduction to algorithms and program design | |
| Unit I | Unit 1: Introduction to Algorithms Problem solving techniques, Algorithm | |
| Unit II | Pseudo-codes and Flowcharts Tools of Algorithm, Pseudo codes, Flowchart | |
| Unit III | Program design principles Introduction to computer programming, Program design principles, Programming techniques, Program Errors | |
| Block 2 | Introduction to the 'C' programming language | |
| Unit 1 | Unit 1: Introduction History of C Language, Structure of a 'C' program, Creating and Executing a 'C' program | |
| Unit 2 | Data Types in 'C' Character Set of 'C' language, Tri graph characters, Tokens, Identifiers, Keywords, Constants, Data types, Variables | |
| Unit 3 | Storage Classes Scope and lifetime of variable, Storage classes, Automatic storage class, Register storage class, Static storage class, External storage class | |
| Unit 4 | Input and Output Functions Reading a single character, Writing a single character, Formatted Input-Output, Formatted Input, Formatted Output | |
| Block 3: | Operator and Control Structures | |
| Unit 1: | Operators and Expressions Arithmetic operators, Relational operators, Logical operators, Assignment operators, | |

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| | Increment and decrement operators, Conditional operators, Bitwise operators, Special operators, Operator Precedence and Associativity, lvalue and rvalue, Type casting: Promotion and Demotion of variable types |
| Unit 2: | Decision Structures in ‘C’ if statement, if else statement, nested if ... else statement, switch statement, goto statement |
| Unit 3: | Loop Structures in ‘C’ for statement, while statement, do while statement, break statement, continue statement |
| Unit 4: | Arrays One dimensional array, Two dimensional array, Multidimensional arrays, Strings, String handling functions, Character functions |
| Block 4 | Advanced Features of C |
| Unit 1: | Pointers Pointers and Address (&) operator, Pointer declaration and Initialization , Indirection operator, Pointer Arithmetic, Arrays and Pointers, Character strings and Pointers, Array of Pointers, Pointer to Pointer |
| Unit 2: | Functions Functions, user-defined functions, categories of function, returning non-integer values, function arguments, recursion, arrays as function arguments |
| Unit 3: | Structures, Unions, enum and typedef Structure definition, Structures within structures, Structures as function arguments, Pointers to structures, Unions, Enumerated data type, Type definition |
| Unit 4: | File and Memory Management in ‘C’ Files, File Pointer Variable, Opening a file, Reading and writing to files, File Status Functions, Random Access to files, Command Line Arguments, Memory management |
| Unit 5: | Preprocessor Directives and Error reporting Macro directives, Conditional directives, Control directives, Error reporting |
| Suggested Readings: SLM of University 1. Kanetkar Y., “Let Us C”, BPB Publications. 2. E. Balagurusamy, Computer Concepts and Programming in C, McGraw Hill. 3. Yashwant Kanetkar, “Working with C”, BPB Publications. 4. E. Balagurusamy, “Programming in ANSI C”, TMH. 5. Reema Thareja, Computer Fundamentals and Programming in C, Oxford Publication. 6. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Education. 7. Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Computer Science- A Structured Programming Approach Using C, Cengage Learning. 8. Schildt H., “C- The Complete Reference”, McGraw-Hill. 9. Goyal K. K. and Pandey H.M., Trouble Free C”, University Science Press 10. Gottfried B., “Schaum’s Outlines- Programming in C”, McGraw-Hill Publications. | |
| Electronic media and other digital components in the curriculum: | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year:1 | Semester:2 |
| Subject: Computer science | | |
| Course Code: UGCS 102P (N) | Course Title: Practical Work Based on UGCS 102 | |
| Course Objectives: | | |
| <ol style="list-style-type: none"> 1. To write, compile, debug and execute programs in a C programming environment. 2. To learn programs that incorporate use of variables, operators and expressions along with data types. 3. To learn programs for solving problems involving use of decision control structures and loops. 4. To learn programs that involve the use of arrays, structures and user defined functions. 5. To Write programs using file handling operations. | | |
| Course Outcomes: | | |
| CO1. Write, compile, debug and execute programs in a C programming environment. | | |
| Credits:2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Suggestive List of Practical | | |
| <ul style="list-style-type: none"> • Program to implement conditional statements in C language. • Program to implement switch-case statement in C language • Program to implement looping constructs in C language. • Program to perform basic input-output operations in C language. • Program to implement user defined functions in C language. • Program to implement recursive functions in C language. • Program to implement one-dimensional arrays in C language. • Program to implement two-dimensional arrays in C language. • Program to perform various operations on two-dimensional arrays in C language. • Program to implement multi-dimensional arrays in C language. • Program to implement string manipulation functions in C language. • Program to implement structure in C language. • Program to implement union in C language. • Program to perform file handling operations in C language. | | |
| Suggested Text Book Readings: | | |
| SLM of University | | |
| <ol style="list-style-type: none"> 1. Kanetkar Y., "Let Us C", BPB Publications. 2. E. Balagurusamy, Computer Concepts and Programming in C, McGraw Hill. 3. Yashwant Kanetkar, "Working with C", BPB Publications. 4. E. Balagurusamy, "Programming in ANSI C", TMH. 5. Reema Thareja, Computer Fundamentals and Programming in C, Oxford Publication. 6. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Education. 7. Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Computer Science- A Structured Programming Approach Using C, Cengage Learning. 8. Schildt H., "C- The Complete Reference", McGraw-Hill. 9. Goyal K. K. and Pandey H.M., Trouble Free C", University Science Press 10. Gottfried B., "Schaum's Outlines- Programming in C", McGraw-Hill Publications. | | |
| Electronic media and other digital components in the curriculum: | | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 | |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 1 | Semester: 2 |
| Subject: Computer science | | |
| Course Code: SBSCS-02N | Course Title: Python Programming | |
| Course Objectives: | | |
| <ol style="list-style-type: none"> 1. To acquire programming skills in core Python. 2. To explore the use of data structures, strings, text files, lists and dictionaries. 3. To acquire Object Oriented Skills in Python. 4. To understand to solve the problems with Python database, Python multithreading. 5. To work with Django framework, Numpy and other libraries. | | |
| Course Outcomes: | | |
| CO1. Understand and comprehend the Basics of Python programming. | | |
| CO2. Describe and explain the use of the built-in data structures list, sets, tuples and dictionary. | | |
| CO3. Make use of functions, modules and its applications. | | |
| CO4. Demonstrate the principles of OOPs and identify real-world applications using OOPs, files and exception handling provided by Python. | | |
| Credits: 4 | Type of Course: Core | |
| Category of Course | Value-added / employability/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | BASICS OF PYTHON | |
| Unit I | UNIT – 1: Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Python IDLE. | |
| Unit II | Tokens and Statements: Variables, Constants, Assignment, Multiple Assignment, Keywords, Punctuators, Identifiers, Input-Output, Indentation, Statements, Comments, Single Comment and Multiline Comment. | |
| Unit III | Data Types, Operators & Expressions: Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Operators precedence, Expressions and order of evaluations Control Flow- if, if-else, if-elif-else, for, while, break, continue, pass. | |
| Block 2 | DATA STRUCTURE IN PYTHON | |
| Unit IV | Data Structures: Stack & Queue, Lists – Operations, Slicing, Methods; Tuples – Operations, Methods, Sets– Operations, Methods, Dictionaries– Operations, Methods, Sequences– Operations, Methods. Comprehensions– Operations, Methods. | |
| Unit V | Functions – Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables | |
| Unit VI | Modules & Packages: Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages. | |
| BLOCK 3 | OOPS IN PYTHON | |
| Unit VII | UNIT – 7: Object-Oriented Programming OOP in Python: Classes, ‘ self-variable’, Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding. | |
| Unit VIII | UNIT – 8: Exception Handling : Error, and Exceptions: Difference between an error and | |

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| | Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions |
| Unit IX | UNIT – 9: Python Libraries: Brief Tour of the Standard Library – Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression |
| Unit X | UNIT – 10: GUI Programming and Testing : Multithreading, GUI Programming, Turtle Graphics Testing: Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests. |
| BLOCK 4: | MACHINE LEARNING IN PYTHON |
| Unit XI | UNIT – 11: Machine Learning Using Python : Machine Learning Basics, Features and Labels, Supervised and Unsupervised Learning. |
| Unit XII | UNIT – 12: Regression and Classification in Machine Learning: Simple Linear Regression, Multiple Regression, Data Collection for Machine Learning, Classification – Features and Types |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Kenneth A. Lambert, Martin, Juneja "Fundamentals of Python", Cengage Learning. 2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson. 3. Learning Python, Mark Lutz, Orielly. 4. Harsh Bhasin, “Python for Beginners”, New Age International. 5. Ashok Namdev Kamthane , Programming and Problem Solving with Python, TMH. 6. Allen Downey, Learning with Python, Dreamtech. | |
| Suggestive digital platforms web links- | |
| http://docs.python.org/3/tutorial/index.html | |
| http://interactivepython.org/courselib/static/pythonds | |
| http://www.ibiblio.org/g2swap/byteofpython/read/ | |
| Electronic media and other digital components in the curriculum: | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year:2 | Semester:3 |
| Subject: Computer science | | |
| Course Code: UGCS -103N | Course Title: Data Structures | |
| Course Objectives: | | |
| <ol style="list-style-type: none"> 1. To develop the understanding of data structures, their types and applications. 2. To familiarize with concepts of algorithm and complexity. 3. To implement, analyze various data-structures as array, linked-list, stack, queue, tree, graph, etc. in detail and utilization of data structure techniques in problem solving. 4. To develop the understanding of various sorting and searching techniques. | | |
| Course Outcomes: | | |
| CO1. Explain the concept of data structure, abstract data types, algorithms and analysis of algorithms. | | |
| CO2. Describe basic data organization schemes such as arrays and linked lists, implementation of linked lists, operations on linked-list, | | |
| CO3. Describe stacks and queues, their applications and implement various operations on them using arrays and linked lists | | |
| CO4. Describe the properties of trees and graphs and implement various operations such as searching and traversal on them | | |
| Credits: 2 | Type of Course: Core | |
| Category of Course | Value-added / employability/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | UNIT 1: Introduction to data structure Algorithm, Basic criteria for algorithms, Data type, Data structure, Data representation, linear and non linear data structure. | |
| Unit II | UNIT 2: Basics of algorithm Algorithm, Basics of complexity of algorithm | |
| Unit III | UNIT 3: Array Definition, Representation of array, Single and multi-dimensional array, address calculation (one dimensional, two dimensional, multidimensional), sparse matrices | |
| Block 2 | | |
| Unit IV | UNIT 4: Stack Definition, Operations on stacks, Array representation and implementation of stack; infix, prefix and postfix representation of expression and evaluation multiple stacks, Application of stacks. | |
| Unit V | UNIT 5: Recursion Recursive definition and processes, some named problems of recursion, principle of recursion: designing recursive algorithm, how recursion works, tail recursion. | |
| Unit VI | UNIT 6: Queue Definition, operation on queues, circular queue, dequeue, priority queue, Application of queue. | |
| BLOCK 3 | | |
| Unit VII | UNIT 7: Linked List Representation and implementation of single linked list, Operations in the singly linked list, stack and queue as a linked list, circularly linked list, doubly linked list, circularly doubly linked list, Application of linked list: polynomial representation and addition, garbage collection | |
| Unit VIII | UNIT 8: Tree | |

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| | Basic terminology, binary tree, binary tree representation, complete binary tree, extended binary tree, array and linked list representations, traversing binary tree, threaded binary tree, binary search tree, Operations on BST, AVL tree, Operations on AVL tree, B-tree Insertion and deletion in B tree. |
| Unit IX | UNIT 9: Graph Basic terminology Graph representation Depth first search, breadth first search, topological sort, connected components, spanning tree, minimum cost spanning tree, Kruskal's and prim's algorithm, Shortest path algorithms: Bellman Ford Algorithm, Dijkstra's algorithm, Floyd-Warshall algorithm. |
| BLOCK - 4 | |
| Unit X | UNIT 10: Searching and sorting Sequential search, binary search, comparison and analysis, Selection sort, Bubble sort, Insertion sort, Heap sort, Quick Sort, Merge sort, Shell sort, radix sort. |
| Unit XI | UNIT 11: Hashing Hash table, hash function, collision resolution strategies, hash table implementation |
| Unit XII | UNIT 12: File Structure Terminology, File organization, Sequential files, Direct File organization, Indexed Sequential file organization |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Y. Langsam, M. Augenstein and A. Tannenbaum, Data Structures using C and C++, Pearson Education Asia. 2. Ellis Horowitz, S. Sahni, D. Mehta Fundamentals of Data Structures in C++, Galgotia Book Source, New Delhi. 3. S. Lipschutz, Data Structures Mc-Graw Hill International. 4. Data Structures: A Pseudocode Approach with C, Second Edition, Richard F. Gilberg, Behrouz A. Forouzan 5. Jean-Paul Tremblay, Paul. G. Soresan, An introduction to Data Structures with Applications, Tata Mc-Graw Hill International Edition. 6. A. Michael Berman, Data structures via C++, Oxford University Press. 7. Thomas H. Cormen, Introduction to Algorithms, 3rd Edition (The MIT Press). 8. M. Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education. 9. Tremblay & Sorenson, An Introduction to Data Structures with Applications, Mcgraw Hill. 10. R.S. Salaria, Data Structures and Applications using C, Khanna Book Publishing. 11. Samanta D., "Classic Data Structures", Prentice Hall India. 12. Aho, Ullman and Hopcroft, "Design and Analysis of algorithms", Pearson Education. 13. R. Neapolitan and K. Naimipour, "Foundations of Algorithms", Jones an Bartlett, Student edition. 14. Reema Thareja, Data Structures using C, Oxford Univ. Press | |
| Suggestive digital platforms web links or online course- | |
| https://www.oercommons.org/authoring/14873-data-structure/view https://www.oercommons.org/courses/data-structure-and-algorithms https://onlinecourses.swayam2.ac.in/cec19_cs04/preview (online course) | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: e-SLM/ Other electronic and digital contents | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 2 | Semester: 3rd |
| Subject: Computer science | | |
| Course Code: UGCS -103(P)N | Course Title: Practical Work Based on UGCS 103 | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To learn implementation of various Data Structures. • To applying data structures in solving real life problems using C/Python. • To learn implementation of various Data Structures. | | |
| Course Outcomes: | | |
| CO1. Write and execute programs to implement different searching algorithms. | | |
| CO2. Write and execute programs to implement various sorting algorithms | | |
| CO3. Write and execute programs to implement various operations on two-dimensional arrays.. | | |
| CO4. Implement various operations of Stacks and Queues using both arrays and linked lists data structures. | | |
| CO5. Implement graph algorithm to solve the problem of spanning tree | | |
| Credits: 2 | Type of Course: Core | |
| Category of Course | value-added / employability/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Practical Work Based on UGCS 103) | | |
| <ul style="list-style-type: none"> • To implement addition and multiplication of two 2D arrays. • To transpose a 2D array. • To implement stack using array • To implement queue using array. • To implement circular queue using array. • To implement stack using linked list. • To implement queue using linked list. • To implement BFS using linked list. • To implement DFS using linked list. • To implement Linear Search. • To implement Binary Search. • To implement Bubble Sorting. • To implement Selection Sorting. • To implement Insertion Sorting. • To implement Merge Sorting. • To implement Heap Sorting. • To implement Matrix Multiplication by Strassen's algorithm • Find Minimum Spanning Tree using Kruskal's Algorithm | | |
| Electronic media and other digital components in the curriculum: | | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 | |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year:2 | Semester:3 |
| Subject: Computer science | | |
| Course Code: SBSCS-01N | Course Title: Discrete Mathematics | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To perform operations on discrete structures such as sets, functions, relations. • To apply mathematical arguments using logical connectives and quantifiers. • To identify and prove properties of Algebraic Structures. • To formulate and solve recurrences and recursive functions. • To apply the concept of combinatorics to solve basic problems in discrete mathematics. | | |
| Course Outcomes: | | |
| CO1. Use mathematical and logical notation to define and formally reason about basic discrete structures such as Sets, Relations and Function | | |
| CO2. Apply mathematical arguments using logical connectives and quantifiers to check the validity of an argument through truth tables and propositional and predicate logic | | |
| CO3. Identify and prove properties of Algebraic Structures like Groups, Rings and Fields | | |
| CO4. Formulate and solve recurrences and recursive functions | | |
| CO5. Apply the concept of combinatorics to solve basic problems in discrete mathematics | | |
| Credits: 4 | Type of Course: Core | |
| Category of Course | Skill development | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Language of Mathematics and its application | |
| Unit I | Mathematical Logic: statements, operations, truth values, tautology and quantifiers. | |
| Unit II | Arguments: Rule of Detachment, Validity of a compound statement by using Truth Table, Validity using Simplification Methods, Validity using Rules of Inference, Invalidity of an Argument, Indirect Method of proof and Proof by Counter-Example. | |
| Unit III | Boolean Algebra: Boolean Algebra, Principle of Duality, Isomorphic Boolean Algebras, Boolean Algebra as Lattices, Boolean Functions, Disjunctive Normal Form, Conjunctive Normal Form, Minimization of Boolean Functions (Karnaugh Map) | |
| | Switching circuits and logical Circuits : Switching Circuits, Simplification of circuit, Non-Series Parallel Circuits, Relay Circuits, Logic Circuits | |
| Block 2 | Set theory and its application | |
| Unit I | Set theory: sets, Subsets, Operations on Sets, Complementation, Intersection and Union, Laws Relating Operations, Distributive Laws and De Morgan's Laws | |
| Unit II | Relation: Relation, binary relations in a Set, Domain and Range of a Relation, Total number of Distinct Relations, Relations as Sets of Ordered Pairs, Types of Relations, Composition of Relations, Equivalence relation in a set, Partition of a Set, Equivalence Class and Quotient set of a set. | |
| Unit III | Partitions and Distributions: Equivalence Relations, Equivalence Classes, Properties of Equivalence Classes, Quotient set and Partition. | |
| Unit IV | Function: Functions, Direct and Inverse image, Inverse Functions, Operations on Functions, Composite of functions, Types of Functions and Connection between Equivalence relation and mapping. | |
| Block – 03 | Counting Process | |

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| Unit I | Mathematical Induction: Principle of Mathematical Induction, Second Principle of Induction and Well ordering property. |
| Unit II | Combinatorics: Basic counting principles, Principle of Disjunctive counting, Principle of Sequential counting and Ordered and Unordered Partitions. |
| Unit III | Permutation |
| Unit IV | Combination |
| Block – 04 | Probability theory and application |
| Unit I | Binomial theorem: Binomial theorem, General term in a binomial expansion, Middle term in a binomial expansion and Binomial expansion for rational exponents |
| Unit II | Probability: Definition of Probability, Addition law for counting and Product law for counting. |
| Unit III | General Counting methods: General Counting method is the extension part of counting process. It discusses Sum and Product Rules and The Pigeonhole Principle . |
| Unit IV | The Inclusion- Exclusion Principle: inclusion-exclusion principle, Alternative form of the inclusion-exclusion principle and Onto Functions. |
| Suggested Text Book Readings: | |
| Suggested online links: | |
| <ol style="list-style-type: none"> 1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", McGraw Hill. 2. B. Kolman, R.C Busby and S.C Ross, "Discrete Mathematics Structures", Prentice Hall. 3. R.P Girimaldi, "Discrete and Combinatorial Mathematics", Addison Wesley. 4. Y.N. Singh, "Discrete Mathematical Structures", Wiley- India. 5. Swapankumar Sarkar, "A Textbook of Discrete Mathematics", S. Chand & Company PVT. LTD.V. 6. Krishnamurthy, "Combinatorics Theory & Application", East-West Press Pvt. Ltd., New Delhi. 7. Liptschutz, Seymour, "Discrete Mathematics", McGraw Hill. 8. J.P. Trembely&R.Manohar, "Discrete Mathematical Structure with application to Computer Science", McGraw Hill. | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: e-SLM/ Other electronic and digital contents | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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|---|--|--------------|
| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 2 | Semester:4th |
| Subject: Computer science | | |
| Course Code: UGCS -104N | Course Title: Introduction to Database Management System) | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To learn the features of a database system and its application and compare various types of data models. • To construct an ER Model for a given problem and transform it into a relation database schema. • To formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus. • To understand the need of normalization and normalize a given relation to the desired normal form. • To understand different approaches of transaction processing and concurrency control. | | |
| Course Outcomes: | | |
| CO1. Describe the features of a database system and its application and compare various types of data models. | | |
| CO2. Construct an ER Model for a given problem and transform it into a relation database schema. | | |
| CO3. Formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus. | | |
| CO4. Explain the need of normalization and normalize a given relation to the desired normal form | | |
| CO5. Explain different approaches of transaction processing and concurrency control. | | |
| Credits: 2 | Type of Course: Core | |
| Category of Course | employability/ skill development/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | UNIT 1: Overview of database management Introduction, Traditional oriented approach, Three view of data, The three level architecture of DBMS, DDL, DML, data model schemas and instances, Advantage and disadvantage of database management system. | |
| Unit II | UNIT 2: Database Models and implementation Introduction, file management system, entity relationship model, the hierarchical model, network model. the relational model | |
| Unit III | UNIT 3: Entity relationship model ER model concept, notations of ER diagram, mapping constraints, keys, concept of super key, candidate key, primary key, verbalization, aggregation reduction of ER diagram to tables, extended ER model, relationship of higher degree | |
| Block 2 | | |
| Unit IV | UNIT 4: Relational Model Concept, Formal definition of a relation, entirety. constraint, entity indignity, referential integrity, keys constraints, domain constraint, relational algebra relational calculus. | |
| Unit V | UNIT 5: SQL Characteristic of SQL, Advantage of SQL, SQL data types, SQL commands, SQL operators, insertion, update and delete operations, joins, unions intersection, minus, views, queries and sub queries, aggregate function, cursor in SQL | |
| Unit VI | UNIT 6: Database Design | |

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| | Conceptual, logical and physical design, Functional dependencies, normal form, first, second, third, BCNF, multi-valued dependencies, fourth normal form, join dependencies, fifth normal form, inclusion dependencies, lossless join decomposition, normalization using FD, MVD and JDs. |
| BLOCK - 3 | |
| | UNIT 7: File Organization Introduction, file organization, sequential file organization, index-sequential file organization, direct file organization, multi key file organization. |
| | UNIT 8: Transaction Processing Concept Transaction system, testing of serializability, serializability of schedules, conflict and view serializable schedule, recoverability, recovery from transaction failure, Joe based recovery, checkpoints, deadlock handling, concept of concurrency. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Date, C.J., "An Introduction to Database Systems", Narosa Publishing House, New Delhi. 2. Korth, Silbertz, Sudarshan, "Database Concepts", Tata Mcgraw-hill Education (India). 3. Elmasri, Navathe, "Fundamentals Of Database Systems", Pearson Education New Delhi India. 4. G.K. Gupta, "Database Management System", Tata Mcgraw-hill Education (India) Pvt. Ltd. 5. Bipin C. Desai, "An introduction to Database Systems", Galgotia Publication. 6. Majumdar & Bhattacharya, "Database Management System", Tata Mcgraw-hill Education. 7. Ramakrishnan, Gehrke, "Database Management System", McGraw Hill (India) Pvt Ltd. 8. Chakravarti, "Advanced Database Management System" Wiley Dreamtech Publications. 9. Ullman, J.D., "Principles of Database Systems", Galgotia Publications, New Delhi. 10. James Mortin- Principles of Database Management Object Oriented Modeling & Design. | |
| Suggestive digital platforms web links | |
| Electronic media and other digital components in the curriculum: | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 2 | Semester:4th |
| Subject: Computer science | | |
| Course Code: UGCS -104(P)N | Course Title: Practical Work Based on UGCS104 (Introduction to Database Management System) | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To write SQL commands to query a database. • To develop database and writing queries using MySQL, SQL Server. • To write, debug and implement SQL programs in MySQL, SQL Server. • To learn programming in SQL. | | |
| Course Outcomes: | | |
| CO1. Describe the features of a database system and its application and compare various types of data models. | | |
| CO2. Construct an ER Model for a given problem and transform it into a relation database schema. | | |
| CO3. Formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus. | | |
| CO4. Explain the need of normalization and normalize a given relation to the desired normal form | | |
| CO5. Explain different approaches of transaction processing and concurrency control. | | |
| Credits: 2 | Type of Course: Core | |
| Category of Course | Employability/ skill development/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Suggestive Practical's | | |
| <ol style="list-style-type: none"> 1. Installing SQL Server/MYSQL. 2. Creating Entity-Relationship Diagram using case tools. 3. Writing basic SQL statements. 4. Restricting and sorting data. 5. Displaying data from multiple tables. 6. Aggregating data using group function. 7. Manipulating data. 8. Creating and managing tables. 9. Normalization. 10. Creating procedure and functions etc. 11. Design and implementation of Payroll processing system. 12. Design and implementation of Library Information System. 13. Design and implementation of Student Information System. 14. Automatic Backup of Files and Recovery of Files. | | |
| Suggested Text Book Readings: | | |
| 1. Date, C.J., "An Introduction to Database Systems", Narosa Publishing House, New Delhi. | | |
| 2. Korth, Silbertz, Sudarshan, "Database Concepts", Tata Mcgraw-hill Education (India). | | |
| 3. Elmasri, Navathe, "Fundamentals Of Database Systems", Pearson Education New Delhi India. | | |
| 4. G.K. Gupta, "Database Management System", Tata Mcgraw-hill Education (India) Pvt. Ltd. | | |
| 5. Bipin C. Desai, "An introduction to Database Systems", Galgotia Publication. | | |
| 6. Majumdar & Bhattacharya, "Database Management System", Tata Mcgraw-hill Education. | | |
| 7. James Mortin- Principles of Database Management Object Oriented Modeling & Design. | | |

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| Suggestive digital platforms web links | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | |
| Programme: B.Sc. | Year: 3 |
| Semester: 5th | |
| Subject: Computer science | |
| Course Code: DCECS -105N | Course Title: Computer Network |
| Course Objectives: | |
| <ul style="list-style-type: none"> • To understand the computer networks and concentrates on building a firm foundation • To provide the fundamental knowledge of the various aspects of computer networking • To understanding the OSI Reference Model and TCP/IP Model • To have a good knowledge of Reference Model Layers and associated protocols. • Analyze the requirements for a given organizational structure. Select the most appropriate networking architecture and technologies and appreciate recent developments in the area. | |
| Course Outcomes: | |
| CO1. Understand computer network basics, network architecture, TCP/IP & OSI reference models and other concepts. | |
| CO2. Understand error handling concepts, data link protocols, flow-error control, multi-channel access protocols and Standards | |
| CO3. Describe network layer protocols, IP addressing, IPV4 addressing, Routing algorithms, etc. | |
| CO4. Describe functionality of Transport layer and related protocols; concept of QoS and techniques. | |
| CO5. Define various application layer protocols such as DNS, Electronic Mail, FTP, HTTP, Telnet and understand network security | |
| Credits: 2 | Type of Course: Elective |
| Category of Course | Employability/ skill development/ |
| Max. Marks: 100 | Min. Passing Marks: 36 |
| Block 1 | Computer Network Basics and Services |
| Unit I | Introduction to Computer Network Computer networks, Network Hardware—Local Area networks, Metropolitan Area networks,, Wide Area networks, Wireless networks, Internetworks, Network Software: Protocol Hierarchies |
| Unit II | OSI and TCP/IP Model Design and Issue for layers, Interfaces and services, Connection oriented and Connection less Services. OSI reference model, and its Evolution, TCP/IP model. |
| Unit III | . Unit 3: The Physical Layer: Physical Layer, Transmission media, twisted pair, Base band and Broadband coaxial cable, Fiber optics, unguided media. |
| Unit IV | ISDN and Switching Techniques: MODEM, ISDN services, Switching Message, Packet Circuit switching TDM, and FDM, ATM, X.25. |
| Block 2 | Link Layer Issues and Access Protocols |
| Unit V | Data Link Layer: Data Link Layer, Error detection and Correction, Protocols: Simplex Stop and wait protocols, One bit sliding window protocol, Using Go-Back N. Flow control, Sliding Window Protocol, Channel Allocation Problem |
| Unit VI | Multiple Access Protocol: ALOHA, CSMA protocol, Collision Free protocol, Polling, FDM, TDM |

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| Unit VII | The Medium Access Sub Layer: Framing, Static and Dynamic Channel Allocation in LANs and MANs, IEEE Standard 802.3, and Ethernet IEEE standard 802.4 and token Ring, IEEE Standard 802.5, Token Bus |
| Unit VIII | Network devices: Hub, Bridges, Switch, Gateways, Routers. |
| BLOCK - 3 | IP Addressing and Routing Issues |
| Unit IX | IP Protocol and Addressing: Network layer design issue, IP Protocol, IP Addresses, subnets, |
| Unit X | : Connection Management: Internetworking, connectionless and connection oriented services, tunneling, Fragmentation, Firewall, Internet Controls Protocols. |
| Unit XI | : Routing in Network Layer: Routing Algorithm, shortest path routing, Flooding, Flow-based routing, Broadcast routing, Congestion Control Algorithm, Congestion control and prevention policies; |
| Block 4: | Transport, Session, Presentation and Application Layer |
| Unit XII: | Transport layer: Transport layer connection management, flow control, error control, congestion control, Establishing and releasing a connection, TCP service Model, TCP protocol |
| Unit XIII: | Session and Presentation Layer: Introduction to cryptography and data compression |
| Unit XIV: | The Application Layer: Network Security, Domain Name System, Email: Architecture and Services, Message formats, Message transfer. |
| Suggested Text Book Readings: 1. Forouzen, "Data Communication and Networking", TMH A.S. 2. Tanenbaum, Computer Networks, Pearson Education 3. W. Stallings, Data and Computer Communication, Macmillan Press 4. AnuranjanMisra, "Computer Networks", Acme Learning 5. G. Shanmugarathinam, "Essential of TCP/IP", Firewall Media | |
| Suggestive digital platforms web links | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/Other electronic and digital contents | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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|---|---|---------------|
| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 3 | Semester: 5th |
| Subject: Computer science | | |
| Course Code: DCECS -106N | Course Title: Operating System | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To develop the understanding of the structure and functioning of Operating System. • To learn about Processes, Threads and Scheduling algorithms. • To understand the principles of concurrency and Deadlock. • To learn various memory management schemes. • To study I/O management and File systems. | | |
| Course Outcomes: | | |
| CO1. Explain main components, services, types and structure of Operating Systems. | | |
| CO2. Apply the various algorithms and techniques to handle the various concurrency control issues. | | |
| CO3. Compare and apply various CPU scheduling algorithms for process execution | | |
| CO4. Identify occurrence of deadlock and describe ways to handle it | | |
| CO5. Explain and apply various memory, I/O and disk management techniques. | | |
| Credits: 2 | Type of Course: Elective | |
| Category of Course | Employability/ skill development/ | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | UNIT 1: Introduction Basic definitions, Batch processing, Multi-programming. Time sharing, multiprocessing; Structure and Functions of Operating System | |
| Unit II | UNIT 2: Process and thread Process, Process states, State Transitions, Process Control Block, Context Switching, concept of thread, comparison between process and thread, Thread model, thread usage, implementing thread in kernel and user space. | |
| Unit III | UNIT 3: Process Scheduling Scheduler, Scheduling criteria, Preemptive and non-preemptive scheduling, Process Scheduling, Process scheduling algorithms. | |
| Unit IV | UNIT 4: Concurrent Process Process Interaction, Shared Data and Critical Section, Mutual Exclusion, Synchronization, Classical Problems of Synchronization, Semaphores, Monitors. | |
| Block 2 | | |
| Unit V | UNIT 5: Deadlock Concept of deadlock, necessary condition for deadlock, resource allocation graph, deadlock prevention, deadlock avoidance, Banker's algorithm, Deadlock detection, deadlock recovery. | |
| Unit VI | UNIT 6: Memory management Address Binding, Dynamic Loading and Linking Concepts, Logical and Physical Addresses Contiguous and non-contiguous memory allocation, Paging, Segmentation, Virtual Memory, Demand Paging, Page fault, Page replacement algorithms, thrashing. | |
| Unit VII | UNIT 7: Secondary memory management: Free Space management, Disk Structure, Disk Scheduling, Formatting, Swap space Management. | |
| Unit VIII | Case Study of UNIX. | |
| Suggested Text Book Readings: | | |
| 1. Abraham Siberschatz and Peter Baer Galvin, "Operating System Concepts", Addison-Wesley | | |

2. Milan Milankovic, "Operating Systems, Concepts and Design", Tata McGraw-Hill.
3. Harvey M Deital, "Operating Systems", Addison Wesley
4. Richard Peterson, "Linux: The Complete Reference", Osborne Tata McGraw-Hill.
5. Sibsankar Halder and Alex A Aravind, "Operating Systems", Pearson Education
6. D M Dhamdhere, "Operating Systems : A Concept based Approach", McGraw Hill.
7. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education".
8. Stuart E. Madnick & John J. Donovan. Operating Systems. McGraw Hill.
9. A. S. Tanenbaum, "Modern Operating Systems", PHI.
10. William Stallings, "Operating Systems – internals and design principles", PHI.

Suggestive digital platforms web links

Electronic media and other digital components in the curriculum:

Choose any one or more than: e-SLM/Other electronic and digital contents

Name of electronic media: e-SLM

Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

| | | |
|---|---|--------------|
| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 2 | Semester:4th |
| Subject: Computer science | | |
| Course Code: DCECS -107(P)N | Course Title: Practical Work Based on DCECS106N Operating System | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To develop the understanding of the structure and functioning of Operating System. • To learn about Processes, Threads and Scheduling algorithms. • To understand the principles of concurrency and Deadlock. • To learn various memory management schemes. • To study I/O management and File systems. | | |
| Course Outcomes: | | |
| CO1. Explain main components, services, types and structure of Operating Systems. | | |
| CO2. Apply the various algorithms and techniques to handle the various concurrency control issues. | | |
| CO3. Compare and apply various CPU scheduling algorithms for process execution | | |
| CO4. Identify occurrence of deadlock and describe ways to handle it | | |
| CO5.Explain and apply various memory, I/O and disk management techniques. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| | <ul style="list-style-type: none"> • Installing operating systems. • Run the basics Linux commands. • Writing code to implement scheduling Algorithms. • Try to learn perform the various memory management schemes | |
| Suggested Text Book Readings: | | |
| 1. Abraham Siberschatz and Peter Baer Galvin, “Operating System Concepts”, Addison-Wesley | | |
| 2. Milan Milankovic, “Operating Systems, Concepts and Design”, Tata McGraw-Hill. | | |
| 3. Harvey M Deital, "Operating Systems", Addison Wesley | | |
| 4. Richard Peterson, “Linux: The Complete Reference”, Osborne Tata McGraw-Hill. | | |
| 5. SibsankarHalder and Alex A Aravind, “Operating Systems”, Pearson Education | | |
| 6. D M Dhamdhare, “Operating Systems : A Concept basedApproach”, McGraw Hill. | | |
| 7. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata McGraw Hill Education”. | | |
| 8. Stuart E. Madnick& John J. Donovan.Operating Systems.McGraw Hill. | | |
| 9. A. S. Tanenbaum, "Modern Operating Systems", PHI. | | |
| 10. William Stallings, "Operating Systems – internals and design principles", PHI. | | |
| Suggestive digital platforms web links | | |
| Electronic media and other digital components in the curriculum: | | |
| Choose any one or more than: e-SLM/Other electronic and digital contents | | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 | |

Syllabus for [B.Sc.]: Subject: [Computer science]

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|---|--|---------------|
| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 3 | Semester: 6th |
| Subject: Computer science | | |
| Course Code: DCECS -108N | Course Title: C++ and Object Oriented Programming | |
| Course Objectives: <ul style="list-style-type: none"> • To understand Object Oriented Concepts using C++ Language • To develop, debug and document programs in C++ using OOP paradigms. • Describe the meaning of the object-oriented paradigm and implement real-world entities like inheritance, hiding, polymorphism in programming using the object-oriented design process. | | |
| Course Outcomes: CO1 To understand Object Oriented Concepts using C++ and understand/implement C++ programming basics as data types, variable, constants, operators, control statements, arrays, etc. CO2. To understand and implement concepts of inheritance, hiding, polymorphism, interfaces and packages etc. in C++ programming. | | |
| Credits: 2 | Type of Course: Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | UNIT 1: Principles of object oriented programming Object oriented programming paradigm, Comparison with procedural programming, Basic concepts of object oriented programming, benefits of OOP, object oriented Languages, advantage of C++. | |
| Unit II | UNIT 2: Object Orient Programming System Class, inheritance, abstraction, encapsulation and information hiding, polymorphism, overloading. | |
| Unit III | UNIT 3: Advanced concept Dynamism (Dynamic typing., dynamic binding, late binding, dynamic loading). Structuring programs, reusability, organizing object oriented project, | |
| Block 2 | Overview of C++ | |
| Unit IV | Tokens, keywords, identifiers and constants basic data types, user-defined and derived Data types, type compatibility, reference, variables type Casting, operator precedence, control structures, structure, function. | |
| Unit V | Classes and objects Class specification, class objects, accessing class members, scope resolution operator, data hiding, empty classes, Pointers within a class, passing objects as arguments, returning objects from functions, friend Functions and friend classes, constant parameters and member functions, structures and Classes, static members. | |
| Unit VI | Object initialization and cleanup Constructors destructor, constructor overloading. order of construction and destruction, Constructors with default arguments, nameless objects, dynamic initialization through Constructors, constructors with dynamic operations, constant objects and constructor, static Data members with constructors and destructors, nested classes | |
| BLOCK - 3 | | |
| Unit VII | UNIT 8: Operator overloading and type conversion Defining operator overloading, overloading unary operators, overloading binary operators, overloading binary operators using friends, manipulation of strings using Operators, rules for overloading operators. type conversions. | |
| Unit VIII | UNIT 9: Inheritance: extending classes Deriving derived classes, single multilevel, multiple, hierarchical, hybrid inheritance, | |

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| | Constructors & destructors in derived classes, constructors invocation and data members Initialization, virtual base classes, abstract classes, delegation. |
| BLOCK- 4 | |
| | UNIT 10: Pointers, virtual functions and polymorphism Pointers to objects, this pointer. pointers to derived classes, virtual functions, Implementation of run-time polymorphism, pure virtual functions. |
| | UNIT 11: Working with files Classes for file stream operations. opening and closing a file, file pointers and their Manipulations, sequential input and output operations, error handling during file Operations, command line arguments. |
| | UNIT 12: Object Oriented Modeling Need of object oriented Modeling, Simulation of real life problems using OOP concept: Example, Representation of problem using object and class diagrams at design level. |
| Suggested Text Book Readings: A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH. R.Lafore, “Object Oriented Programming using C++”, Galgotia Publications. E. Balagurusamy, “Object Oriented Programming with C++”, TMH. | |
| Suggestive digital platforms web links: | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/Other electronic and digital contents | |
| Name of electronic media: e-SLM | Year of incorporation: 2022 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year: 3 | Semester: 6th |
| Subject: Computer science | | |
| Course Code: DCECS -109N | Course Title: Software Engineering | |
| <p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To understand the methodologies involved in the development and maintenance of software (i.e.) over the entire life cycle. 2. To learn about generic models of software development process. 3. To understand methods of capturing, specifying, visualizing and analyzing software requirements and analysis modeling. 4. To know basics of testing and understanding concept of software quality assurance and software configuration management process. 5. To understand the different design techniques and their implementation. 6. To learn various testing and maintenance measures. 7. To understand Project management and Quality Assurance plan and measures. | | |
| <p>Course Outcomes:</p> <p>CO1. Understand and comprehend the nature of software development and software life cycle models</p> <p>CO2. Explain needs for software specifications, software requirements and their gathering techniques and their application.</p> <p>CO3. Understand and comprehend software quality assurance techniques.</p> <p>CO4. Learn and implement concepts of software design modeling and principles</p> <p>CO5. Compare, understand and learn different testing strategies and tactic</p> <p>CO6. Understand, compare and apply various software maintenance and management techniques</p> | | |
| Credits: 2 | | Type of Course: Elective |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | | |
| Unit I | <p>UNIT-I Software Engineering Fundamentals: Definition of Software, Software characteristics, Software Applications. Software Process: Software Process Models - Waterfall model, prototyping model, spiral model, incremental model, concurrent development model. Project management Concepts: The Management Spectrum - The People, The Product The Process, The Project.</p> | |
| Unit II | <p>UNIT-II Software Process and Project Metrics : Measures , Metrics and Indicators , Software measurement Size -Oriented Metrics , Function - Oriented Metrics , Extended Function point metrics Software Project Planning : Project Planning Objectives , Software Project Estimation , Decomposition Techniques - Problem Based Estimation Process Based Estimation ,Empirical Estimation Models- The COCOMO Model Risk Analysis and Management: Software risks, Risk identification, Risk Projection, Risk Refinement, Risk Mitigation , Monitoring and Management.</p> | |
| Unit III | <p>UNIT-III Software Quality Assurance: Basic concepts- Quality, Quality Control, Quality Assurance, Cost of Quality , Software Quality Assurance (SQA) , Formal Technical Review Software Configuration Management: Baselines , Software Configuration Items, The SCM Process, Version Control, Change Control, Configuration Audit, Status Reporting. Analysis Concepts and Principles: Requirements Elicitation for Software, Analysis Principles. The Information Domain, Modeling, Partitioning, Essential and Implementation Views, Specification: Specification Principles, Representation, The Software Requirement Specification (SRS)</p> | |
| Block 2 | | |

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| Unit IV | UNIT-IV Design Concepts and Principles: Design Principles, Design Concepts — Abstraction, Refinement, Modularity, Software Architecture, Control Hierarchy, Structural Partitioning, Data Structure. Software Procedure, Structure, Information Hiding, Effective Modular Design- Cohesion, Coupling Software Testing: Testing Objectives & principles, Unit Testing, Integration Testing (Top Down Integration , Bottom. Up Integration, Regression Testing, Smoke Testing), Validation Testing (Alpha and Beta Testing), System Testing (Recovery Testing, Security Testing, Stress Testing, Performance Testing). |
| Unit V | UNIT-V Reengineering: Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering CASE Tools: What is CASE, Building Blocks of CASE, A Taxonomy of CASE Tools, Integrated CASE Environments, The integration Architecture, The CASE Repository. |
| <p>Suggested Text Book Readings:</p> <p>R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.</p> <p>Rajib Mall, Fundamentals of Software Engineering, PHI Publication.</p> <p>K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.</p> <p>Pankaj Jalote, Software Engineering, Wiley.</p> <p>Deepak Jain, "Software Engineering: Principles and Practices", Oxford University Press.</p> <p>Munesh C. Trivedi, Software Engineering, Khanna Publishing House.</p> <p>N.S. Gill, Software Engineering, Khanna Publishing House.</p> <p>Suggestive digital platforms web links:</p> | |
| Electronic media and other digital components in the curriculum: | |
| Name of electronic media: e-SLM | Year of incorporation: 2022 |

Syllabus for [B.Sc.]: Subject: [Computer science]

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| Course prerequisites: 10+2 with Computer science, Mathematics | | |
| Programme: B.Sc. | Year:3 | Semester:6th |
| Subject: Computer science | | |
| Course Code: DCECS -110(P)N | Course Title: Practical Work based on 108 | |
| Course Objectives: <ol style="list-style-type: none"> 1. To write, compile, debug and execute programs in a C programming environment. 2. To learn programs that incorporate use of variables, operators and expressions along with data types. 3. To learn programs for solving problems involving use of decision control structures and loops. 4. To learn programs that involve the use of arrays, structures and user defined functions. 5. To Write programs using file handling operations. | | |
| Course Outcomes: <p>CO1. Write, compile, debug and execute programs in a C programming environment</p> <p>CO2. Write programs that incorporate use of variables, operators and expressions along with data types.</p> <p>CO3. Write programs for solving problems involving use of decision control structures and loops.</p> <p>CO4. Write programs that involve the use of arrays, structures and user defined functions</p> <p>CO5. Write programs using file handling operations.</p> | | |
| Credits:2 | Type of Course: Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Unit I | <p>Program to implement conditional statements in C++ language.</p> <ul style="list-style-type: none"> • Program to implement switch-case statement in C++ language • Program to implement looping constructs in C++ language. • Program to perform basic input-output operations in C++ language. • Program to implement user defined functions in C++ language. • Program to implement recursive functions in C++ language. • Program to implement one-dimensional arrays in C++ language. • Program to implement two-dimensional arrays in C++ language. • Program to perform various operations on two-dimensional arrays in C++ language. • Program to implement multi-dimensional arrays in C++ language. • Program to implement string manipulation functions in C++ language. • Program to implement structure in C++ language. • Program to implement union in C++ language. • Program to perform file handling operations in C ++language. | |
| Suggested Text Book Readings: <p>A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH.</p> <p>R.Lafore, “Object Oriented Programming using C++”, Galgotia Publications.</p> <p>E. Balagurusamy, “Object Oriented Programming with C++”, TMH.</p> | | |

Year-2023-2024

Syllabus of B.Sc. Programme: [Subject Name: Environmental Science]

In accordance with NEP-2020

| Year | Semester | Course Code | Title of course | Theory/ Practical | Credits Marks | | |
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| 1 | I | UGEVS-101N | Fundamentals of Environmental Sciences | Theory | 2 | 100 | |
| | | UGEVS-101N(P) | Practical work | Practical | 2 | 100 | |
| | | Skill Enhancement Course | | | | | |
| | | SBSEVS-01(N) | Energy Resources and Green Technology | Theory | 4 | 100 | |
| 1 | II | UGEVS-102(N) | Ecology and Biodiversity Conservation | Theory | 2 | 100 | |
| | | UGEVS-102N(P) | Practical work | Practical | 2 | 100 | |
| | | Skill Enhancement Course | | | | | |
| | | SBSEVS-02(N) | Environmental Impact Assessment and Legislation | Theory | 4 | 100 | |
| 2 | III | UGEVS-103(N) | Environmental Microbiology and Biotechnology | Theory | 2 | 100 | |
| | | UGEVS-103N(P) | Practical work | Practical | 2 | 100 | |
| 2 | IV | UGEVS-104N | Plant Physiology and Biochemistry | Theory | 2 | 100 | |
| | | UGEVS-104N(P) | Practical Work | | 2 | 100 | |
| Discipline Centric Elective Course | | | | | | | |
| | | DCEVS-105N | Environmental Pollution | Theory | 2 | 100 | |
| | | DCEVS-106N | Remote Sensing, GIS and Hydrology | Theory | 2 | 100 | |
| | | DCEVS-107N(P) | Practical work based on 105 &106 | Practical | 2 | 100 | |
| Discipline Centric Elective Course | | | | | | | |
| | | DCEVS-108N | Statistics and Environmental Quality Assessment | Theory | 2 | 100 | |
| | | DCEVS-109N | Environmental Geology | Theory | 2 | 100 | |
| | | DCEVS-110N(P) | Practical Work based on 108 &109 | Practical | 2 | 100 | |
| Total Credit /Marks | | | | | 36 | 1600 | |

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| Programme: B.Sc. | Year: 1 | Semester: I |
| Subject: Environmental Sciences | | |
| Course Code: UGEVS-101N | Course Title: Fundamentals of Environmental Sciences | |
| Course Objectives: <ul style="list-style-type: none"> ➤ To understand basics of outline of environment. ➤ To learn about nature and its behavior for living beings. ➤ To understand modern concept of environment. ➤ To understand basic concept of sustainable development. | | |
| Course Outcomes: CO 1: Gain knowledge of Bhartiya Gyan Parampara about nature CO 2: Learn about the concept of environment and its components CO3: Able to analyze ambient environment and their future prospects. CO4: Learn about origin of life and theory of evaluation and natural selection. CO5: Also learn about environmental education and their implementation for sustainable development | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Environmental History and Evaluation | |
| Unit I | Vedic Concept of Environment: Bhartiya gyan parampara aur bhartiya vaigyanik; moral and aesthetic nature of environmental science; objectives and historic roots of the subject. | |
| Unit II | Modern Concept of Environment: Definition, principles and scope of environmental science, environmental studies and environmental technology, concept of environmental chemistry, biotechnology and microbiology need for public awareness. | |
| Unit III | Evolution: Origin of life and speciation, Darwinism and modern synthetic theory of evolution, natural selection; biochemical basis of origin of life; Hardy -Weinberg equilibrium; genetic drift. | |
| Block 2 | Environmental Education | |
| Unit IV | Segment of Environment: Atmosphere, hydrosphere, lithosphere, biosphere and anthrosphere; factors affecting environment, natural and artificial environment, biogeochemical cycle. | |
| Unit V | Environmental Education: Definition and opportunity of environmental education, environmental justice, Environmentalism, environmental education at primary and secondary level. | |
| Unit VI | Environmental Issues: Integration of environmental concerns, equality and integrity, causes and types of environmental issue, local, regional and global environmental issues and challenges, solution for environmental issues. | |
| Block 3 | Man and Environmental Sustainability | |
| Unit VII | Man and Environment: | |

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| | Population and density, natality and mortality, biotic potential and growth form of populations, man-environment relationships; impacts of human activity on environment. |
| Unit VIII | Environment and Human Health: Basic understanding between environment and human health, environmental pollution diseases- allergies, respiratory, cardiovascular, and cancer, personal hygiene- food - balanced diet? |
| Unit IX | Environmental Sustainability: Concept of sustainability and sustainable development, social, environmental and economic sustainability concepts, carrying capacity, challenges for sustainable development. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. S.C. Sandra, "Environmental Science", A new Central Book Agency, 2008 2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017 3. Neerj Nachiketa, Environment and Ecology: A Dynamic Approach, G.K. Publication Ltd, 2021 4. V. K. Ahluwalia, "Environmental Science, Ane Books India, 2013S. 5. M.C. Dash, "Concepts of Environmental Management for Sustainable Develop Concepts of Environmental Management for Sustainable Development, I K International Publishing House Pvt. Ltd | |
| Suggested online links: | |
| <ol style="list-style-type: none"> 1. Origin of Environmental Science From Vedas: https://youtu.be/2MJb5JrLNpA 2. Environment: Definition, Scopes and importance: https://youtu.be/L0uF8121F-0 3. Environmental Education: (316) Environmental Education World and Indian Perspective Environmental Geography Dr. Krishnanand - YouTube 4. Human Health and the Environment: Untitled Document (oecd.org) 5. Global and local environmental sustainability, development and growth: FINAL POST-2015 global and local environmental sustainability.pdf (oecd.org) | |
| This course can be opted as an elective by the students of following subjects: NO | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: 2023-24 | Semester: I |
| Subject: Environmental Sciences | | |
| Course Code: SBSEVS-01N | Course Title: Energy Resources and Green Technology | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the concept of energy and its sources ➤ To understand fossil fuel energy ➤ To learn about biomass energy production ➤ To know about green technology | | |
| Course Outcomes: | | |
| CO1: Able to know about structure and composition of sun. | | |
| CO2: Learn about solar energy | | |
| CO3: Gain the knowledge of fuel energy resource | | |
| CO4: Learn about energy production by water and wind | | |
| CO5: Able to know the concept of green technology and green building | | |
| Credits: 4 | Type of Course: Skill Enhancement Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Solar and Fossil Fuel | |
| Unit I | Sun as Source of Energy: Concept of energy, energy use from a historical perspective, solar energy, solar radiation, Solar shell, status of solar energy in India. | |
| Unit II | Fossil Fuel: Classification and composition of fossil fuel, physico-chemical properties of fuel, origin, composition and types of coal, origin, composition and types of liquid fuel (crude oil), classification of gaseous fossil fuels, gross calorific value and net calorific value of different fuels, oil and gas reservoirs and reserves. | |
| Unit III | Renewable Energy Resources: Solar energy, hydro energy or water power, wind energy, ocean energy (ocean tidal and wave energy and ocean thermal energy conversion (OTEC)), geothermal energy, Indian scenario of renewable energy consumption. | |
| Block 2 | Biomass Energy and Energy Polices | |
| Unit IV | Biomass as energy source: Biomass resources, dedicated bioenergy crops, characteristics of bioenergy crops, bioenergy routes from biomass, conversion of biomass into fuels challenges in bioenergy utilization, biomass states energy in India. | |
| Unit V | Other Source of Energy: Conventional and nonconventional energy sources, nuclear fusion for energy, Ethanol and methanol production, pyrolysis and sources gasification, composition of biogas, Urban waste to resource recovery and recycling for energy. | |
| Unit VI | Energy Policies: Indian emission norms in transportation sector, national programmes to promote biomass energy production in India, solar photovoltaic programmes in India, | |

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| | energy resources available in India, urban and rural energy consumption, national green tribunal (NGT) act, NGT activities. |
| Block 3 | Energy Conservation and Green Energy |
| Unit VII | Energy Conservation and Green Building: Definition of energy conservation, need for energy conservation in India, benefits of energy conservation, principles of energy conservation, government initiatives for energy conservation; concepts, scope and components of green building, green buildings in India, certification of green building. |
| Unit VIII | Green Energy: Aim and scope of green technology, concept of green energy and green technology, biomass energy production, solar and green battery technology; Fuel cell technologies and application to waste-to-energy conversion. |
| Unit IX | Green Nanotechnology: Understanding green tech, sectors using green tech, green nanotechnology necessity of green technology, categories of green technology; environmental profits of green building, economic benefits of green building, goals of green technology, limitations of green processes and technology. |
| Suggested Text Book Readings: <ol style="list-style-type: none"> 1. S.C. Bhatia and R. K. Gupta, "Textbook of Renewable Energy", WPI Publishing-2019 2. Renu, Dhupper, "Textbook on Energy Resources and Management" CBS Publishers & Distributors-2015 3. Mahmood Zohoori, Advantages and Disadvantages of Green Technology; Goals, Challenges and Strengths, International Journal of Science and Engineering Applications, ISSN-2319-7560 4. G.D. Rai, Non conventional energy sources, Khanna publication. 5. Sameer Sarkar, Fuel Technology, New Delhi, orient longman. | |
| Suggested online links: <ol style="list-style-type: none"> 1. Energy from the Sun: EnergyfromtheSunStudentGuide.pdf (need.org) 2. Energy Conservation, Renewable Energy: Introduction: (ernet.in) 3. Renewable Energy and Green Growth in India: Project ReportTemplate (teriin.org) 4. What is Biomass: https://youtu.be/DueF2df52IE | |
| Energy sources and Conversion Process - YouTube | |
| This course can be opted as an elective by the students of following subjects: NO | |
| Suggested equivalent online courses (MOOCs) for credit transfer; | |
| 1. Energy Resources and conversion processes - Course (swayam2.ac.in) | |
| Electronic media and other digital components in the curriculum: Electronic media and other digital components in the curriculum: Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: 2023-24 | Semester: II |
| Subject: Environmental Sciences | | |
| Course Code: UGEVS-102N | Course Title: Ecology and Biodiversity Conservation | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand about ecology and this types ➤ To learn about ecosystem and its function. ➤ To learn about biodiversity and its conservation. | | |
| Course Outcomes: | | |
| CO1: Able to know the concept of ecology and their role in understanding of environment. | | |
| CO 2: Gain basic understanding of ecosystem and its function in nature for natural balance. | | |
| CO3: Ability to understand the characteristic of autecology and synecology. | | |
| CO4: Learn about natural diversity, its types and role in nature. | | |
| CO5: Also learn assessment of biodiversity. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Ecology | |
| Unit I | Ecology and Environment: Concept and Definition of ecology and environment, types of ecology; Environmental factors (Abiotic and biotic), their importance and role, ecological Hierarchy. | |
| Unit II | Autecology: Population characteristics- dispersion, density, natality, mortality, age, structure, population growth; human population & growth; ecological niche and habitat | |
| Unit III | Synecology: Community structure, growth forms, concept of keystone species, ecotone, ecotypes, ecophene, ecological indicators; ecological succession. | |
| Block 2 | Ecosystem | |
| Unit IV | Components of Ecosystem: Components, structure and function of ecosystem; properties of ecosystem, major ecosystems, types of ecosystem in nature, terrestrial, aquatic ecosystem, and biome. | |
| Unit V | Trophic Levels: Energy flow in ecosystem, food chain and food web, ecological pyramid, types of ecological pyramid, productivity. | |
| Unit VI | Energy-its Flow in Ecosystem: Energy-defined in ecosystem, three sources of energy in ecosystem, Y-shaped energy flow model, Two channel energy flow model. | |
| Block 3 | Biodiversity | |
| Unit VII | Introduction to Biodiversity: Concept of biodiversity, types of biodiversity, biodiversity as a natural resource, loss of biodiversity, factors affecting biodiversity, biodiversity hotspots; hotspots in India. | |
| Unit VIII | Biodiversity Conservation: | |

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| | Conservation of natural biodiversity-approaches and conventions, In-situ conservation, Ex-situ conservation; Role of local communities and traditional knowledge in conservation. |
| Unit IX | Biodiversity Assessment: Identification of biodiversity, measuring biodiversity, biodiversity at local, national and global levels, habitat destruction, fragmentation, transformation, degradation and overexploitation, causes, impacts of pesticide and pollution on biodiversity. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. S.C. Sandra, "Environmental Science", A New Central Book Agency, 2008. 2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017 3. Neerj Nachiketa, Environment and Ecology: A Dynamic Approach, G.K. PublicationLtd, 2021 4. A text Book of Environment Studies, Asthana, D. K. and Asthana, M. 2006, S. Chand & Co.- 2010. 5. Dr. Y. K. Singh, "Environmental Science" New Age International Private Limited-2006 | |
| Suggested online links: | |
| <ol style="list-style-type: none"> 1. Textbook for Environmental Studies, Erach Bharucha https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf 2. Environmental Science, Tom Theis and Jonathan Tomkin, OpenStax CNX, National Digital Library of India. http://ndl.iitkgp.ac.in/document/N2tzeE1aWWpUMm04b211VVZEdSsvK09RckFISkE0OWI3b1Flb2ZTNHFxST0 3. Environmental Science, CEC EduSat, National Digital Library of India. 4. Biodiversity: Chapter4.p65 (ugc.ac.in) | |
| This course can be opted as an elective by the students of following subjects: Anyone | |
| Suggested equivalent online courses (MOOCs) for credit transfer; | |
| 1. Biodiversity and Ecological Resources - Course (swayam2.ac.in) | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: 2023-24 | Semester: II |
| Subject: Environmental Sciences | | |
| Course Code: SBSEVS-02N | Course Title: Environmental Impact Assessment and Legislation | |
| Course Objectives: <ul style="list-style-type: none"> ➤ To understand the basic concept of EIA ➤ To understand methodology of data collection ➤ To learn about environmental impact and social impact ➤ To know environmental legislation and policy | | |
| Course Outcomes: CO1: Learn the concept of EIA and why it is useful in environmental clearance. CO2: Learn the components of EIA and its methodology to use CO3: Able to know the role of EIA in water, soil and air analysis. CO4: Learn about EIA regulation of in India CO5: Also learn about environmental law and its implementation of conservation of nature. | | |
| Credits: 4 | Type of Course: Skill Enhancement Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | EIA Components and Data Collections | |
| Unit I | Basic Concept of EIA: Definition, principle and objectives of EIA, need for EIA, Types of EIA, Hierarchy in EIA, Advantages of EIA, application form of EIA, composition of expert committee for EIA process. | |
| Unit II | Components of EIA: EIA process, screening, scoping, baseline data, impact prediction, assessment of alternatives, delineation of mitigation measure and EIA report, public hearing, decision making, monitoring, environmental clearance conditions. | |
| Unit III | Impact Assessment and Data Collections: Environmental impact, social impact, impact identification and prediction, baseline data collection, construction stage impacts, post project impacts. | |
| Block 2 | EIA Policies and Life Cycle Assessment (LCA) | |
| Unit IV | EIA policies: EIA notifications, Government of India Ministry of Environment and Forest Notification (2000), list of projects requiring, environmental clearance. | |
| Unit V | EIA Regulations in India: Status of EIA in India; current issues in EIA; case study of hydropower projects/ thermal projects, salient features of 2006 amendments to EIA notification | |
| Unit VI | Life Cycle Assessment (LCA): Life cycle analysis, methodology, management, flow of materials-cost criteria- case studies, introduction to ISO 14000. | |
| Block 3 | Environmental Management, Act and Polices | |
| Unit VII | Environmental Management: | |

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| | Environmental appraisal, environmental impact statement (EIS), environmental management plan (EMP), environmental audit; sustainable development. |
| Unit VIII | Environmental Act: Environmental laws and protection acts, existing provision of central and state government on environment protection, the Environment (protection) act (1986), the water act (1974), the air act (1981), wild life act (1972). |
| Unit IX | Guidelines and Policies: Guidelines and policies for control of environmental pollution, Environmental Policy of India, solid and hazardous waste management, handling and management rules. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. S.R. Khandeshwar, N.S. Raman and A.R. Gajbhiye , Environmental Impact Assessment, Dreamtech Press-2019. 2. Anjaneyulu Yerramilli, Environmental Impact Assessment Methodologies, BS Publications-2020. 3. George Alex, Environmental Impact Assessment (EIA), Blue Rose Publishers-2020. 4. Teacher_manual_master_EIA.pdf (iitr.ac.in) 5. N. Maheshwara Swamy, Text Book on Environmental Law, Asia Law House-2022 | |
| Suggested online links: | |
| <ol style="list-style-type: none"> 1. (187) Everything About EIA - Environmental Impact Assessment 2006 - Draft 2020 - YouTube 2. (187) Environmental Impact Assessment EIA Process Its Components Benefits of EIA Environmental Sci - YouTube 3. Environmental Science II Environmental Assessment ,Management & Legislation II UGC NET II PAPER-2 - YouTube 4. (187) Lecture 13: EIA – Law, Policy and Institutional arrangements for EIA system - YouTube 5. Environmental Management - ISO 14000 - 20 Nov, 6 PM - YouTube | |
| (187) Environment Law (पर्यावरण विधि) - YouTube | |
| This course can be opted as an elective by the students of following subjects: Any one | |
| Suggested equivalent online courses (MOOCs) for credit transfer: | |
| 1. Environmental Impact Assessment - Course (nptel.ac.in) | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: 2023-24 | Semester: III |
| Subject: Environmental Sciences | | |
| Course Code: UGEVS-103N | Course Title: Environmental Microbiology and Biotechnology | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the microbial diversity and culture. ➤ To learn about role microbial degradation of pollutants. ➤ To know about nucleic acid and gene expression. | | |
| Course Outcomes: | | |
| CO1: Able to know the microbial world and their classification CO2: Able to know the role of microbes in environment CO3: Learn the concept of microbial transformation CO4: Knowledge gain about nature of microbial degradation CO5: Learn about the nucleic acid and protein and also the DNA technology and gene expression. | | |
| Credits:2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Microbial World | |
| Unit I | Introduction to Microbes: Classification of micro-organisms, and their nomenclature, Whittaker's five kingdom classification system and their utility, culture media, nutritional requirements and growth characteristics of bacteria. | |
| Unit II | Microbial Transformation: Concept of microbial transformation, accumulation and concentration of metals, metal leaching, extraction; role of microbes in copper and uranium extraction, use of bioreactors for bioremediation. | |
| Unit III | Microbial Degradation: Microbes in waste decomposition, role of microbes in soil fertility, microbes in agriculture, industry, medicine and wastewater treatment use, degradation of xenobiotics in environment | |
| Block 2 | Microbial Bioremediation: | |
| Unit IV | Microbes in gaseous production: Bioreactors for bioremediation, composting, bioventing, biogas production; methane, factor effecting methane, biodegradation of hydrocarbon. | |
| Unit V | Ecological Restoration and Bioremediation: Bioremediation and phytoremediation, specific bioremediation technologies for water and land forming, biosparging, degradative pathways of plasmids, hydrocarbons, pesticides, heavy metals and heavy metal tolerance in microbes. | |
| Unit VI | Ecologically Safe Products and Processes: Plant growth Promoting Rhizobacteria (PGPR): biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuels; mining and metal biotechnology. | |
| Block 3 | Nucleic Acid and Gene Expression | |

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| Unit VII | Structure of Nucleic acid and Proteins: Nucleoside, nucleotide and nucleic acids, structural forms and characteristics of DNA and RNA, physical and chemical properties of nucleic acid. |
| Unit VIII | Recombinant DNA technology: Recombinant DNA: origin and current status; steps of preparation; restriction enzymes, polymerases, R-DNA technology in environmental management. |
| Unit IX | Gene Expression: Gene vs. Allele concept, quantitative genetics and multiple factors, inheritance and polygenic inheritance, sex chromosome structure and sex linked inheritance, sex linked diseases. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. R.C. Dubey and D.K. Maaheshwari, A Textbook of Microbiology, S. Chand Publication-2013. 2. Ian L. Pepper, Charles P. Gerba, Terry J. Gentry, A Microbiology, Academic Press-2015. 3. K Vijaya Ramesh , Environmental Microbiology, MJP Publication-2019. 4. P.K. Mahapathra, A Textbook of Environmental Microbiology, I K International Publishing House Pvt. Ltd-213. 5. Gareth M. Evans Judith C. Furlon, Environmental Biotechnolog, Theory and Application, John Wiley & Sons Ltd, 2003. 6. R. K. Sinha, Environmental Biotechnology, Aavishkar Publishers & Distributors-2007 | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Introduction of Microorganism B.Sc-1st Year Botany (Paper-I) Microbiology Prahalad bhaiya - YouTube 2. Microorganism, Bacteria, Algae, Fungi & Protozoa - Chapter 2 - Microorganisms: Friend and Foe - YouTube 3. BIODEGRADATION OF PESTICIDES - YouTube 4. Bioremediation Microbiology Environmental Microbiology - YouTube 5. Biogas (Methane) Production - Process, Applications, Advantages and Disadvantages - YouTube 6. (185) Recombinant DNA technology (Genetic engineering) - YouTube 7. (185) Biomolecule Proteins & Nucleic Acid L4 NEET 2022/23 Seep Pahuja - YouTube | |
| This course can be opted as an elective by the students of following subjects: NO | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: 2023-24 | Semester: IV |
| Subject: Environmental Sciences | | |
| Course Code: UGEVS-104N | Course Title: Plant Physiology and Biochemistry | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the plant stress and their its control ➤ To know about mineral and nitrogen fixation. ➤ To know about mechanism of photosynthesis and respiration in plant. | | |
| Course Outcomes: CO 1: Able to understand about plant cell absorption mechanism. CO 2: Learn the role of plant growth regulator. CO 3: Gain the concept of nitrogen fixation. CO 4: Learn about plant minerals and its transportation CO 5: Also learn about photosynthesis and respirator regulation. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Plant Cell, Stress and Growth Regulator | |
| Unit I | Plant Cell and Transportation: Plant cell, absorption, transportation of water, properties of solution, permeability, imbibitions, osmosis, ascent of sap. | |
| Unit II | Plants Stress: Abiotic and biotic stress; salinity, water stress, chilling, heat, pathogenesis, heavy metals and their impact on plant growth and metabolism. | |
| Unit III | Plant Growth Regulator: Phytohormones and its effect on plant growth and development, regulation of plant morphogenetic processes by light, role plant growth hormone in agriculture. | |
| Block 2 | Minerals and Nitrogen Fixation | |
| Unit IV | Plant Minerals: Mineral elements in plants, types of plant nutrients, classification of minerals nutrients, availability of micro and macronutrients, essential and non-essential nutrients, common mineral diseases in plants. | |
| Unit V | Nitrogen Fixation and Assimilation: Nitrogen cycle, Biological nitrogen fixation by free living and in symbiotic association, structure and function of enzyme nitrogenase. | |
| Unit VI | Nitrogen Metabolism: Assimilation of nitrate, enzyme of nitrate reduction and their regulation and assimilation of ammonia into organic compounds. | |
| Block 3 | Photosynthesis and Respiration: | |
| Unit VII | Photosynthesis: Chloroplast structure, photosynthetic apparatus, photosynthetic apparatus, photosynthetic membranes and organelles, z scheme, light dependent reactions, Hill | |

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| | reaction, generation of NADPH and ATP, Cyclic and non cyclic Photophosphorylation, |
| Unit VIII | Carbon Assimilation: Calvin cycle, and photorespiration, C4 cycle and CAM cycle, carbon cycle. |
| Unit IX | Respiration: Structure of mitochondria, Types of respiration, glycolysis, regulation of plant glycolysis, translocation of metabolites across mitochondrial membrane, TCA cycle. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. A Textbook of Plant Physiology, Biochemistry And Biotechnology, S K Verma, Mohit Verma, S Chand Publication, 1995. 2. Fundamentals of Plant Physiology, by V. K. Jain , S Chand Publication, 2017. 3. Introduction to Plant Physiology, Norman P. A. Hüner ,William G. Hopkins, Wiley publication, 2008. 4. Outline Of Plant Physiology, Robert M. Devlin, Medtech Publication, 2017. 5. Physiochemical and Environmental Plant Physiology, Nobel, P. S. Academic Press; 4 edition, 2009. | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Temperature stress in plants Stress Physiology in Plants - YouTube 2. Mineral Nutrition in Plants - Biological Nitrogen Fixation - Nitrate Assimilation - YouTube 3. Photosynthesis - Non cyclic Photophosphorylation - YouTube 4. Photosynthesis - Pigments - YouTube. 5. Plant Respiration Biology NEET 2020 Ritu Rattewal - YouTube | |
| This course can be opted as an elective by the students of following subjects: Any one | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: 2023-24 | Semester: V |
| Subject: Environmental Sciences | | |
| Course Code: DCEVS-105N | Course Title: Environmental Pollutions | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand about environmental pollution ➤ To learn water, air, soil and radioactive pollution ➤ To learn how to control environmental pollution. | | |
| Course Outcomes: | | |
| CO1: Gain the knowledge of environmental pollution its source and sink | | |
| CO 2: Learn the physiochemical characteristic water and its effects on living beings. | | |
| CO3: Learn how to detect and control the soil and air pollution. | | |
| CO4: Learn about techniques used in assessment of environmental pollution | | |
| CO5: Learn how to ecological balance is necessary to control environmental pollution. | | |
| Credits: 2 | Type of Course: Discipline Centric Elective Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Water and Air Pollution | |
| Unit I | Introduction of Pollutant: Definition of pollution and pollutants, source and sink of pollutants, classification of pollutants, difference between pollutants and contaminants. | |
| Unit II | Water Pollution: Definition and sources of water pollution, types of water pollutants, effects of water pollutants on river water and potable water in India, measure of water pollution. | |
| Unit III | Air Pollution: Definition and sources of air pollution, atmospheric composition, types of air pollutants, acid rain, particulate matter, factors effecting air pollution, control measure of air pollution. | |
| Block 2 | Soil, Noise and Radioactive Pollution | |
| Unit IV | Soil pollution: Definition and sources of soil pollution, nature of soil pollutants, physiochemical and biological properties of soil, factor effecting soil pollution, measure of soil pollution. | |
| Unit V | Noise Pollution: Definition of noise pollution, noise exposure level, effects of noise pollution, measure and control of noise pollution. | |
| Unit VI | Radioactive Pollution: Definition and sources of radioactive pollution, sources of radiations, nuclear pollution, biological effects of radiations, control measures, radioactive pollution. | |
| Block 3 | Effects and Control of Pollution | |

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| Unit VII | Thermal Pollution: Definition and sources of thermal pollution, causes of thermal pollution, control and measure of thermal pollution. |
| Unit VIII | Effects of Environmental Pollution: Effects of heavy metal pollution on natural water and soil, metal toxicity and its effects on human beings, effects of environmental pollution on agriculture. |
| Unit IX | Pollution Control: Techniques used in water treatment, oxidation ponds, fluidized bed reactors, air samplers, sequencing batch reactor, bioscrubbers, biotrickling filters, Afforestation. |

Suggested Text Book Readings:

1. S.C. Sandra, "Environmental Science", A new Central Book Agency, 2008.
2. A.K. De, "Environmental Chemistry" Publisher: New Age Publisher International Pvt Ltd-2016.
3. Balram Pani, "Textbook of Environmental Chemistry" I K International Publishing House Pvt. Ltd-2103.
4. A text Book of Environment Studies, Asthana, D. K. and Asthana, M. 2006, S. Chand & Co.-2010.
5. Dr. Y. K. Singh, "Environmental Science" New Age International Private Limited-2006.

Suggested on line link:

1. Textbook for Environmental Studies, Erach Bharucha
<https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf>
2. Environmental Science, Tom Theis and Jonathan Tomkin, OpenStax CNX, National Digital Library of India.
<http://ndl.iitkgp.ac.in/document/N2tzeE1aWWpUMm04b211VVZEdSsvK09RckFISkeE0OWI3b1Flb2ZTNHFxST0>
3. Environmental Science, CEC EduSat, National Digital Library of India.
4. POLLUTION <https://youtu.be/kOGqRMwAC6U>
5. Pollution and its Control: [\(316\) Pollution and its Control - Environmental and Ecology | Crack UPSC CSE/IAS - YouTube](#)

This course can be opted as an elective by the students of following subjects: NO

1. Environmental Pollution and Global issues - Course (swayam2.ac.in)
https://onlinecourses.swayam2.ac.in/cec19_cs06/preview

Electronic media and other digital components in the curriculum:

Choose any one or more than:(Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents)

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| Name of electronic media: | Year of incorporation: 2023-24 |
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| Programme: B.Sc. | Year: 2023-24 | Semester: V |
| Subject: Environmental Sciences | | |
| Course Code: DCEVS-106N | Course Title: Remote Sensing, GIS and Hydrology | |
| Course Objectives: <ul style="list-style-type: none"> ➤ To understand to Remote sending and GIS in environmental management. ➤ To understand the water hydrology and it role in environmental balance. ➤ To learn how to about hydrological process. | | |
| Course Outcomes: CO1: Able to know the principle of remote sensing and tools used in remote sensing. CO2: Learn about the role GIS in determination of real time data sampling. CO3: Known the concept of hydrological maintenance of environment. CO4: Learn about hydrograph, and hydrograph Analysis for water resources CO5: Also learn about water harvesting and food management system. | | |
| Credits: 2 | Type of Course: Discipline Centric Elective Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Concept and Application of Remote Sensing | |
| Unit I | Concept of Remote Sensing: Electromagnetic radiation and atmospheric window, principle of remote sensing, types of remote sensing, data acquisition and it applications | |
| Unit II | Geographical Information System (GPS): Concept of GIS, Principles, Elements and its applications, GPS principle and applications. | |
| Unit III | Application of Remote Sensing: Application of remote sensing in atmospheric and ocean studies, climate change, forestry, and environment. | |
| Block 2 | Concept and Hydrological Process | |
| Unit IV | Concept of Hydrology: Hydrologic cycle, water availability, water balance, precipitation, evapotranspiration study by remote sensing. | |
| Unit V | Hydrological Process: Water table, aquifer, evaporation and transpiration, Interflow, Gravity Drainage, Surface Runoff, Return flow, Recharge. | |
| Unit VI | Hydrograph Analysis: Hyetograph, Runoff, drainage basin characteristics; Hydrograph concepts, assumptions and limitations, Unit of hydrograph. | |
| Block 3 | Flood Management and Water Harvesting | |
| Unit VII | Reservoir: Types, site selection, zones of storage, safe yield, reservoir capacity, reservoir sedimentation and control study. | |
| Unit VIII | Flood Management: | |

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| | Types of floods, Causes of flooding, Alleviation, Levees and floodwalls, Floodways, Channel improvement, Flood damage analysis by remote sensing. |
| Unit IX | Water Harvesting: Rainwater collection, runoff collection, ponds, tanks, natural and artificial ground water recharge methods, agriculture rain water harvesting. |
| Suggested Text Book Readings: <ol style="list-style-type: none"> 1. M. Anji Reddy, Text Book of Remote Sensing and Geographical Information Systems, Publications/BSP Books-2012. 2. Kali Charan Sahu, Textbook of Remote Sensing and Geographical Information Systems, Atlantic Publishers and Distributors (P) Ltd-2022. 3. K. Subramanya, Engineering Hydrology, McGraw Hill Education, 2017. 4. Savindra Singh, Fundamentals of Hydrology, Pravalika, 5. R. N. Saxena, Elements of Hydrology and Groundwater, PHI Learning-2017. | |
| Suggested online link: <ol style="list-style-type: none"> 1. (185) Remote sensing in hindi remote sensing and gis lecture 1 - YouTube 2. (185) GIS (geographic information systems) introduction to gis lecture 1 - YouTube 3. (185) Application of remote sensing remote sensing and gis lecture 6 - YouTube 4. (185) Hydrologic Processes - YouTube 5. (185) Basics of Hydrograph Analysis and Uses - Hydrograph Analysis - GATE Hydrology - YouTube (185) Hydrograph and Runoff - Hydrology - YouTube | |
| This course can be opted as an elective by the students of following subjects: NO | |
| Suggested equivalent online courses (MOOCs) for credit transfer: <ol style="list-style-type: none"> 1. Basics of Remote sensing, GIS & GNSS technology and their applications - Course (swayam2.ac.in) & 2. Surface Water Hydrology - Course (nptel.ac.in) | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: 2023-24 | Semester: VI |
| Subject: Environmental Sciences | | |
| Course Code: DCEVS-108N | Course Title: Statistics and Environmental Quality Assessment | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To learn graphical representation of environmental data ➤ To learn about data analysis techniques ➤ To know about water and soil quality analysis | | |
| Course Outcomes: | | |
| CO1: Useful to known about environmental statistics and data management. | | |
| CO2: Learn about the diagram and graphs plot | | |
| CO3: Able to understand the probability, variable and standard deviation | | |
| CO4: Able to understand the analysis of variance. | | |
| CO5: Able to Learn about air water and soil quality assessment. | | |
| Credits: 2 | Type of Course: Discipline Centric Elective Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Graphical representation of Environmental data | |
| Unit I | Environmental Statistics: Concept and scope of environmental statistics, role of statistics in environmental data interpretation, environmental data accuracy and environmental quality measurement, statistical tools | |
| Unit II | Data and Frequency: Concept of data, types of data, grouped data, tools of data management, frequency, frequency distribution, types of frequency distribution, frequency distribution table and graphs. | |
| Unit III | Diagram and Graphs: Graphical interpretation, simple diagram, multiple diagram, component bar diagram, percentage bar diagram, Pie-diagram, histogram, frequency curve, frequency polygon and line graph. | |
| Block 2 | Data Analysis Techniques | |
| Unit IV | Data Analysis Tools: Concepts of mean, mode, median and geometric mean percentile and quartiles. | |
| Unit V | Probability and Standard Distribution: Probability distribution, normal distribution, sampling distribution, standard deviation and standard error, testing of hypothesis | |
| Unit VI | Analysis of Variance: Concept of statistical variance, basic principles of one way and two way analysis | |
| Block 3 | Air Water and Soil Quality Assessment | |
| Unit VII | Air Quality Monitoring: Composition of air, air quality standard, air sampling, Particulate matter, qualitative analysis of SO ₂ , and NO ₂ . | |
| Unit VIII | Water Quality Monitoring: | |

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| | Water quality analysis, water quality parameters study as BOD, COD, pH, turbidity and nitrate, salinity, test of <i>coli</i> forms, water quality standard in India. |
| Unit IX | Soil Quality Monitoring: Soil quality, organic matter determination, exchangeable calcium and magnesium, soil quality standard in India. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. S.C. Sandra, "Environmental Science", A new Central Book Agency, 2008. 2. A.K. De, "Environmental Chemistry" Publisher: New Age Publisher International Pvt Ltd-2016. 3. Balram Pani, "Textbook of Environmental Chemistry" I K International Publishing House Pvt. Ltd-2103. 4. Practical Statistics for Environmental & Biological Scientists, John Townened, John Wiley & Sons Inc publication. | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. Environment Statistics: Microsoft Word - Brochure Environment 2015 (un.org) 2. Fundamentals of environment statistics: Microsoft PowerPoint - Session 2-1 Basic concepts of environment statistics (UNSD).ppt 3. Mean, Median and Mode: meanmedianmode (statstutor.ac.uk) 4. Soil Quality and Methods for its Assessment: Brimoh_FM.indd (core.ac.uk) 5. Water Quality Assessment Of Water Bodie: Slide 1 (cpcb.nic.in) 6. Air Quality Assessment: Microsoft Word - air quality technical report (nj.gov) | |
| This course can be opted as an elective by the students of following subjects: Anyone | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: | |
| Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

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| Programme: B.Sc. | Year: 2023-24 | Semester: VI |
| Subject: Environmental Sciences | | |
| Course Code: DCEVS-109N | Course Title: Environmental Geology | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the history of earth origin and their surface process. ➤ To understand atmosphere and its composition and heat balance in nature. ➤ To learn how rocks and minerals are formed by natural process ➤ To know how the mountain and river are originate. | | |
| Course Outcomes: | | |
| CO1: Useful to know about earth formation, earth composition, atmosphere and hydrosphere. | | |
| CO2: Understanding the surface process of earth system that how the rocks, mineral are available for living being and how the geographical formation are occurs like mountain and river. | | |
| CO3: Understand the formation of rocks and mineral, its composition, and weathering process and rock cycling. | | |
| CO4: Learn about Plate tectonic in mountain formation and its role in earthquake generation. | | |
| CO5: Able to understand about geological hazardous like earthquakes and volcano | | |
| Credits: 2 | Type of Course: Discipline Centric Elective Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Earth and Atmosphere | |
| Unit I | History of Earth: Concept of the earth formation, formation and composition of core, mantle, crust, atmosphere and hydrosphere; chemical composition of the earth. | |
| Unit II | Origin of Earth: Geological time scale and major changes on the Earth's surface, Holocene and the emergence of humans, Concept of plate tectonics and continental drift theory, gravitational and magnetic fields of the earth. | |
| Unit III | Earth Atmosphere: Atmosphere, evolution of earth's atmosphere, composition of atmosphere, physical and optical properties, earth's energy balance; energy transfers in atmosphere; earth's radiation budget. | |
| Block 2 | Earth Surface Process and Rocks Formation | |
| Unit IV | Earth Surface Processes: Circulation, interfaces, atmosphere-ocean interface, atmosphere-land interface, ocean-land interface; land surface processes, fluvial and glacial processes, rivers and geomorphology. | |
| Unit V | Minerals and Rocks Formation: Composition of rocks and minerals, rock cycle: lithification and metamorphism; Three rock laws; rock structure, igneous, sedimentary and metamorphic rocks. | |
| Unit VI | Weathering of Minerals and Rocks: | |

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| | Physical, biogeochemical processes of weathering; physical processes of erosion, factors affecting erosion and agents of erosion; aeolian transportation and deposition of sediments by running water. |
| Block 3 | Mountain and River Origin and Natural Hazardous |
| Unit VII | Mountain Origin: Plate tectonic in mountain formation, continental collision and formation of the Himalaya; ocean floor spreading, formation of peninsular Indian mountain systems - western and eastern ghats, Vindhyas and Aravallis. |
| Unit VIII | River Origin: Perennial river systems and evolution of monsoon in Indian subcontinent; formation of Indo-Gangetic Plains, progression of agriculture in the Indian subcontinent in Holocene. |
| Unit IX | Natural Hazards: Geological hazards, earthquakes and volcano, characteristics of earthquakes, Types of waves, magnitude scales, Richter scale, volcanic feature, types of volcanic eruptions, active and inactive volcanoes. |
| Suggested Text Book Readings: <ol style="list-style-type: none"> 1. Savindra Singh, "Fundament of physical geography, Pravalika Publcatons-2022 2. Savindra Singh, Environmental Geography" Pravalika Publications-2019 3. Thompson and Turk, "Environmental Geoscience: Thomson Learning-1995 4. Jeff Keller, "Environmental Geology" Pearson-1999. 5. Savindra Singh, Fundamentals of Hydrology, Pravalika - 2018 6. Dorothy Merits, Environmental Geology: An Earth Systems Approach, W.H. Freeman-2014 | |
| Suggested online link: <ol style="list-style-type: none"> 1. Theories of Origin of Earth - Part 1 (Examrace - Dr. Manishika) - YouTube 2. History of the Earth: History Of The Earth (Eolss.Net) 3. History of Earth: History Of Earth - Wiki.Pdf (Content-Calpoly-Edu.S3.Amazonaws.Com) 4. Weathering & Mass-Wasting Processes: Weathering, Erosion, and Mass-Wasting Processes (cuny.edu) 5. The Evolution of Mountain: D:WPYSGSG3ERTHHIST.99.wpd (jmu.edu) | |
| This course can be opted as an elective by the students of following subjects: NO | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NO | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: (Electronic Media: Audio/Video Lectures, Online Counseling/Virtual Classes/E-Contents/e-SLM/OER/supplementary links for reference/Video Conferencing/Radio broadcast/Web Conferencing/ Other electronic and digital contents) | |
| Name of electronic media: | Year of incorporation: 2023-24 |

Year-2023-2024

Syllabus of B.Sc. Programme: [Subject Name: Mathematics]

In accordance with NEP-2020

| Year | Sem. | Course Code | Paper Title | Theory/ Practical | Max. Marks. | Credits |
|---------------------------|------|---|--|----------------------|----------------|-----------|
| 1 | I | UGMM-101(N) | Differential Calculus | Theory | 100 | 2 |
| | | UGMM-102(N) | Analytical Geometry | Theory | 100 | 2 |
| | II | UGMM-103(N) | Integral Calculus | Theory | 100 | 2 |
| | | UGMM-104(N) | Differential Equation | Theory | 100 | 2 |
| 2 | III | UGMM -105(N) | Mechanics-I (Statics and Dynamics) | Theory | 100 | 2 |
| | | UGMM -106(N) | Mechanics-II (Dynamics and Hydrodynamics) | Theory | 100 | 2 |
| | IV | UGMM -107(N) | Linear Algebra | Theory | 100 | 2 |
| | | UGMM -108(N) | Calculus of function of several variable and Vector Calculus | Theory | 100 | 2 |
| 3 | V | Discipline Centric Elective Course | | | | |
| | | DCEMM -109(N) | Abstract Algebra | Theory | 100 | 2 |
| | | DCEMM -110(N) | Number Theory | Theory | 100 | 2 |
| | | DCEMM-111(N)(P) | Viva Voce | Practical | 100 | 2 |
| | VI | Skill Enhancement Course | | | | |
| | | SBSMM-03(N) | Elementary Analysis | Theory | 100 | 4 |
| | | Discipline Centric Elective Course | | | | |
| | | DCEMM -112(N) | Advance Analysis | Theory | 100 | 2 |
| | | DCEMM -113(N) | Function of Complex Variable | Theory | 100 | 2 |
| | | DCEMM-114(N)(P) | Viva Voce | Practical | 100 | 2 |
| Total Marks/Credit | | | | | 1500 | 32 |

Syllabus for B.Sc. Subject: MATHEMATICS

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| Course prerequisites: 10+2 with Mathematics | |
| Programme: B.Sc. | Year: 2023-24 |
| Subject: MATHEMATICS | |
| Course Code: UGMM-101(N) | Course Title: Differential Calculus |
| Course Objectives: | |
| <ul style="list-style-type: none"> ➤ To understand the basics concept of set theory, function and relations with their properties. ➤ To understand the limit, continuity with their applications. ➤ To know about the differentiation and their application in solving real life problem. ➤ To determine the derivative of some special functions. | |
| Course Outcomes: | |
| CO1: The student will be able to understand about the sets, relation and function with their properties. | |
| CO2: The student shall understand the importance and solution procedure of problems related to limit and continuity. | |
| CO3: The student will get to know about differentiation and its applications in determining the derivatives of higher orders. | |
| CO4: The student shall understand the importance and applications of Rolle's theorem, Lagrange's Mean value Theorem and Cauchy Mean value Theorem. | |
| Credits: 2 | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 |
| Block 1 | Set, Relation, Function and its Property |
| Unit I | Set and Relation: Set Theory, Types of sets, Operations on Sets, Laws Relating Operations, De Morgan's Laws, Venn diagram, Cartesian product of two sets, Relation, Definition and Examples Domain and Range of a Relation, Types of Relations, Composition of Relation, Equivalence relation in a set, Partition of a Set, Quotient set of a set, Oder Relation and Examples. |
| Unit II | Functions: Functions or mapping, Direct and inverse images of subsets under maps, Real valued Functions of one variable, Inverse functions, Graphs of functions, Operations on functions, Composite of functions, Even and odd functions, Monotone functions, Periodic functions, Axiomatic introduction of \mathbb{R} as a complete ordered field, Basic properties of \mathbb{R} , Absolute value, Intervals on the real line. |
| Unit III | Limits: Definition of limit of a function at a point of its domain, Algebra of Limits, Infinite Limits (Limits as $x \rightarrow \pm\infty$), One Sided Limits. |
| Unit IV | Continuity: Continuity (Definitions and Examples), Algebra of continuous functions, Properties of continuous functions, Local Boundedness supremum and infimum of a function, Boundedness and intermediate value theorem, properties of continuous functions over closed intervals, Type of discontinuity, Image of a closed interval under continuous maps. |
| Block 2 | Differential Calculus |

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| Unit V | Differentiability and Derivatives: Differentiability of a function at a point, Definition of derivative of a function and its geometrical interpretation, Derivatives of some simple functions, Algebra of derivatives, Chain rule. Sign of derivatives and monotonicity of functions, Continuity versus Differentiability. Derivative of exponential function, Logarithmic functions. |
| Unit VI | Derivative of Hyperbolic Functions and Some Special Functions: Definition of Hyperbolic Functions, Derivative of Inverse Hyperbolic Functions Methods of Differentiation (Derivative of x^r), Logarithmic Differentiation, Derivatives of functions defined in terms of a parameter, Derivatives of Implicit Functions , Derivatives of Trigonometric Functions, Derivative of the Sine Function, Derivative of the Cosine Function, The Derivatives of the other trigonometric functions, Derivative of the Tangent Function, Derivatives of Inverse Functions, Derivatives of Inverse Trigonometric Functions, Use of Transformations. |
| Unit VII | Successive Differentiation: Second and third order Derivatives, n^{th} Order Derivatives. Leibnitz's Theorem. Maclaurin's Series, Taylor's Series |
| Unit VIII | Mean value theorems: Rolle's theorem, Lagrange's Mean value Theorem and Cauchy Mean value Theorem. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. R.G. Bartle & D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 2020. 2. T.M. Apostol, Calculus Vol. I, John Wiley & Sons Inc, 1991. 3. S. Balachandra Rao & C. K. Shantha, Differential Calculus, New Age Publication, 2001. 4. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002. 5. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007. | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. https://archive.nptel.ac.in/courses/111/104/111104092 2. https://onlinecourses.nptel.ac.in/noc23_ma13/preview 3. https://archive.nptel.ac.in/courses/111/104/111104144 4. https://archive.nptel.ac.in/courses/111/105/111105122 | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

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| Course prerequisites: 10+2 with Mathematics | | |
| Programme: B.Sc. | Year: 2023-24 | Semester: I |
| Subject: MATHEMATICS | | |
| Course Code: UGMM-102(N) | Course Title: Analytical Geometry | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the basic concepts of conic section and curve tracing. ➤ To develop working skills with straight line, sphere and cylinder. ➤ To acquire basic knowledge about cones, reciprocal, enveloping and right circular cone. ➤ To learn the concepts and uses of central conicoids. | | |
| Course Outcomes: | | |
| CO1: The student will get to know about conic section and curve tracing, and its applications in finding the area, surface and volumes. | | |
| CO2: The student shall understand the concepts of straight line, plane, sphere, intersection of sphere and plane, cylinder and right circular cylinder, cones and right circular cone. | | |
| CO3: The subjects learn and visualize the fundamental ideas about coordinate geometry and learn to describe some of the surface by using analytical geometry. | | |
| CO4: The student will be able to understand the central conicoids with properties and their applications. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Conic Section | |
| Unit I | Conic Section: Homogeneous equation of second degree and conditions on it to represent different types of conics. Polar coordinates Polar equation of a line, parabola, ellipse and hyperbola when focus is taken as pole. Polar equations of the chord joining two points. | |
| Unit II | Curve Tracing: Tangent, normal, polar (chord of contact), pair of tangent lines, asymptotes, Tracing of a conic. | |
| Block 2 | Sphere and Cylinder | |
| Unit III | Geometry of 3-Dimension: Straight line and plane, direction cosines and direction numbers, distance of a point from a line, various form of the equation of a plane, plane passing through three given points, angle between two lines and two planes, distance of a point from a plane, equation of line of intersection of two planes, intersection of line and plane. Coplanar lines shortest distance between two skew lines. | |
| Unit IV | Sphere: Equation of a sphere, Intersection of sphere and planes, Intersection of two sphere. Sphere passing through a circle, Intersection of a straight line and a sphere. Tangent planes, Polar planes, Plane of contact. Power of a point. Radical planes, Radical lines, Co-axel system of a sphere. Orthogonal system of sphere. | |
| Unit V | Cylinder: Equation of a cylinder with given base, Cylinder with Axis parallel to co-ordinate axes. Enveloping cylinders, Right circular cylinders. Rules surfaces, generating lines of a hyperboloid of one sheet and their simple properties. | |
| Block 3 | Cones and Central Conicoids | |

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| Unit VI | Cones: Equation of a cone with a given base, Intersection of a cone and a plane passing through the vertex of cone, tangent plane, reciprocal cone, Enveloping cone, right circular cone. |
| Unit VII | Central Conicoids-I: Standard equation of a Central conicoid, ellipsoid, hyperboloid of one sheet and two sheets, tangent planes, tangent lines, polar planes and polar lines. |
| Unit VIII | Central Conicoids-II: Enveloping cones and cylinders section with a given centres. Diametric plane, conjugate diameters, normal, normal drawn from a given point. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Robert J.T Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Macmillan India Ltd. 1923. 2. P.R. Vittal, Analytical Geometry 2d & 3D, Pearson, 2017. 3. S.L. Loney, The Elements of Coordinate Geometry, McMillan & Company, London, 2016. 4. Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint, 2002. | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

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| Course prerequisites: 10+2 with Mathematics | | |
| Programme: B.Sc. | Year: 2023-24 | Semester: II |
| Subject: MATHEMATICS | | |
| Course Code: UGMM-103(N) | Course Title: Integral Calculus | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the basics concepts of integration and their methods. ➤ To develop working skills with integration and use of reduction formula in integration. ➤ To learn the integration of rational and irrational function and tangent normal to the curves. ➤ To discuss the applications of integration. | | |
| Course Outcomes: | | |
| CO 1: The student shall understand the Integration and their solvable techniques. | | |
| CO 2: The student will be able to understand the principles of integral and learns to solve a variety of practical problems in science and engineering. | | |
| CO3: The student will get to know about solutions of integration of rational and irrational function. | | |
| CO4: The student will get to know about integral calculus and its applications in finding areas, surface and volumes. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Integration | |
| Unit I | Method of Integration: Standard Integrals, Algebra of Integrals , Integration by Substitution, Integrals using Trigonometric formula, Trigonometric and Hyperbolic Substitution, Two properties of Definite integrals, Integration by Parts, Evaluation of $\int (a^2 - x^2) dx$, $\int (a^2 + x^2) dx$, $\int (x^2 - a^2) dx$, $\int e^{ax}$, $[f(x) + f'(x)] dx$. | |
| Unit II | Reduction Formula: Reduction formula, Integrals Involving trigonometric functions, Integrals involving products of trigonometric functions, Integrals Involving Hyperbolic Functions. | |
| Unit III | Integration of Rational and Irrational Function: Integration of Rational and Irrational Functions Integration of Rational Function, Some simple Rational Function, Partial Fraction Decomposition, Method of Substitution, Integration of Rational Trigonometric Functions, Integration of Irrational Functions. | |
| Unit IV | Tangent Normal of the Curves: Equations of tangents and normal, Angles of intersection of two curves, Tangents at the origin. | |
| Block 2 | Application of Integral Calculus | |
| Unit V | Tracing of curves: Classifying singular points, Asymptotes (Parallel to the axes and oblique asymptotes. Tracing of curves. | |
| Unit VI | Area Under a Curve: Area of the curve in Cartesian form, Polar form, Area Bounded by a closed curve, Length of a Plane Curve in Cartesian Form, Parametric Form, Polar form. | |

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| Unit VII | Volume of a solid of Revolution: Volume of a solid of Revolution in Parametric Form, Polar form, Area of Surface of Revolution in Cartesian Form, Parametric Form and Polar form. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. P. K. Mittal, Integral Calculus, S. Chand Limited, 2005. 2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007. 3. Piskunov, N., Differential and Integral Calculus, Vol 1 & 2, 2nd edition. Mir Publishers, 1974. 4. Kreyszig, E., Advanced Engineering Mathematics, 10th edition. John Wiley & Sons, 2010. 5. Malik, A.K., Mathur, P, Purohit, S.D., A text Book of Engineering Mathematics-I, Manakin Press, 2020. <p>Suggested online link:</p> <ol style="list-style-type: none"> 1. https://archive.nptel.ac.in/courses/111/105/111105122 | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

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| Course prerequisites: 10+2 with Mathematics | | |
| Programme: B.Sc. | Year: 2023-24 | Semester: II |
| Subject: MATHEMATICS | | |
| Course Code: UGMM-104(N) | Course Title: Differential Equation | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To learn the first order ordinary differential equations with first degree and not of first degree. ➤ To understand the applications of differential equations. ➤ To acquire basic application problems described by second order linear differential equations. ➤ To learn the solution of ordinary differential equations of higher orders. | | |
| Course Outcomes: | | |
| CO1: The student shall understand the importance and solution procedure of solving the first order ordinary differential equations with first degree and not of first degree. | | |
| CO2: After completing this course, a student will be able to solve differential equations and applications in science and engineering. | | |
| CO3: The student shall understand the second order linear differential equations with constant coefficient. Furthermore, the student will be able to develop understanding towards Euler-Cauchy linear equations and Simultaneous linear differential equations. | | |
| CO4: To understand and able to solve the various differential equation with variable coefficients used in engineering and science. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Differential Equations of First Order and First Degree | |
| Unit I | Differential equation: Differential equations, Types of differential equations, Order and degree of differential equations, Formation of differential equation, Solution of differential equation, Geometrical meaning of a differential equation, Initial value problems and statement of Existence and Uniqueness Theorems. | |
| Unit II | Methods of solution of a differential equation of first order and first degree: Methods of solution of a differential equation of first order and first degree, Method of separation of variables. Solution of homogeneous equations. Equation reducible to homogeneous form. | |
| Unit III | Linear differential equation: Linear differential equation and Bernoulli's linear differential equation. | |
| Unit IV | Exact differential equations: Exact differential equations. Integrating factors to solve non-exact differential equations in different cases. | |
| Unit V | Differential equation of the first order but not of the first degree: Differential equation of the first order but not of the first degree, Equation solvable for x, y and p. Clairaut's equation and singular solutions. | |
| Block-2 | Applications of differential equation | |
| Unit VI | Geometrical Applications of Differential Equations: Applications of differential equation, geometrical application and physical applications; Newton's law of cooling, | |

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| | Kirchoff's law of electric circuits, motion under Gravity, rectilinear motion, simple harmonic motion, rate of growth or decay, heat flow. |
| Unit VII | Physical applications of differential equations of first order and first degree-I: The n^{th} order linear differential equation with constant coefficients, general solution and particular integrals. Method of finding particular integrals Methods of undetermined coefficient, variation of parameters. |
| Unit VIII | Physical applications of differential equations of first order and first degree-II: Physical applications of differential equations of first order and first degree-II, Method of finding particular integrals by inverse operator methods. |
| Block-3 | The n^{th} order linear differential equation with constant coefficients |
| Unit IX | The n^{th} order linear differential equation with constant coefficients: Method of finding particular integrals by inverse operator methods. |
| Unit X | Methods of finding particular integrals by inverse operator method: Linear differential equations of second order. Transformation of the equation by changing the dependent variable, independent variables and Normal forms. |
| Unit XI | Linear Equations with constant coefficients: Equation reducible to Linear with constant coefficients, Euler-Cauchy linear equations. Simultaneous linear differential equation with constant coefficient. |
| Unit XII | Linear differential equations: Linear differential equations of second order. Transformation of the equation by changing the dependent variable, independent variables and Normal forms. |

Suggested Text Book Readings:

1. G.F. Simmons, Differential Equations with Application and Historical Notes, Tata –McGraw-Hill.
2. B. Rai, D.P. Choudhary & H. J. Freedman, A Course of Ordinary Differential Equations, Narosa Publication.
3. M., D. Rai Singhania, Ordinary Differential Equation, S. Chand, 2020.
4. L.E. Elsgolts, Differential Equation and Calculus of variations, University Press of the Pacific.
5. Malik, A.K., Mathur, P & Purohit, S.D., A text Book of Engineering Mathematics-II, Manakin Press, 2019.

Suggested online link:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=ZLCHeZEhCZ8yCri36nSF3A==>
2. <https://archive.nptel.ac.in/noc/courses/111>

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer:

Differential equations for engineers By Prof. Srinivas Rao Manam
https://onlinecourses.nptel.ac.in/noc22_ma72/preview

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| Course prerequisites: 10+2 with Mathematics | |
| Programme: B.Sc. | Year: 2023-24 |
| Semester: III | |
| Subject: MATHEMATICS | |
| Course Code: UGMM-105(N) | Course Title: Mechanics-I (Statics and Dynamics) |
| Course Objectives: | |
| <ul style="list-style-type: none"> ➤ To learn the stable and unstable equilibrium in statics. ➤ To develop competency in understanding of virtual work and common catenary. ➤ To understand the motion in a plane, tangential and normal directions, rectilinear motion. ➤ To understanding the constrained motion and motion under central forces. | |
| Course Outcomes: | |
| CO1: The student shall understand the basic concepts of Statics. | |
| CO2: The student will get to know about virtual work, displacement, tensions and string. | |
| CO3: The student shall understand the dynamics system and describe the theoretical workings of the rectilinear motion, simple harmonic motion and their utility in real life. | |
| CO4: The student shall understand the importance and solution procedure of constrained motion and motion under central forces. | |
| Credits: 2 | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 |
| Block 1 | Statics |
| Unit I | Stable and Unstable equilibrium: Stable and Unstable equilibrium definition and examples, Stability, Condition of Stability, Heavy body on a fixed body. |
| Unit II | Virtual work: Virtual works and displacement, Principal of Virtual work acting on a particle, Principal of Virtual work of rigid body, tensions, string. |
| Unit III | Common Catenary: Definition of Common Catenary, intrinsic equation, Cartesian equation, definitions to Catenary, Relation for Common Catenary, Stretched wires. |
| Block 2 | Dynamics |
| Unit IV | Motion in a Plane: Motion in a plane, Velocities and accelerations in Cartesian coordinates, along radial and transverse directions, and along tangential and normal directions. Determination of path under a given force. |
| Unit V | Rectilinear Motion: Rectilinear Motion, Simple harmonic motion. Elastic strings. Motion under inverse square law and other miscellaneous laws, Motion in resisting medium. Motion of particles of varying mass, Rocket motion. |
| Unit VI | Constrained Motion: Constrained motion (Vertical circle and vertical cycloid). |
| Unit VII | Motion under Central Forces: Motion under Central forces: Central orbit, Conservation of angular momentum, areal velocity, Kepler's laws of motion, and differential equations to the path of a particle. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. R.C. Hibbeler, Engineering Mechanics-Statics, Prentice Hall Publishers. 2. R.C. Hibbeler, Engineering Mechanics-Dynamics, Prentice Hall Publishers. 3. A. Nelson, Engineering Mechanics Statics and Dynamics, Tata McGraw Hill. 4. J.L. Synge & B.A. Griffith, Principles of Mechanics, Tata McGraw Hill. | |

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| Course prerequisites: 10+2 with Mathematics | | |
| Programme: B.Sc. | Year: 2023-24 | Semester: III |
| Subject: MATHEMATICS | | |
| Course Code: UGMM-106(N) | Course Title: Mechanics-II (Dynamics and Hydrodynamics) | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To learn about moment of inertia and D'Alembert's principle. ➤ To learn the motion about a fixed axis, equation of motion about axis of rotation. ➤ To understand the boundary surfaces, Euler's equation of motion and impulsive motion. ➤ To understanding the doublets, image system of a doublet with respect to a plane, a circle, a sphere. | | |
| Course Outcomes: | | |
| CO1: The student shall understand the basic concepts and application of moment of inertia and D'Alembert's principle. | | |
| CO2: The student will get to know about motion about a fixed axis, equation of motion about axis of rotation. | | |
| CO3: The student shall understand the hydrodynamics system and describe the boundary surfaces, Euler's equation of motion and impulsive motion, and their utility in real life. | | |
| CO4: The student shall understand the importance of doublets, image system of a doublet with respect to a plane, a circle, a sphere. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Dynamics | |
| Unit I | Moment of Inertia: Moment and product of inertia of some standard bodies, principle axis, Momental ellipsoid of a body. | |
| Unit II | D'Alembert Principle: The general equation of motion, motion of the centre of inertia and motion relative to the centre of inertia. | |
| Unit III | Motion about a fixed axis: Moment of the effective forces about the axis of rotation, moment of momentum about the axis of rotation, kinetic energy of the body rotating about a fixed axis, equation of motion about axis of rotation. | |
| Block 2 | Hydrodynamics | |
| Unit IV | Boundary surfaces: Equation of continuity in different coordinate system and boundary surfaces, velocity potential, stream-lines. | |
| Unit V | Euler's equation of motion: Euler's equation of motion, steady motion, Bernoulli's equation, Helmholtz equation, Impulsive motion. | |
| Unit VI | Motion: Motion in two dimensions, stream function, irrotational motion, complex potential, sources and sinks. | |
| Unit VII | Doublet: Doublets, image system of a simple source with respect a plane, a circle, a sphere. Image system of a doublet with respect to a plane, a circle and a sphere, circle theorem. | |
| Suggested Text Book Readings: | | |
| 1. Nag, P.K., Engineering Thermodynamics, 3rd ed., Tata McGraw-Hill, 2005. | | |

2. Robert Norton., “Kinematics and Dynamics of machinery” 1st Ed., McGraw Hill India., 2009.
3. R.C. Hibbeler, Engineering Mechanics-Dynamics, Prentice Hall Publishers.
4. A. Nelson, Engineering Mechanics Statics and Dynamics, Tata McGraw Hill.
5. J.L. Synge & B.A. Griffith, Principles of Mechanics, Tata McGraw Hill.

Suggested online link:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=ZLCHeZEhCZ8yCri36nSF3A==>

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

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| Course prerequisites: 10+2 with Mathematics | | |
| Programme: B.Sc. | Year: 2023-24 | Semester: IV |
| Subject: MATHEMATICS | | |
| Course Code: UGMM-107(N) | Course Title: Linear Algebra | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the vector space, field and their properties. ➤ To learn about the basis and dimension of a vector space and quotient spaces. ➤ To understand the matrices, linear system of equations, Eigen values and Eigen vectors. ➤ To find the characteristic polynomial, inner product space, bilinear and quadratic forms. | | |
| Course Outcomes: | | |
| CO1: The student will be able to understand the basic concepts and uses of vector space field and their properties. | | |
| CO2: The student will get to know about basis and dimension of a vector space and quotient spaces. | | |
| CO3: The student will be able to understand the basic concepts and uses of matrices for solving system the linear system of equations, eigen values and eigen vectors with its importance. | | |
| CO4: The student shall understand the characteristic polynomial, inner product space, bilinear and quadratic forms with their applications. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Vector Space | |
| Unit I | Introduction to Vector Spaces: Binary operations, Field, Examples $\mathbb{Q}, \mathbb{R}, \mathbb{C}, \mathbb{Z}_p$ (p, a prime) of fields. Definition of a vector space, Some basic properties of a vector space, Vector subspace, Subspace spanned by subsets with examples. Linearly dependence and independence of a subset. Finite dimensional vector spaces. | |
| Unit II | Basis, Dimension and Quotient Spaces: Basis of a vector space, Dimension of a vector space, finite dimensional vector space, linear sum and direct sum of subspaces, Quotient spaces. | |
| Unit III | Linear transformations: Definition examples and some properties, Linear transformations and Isomorphism of vector spaces, Null space and range space. Rank and Nullity of linear transformations, Fundamental theorem of vector space homomorphism, Rank-Nullity theorem, Non-singular, Invertible transformations. | |
| Unit IV | Dual Vector Space: $\text{Hom}(V, W)$ as a vector space, dual space V^* of a vector space V , Dual basis of a vector space with examples, Transpose of a linear transformations. Annihilator of a subset of a vector space, Rank of transpose of a linear transformation. | |
| Block 2 | Matrix | |
| Unit V | Matrices: Matrix representation of linear transformations, equality, Algebra of matrices, Multiplication of matrices. Vector space of all $m \times n$ matrices over a field. Ring of all n -square matrices. Invertible matrices (or Non-singular matrix), Transpose of matrix, Equivalent matrices, Similar Matrices, and Orthogonal matrices. | |
| Unit VI | Rank of a matrix: Rank of a matrix, Row rank and column rank of a matrix, Elementary matrices, elementary row and column operations of a matrix, elementary matrices, | |

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| | Normal form of a matrix, Echelon form of matrix, Inverse of a non-singular matrix. Determinant rank of a matrix. Non-homogeneous and homogeneous linear equations. |
| Unit VII | Determinants: Determinant of a square matrix, Cofactor of an element of a determinant, Properties of a determinant, minor of an element of a determinant, Evaluation of a determinant. Laplace expansion of a determinant. Product of two determinants (all statements without proof). |
| Unit VIII | Eigen Vector and Eigen Space: Adjoint of n- square matrix. Inverse of a matrix of a non-singular matrix by using adjoint of the matrix. Characteristic roots or Eigen values of a linear transformation and Eigen vector and Eigen space. |
| Block 3 | Characteristic polynomial inner product space bilinear quadratic forms |
| Unit IX | Characteristic polynomial of a matrix: Characteristic polynomial of a matrix, Diagonalization of a matrix, Caley - Hamilton theorem. Inverse of a matrix of a non-singular matrix by Caley – Hamilton theorem. Characteristic polynomial of a linear transformation, Minimal polynomial, Hermitian Matrix, characteristic roots of a complex Hermitian matrix. |
| Unit X | Inner product space: Definition and examples of inner product, length of a vector, Cauchy Schwarz inequality, distance between two vectors, angle between two vectors, Orthogonal and ortho normal sets. |
| Unit XI | Bilinear, quadratic and Hermitian forms: Bilinear, quadratic and Hermitian forms, bilinear form on a vector space V . Quadratic forms, matrix of quadratic form, normal form or canonical form. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007. 2. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999. 3. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971. 4. Malik, A.K., Mathur, P, Purohit, S.D., A text Book of Engineering Mathematics-II, Manakin Press, 2019. | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=ZLCHeZEhCZ8yCri36nSF3A== 2. https://archive.nptel.ac.in/courses/111/104/111104125 3. https://onlinecourses.nptel.ac.in/noc23_ma07/preview | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

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| Course prerequisites: 10+2 with Mathematics | | |
| Programme: B.Sc. | Year: 2023-24 | Semester: IV |
| Subject: MATHEMATICS | | |
| Course Code: UGMM-108(N) | Course Title: Calculus of Function of Several Variables and Vector Calculus | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To learn about the partial differentiation and jacobians with their applications. ➤ To understand the maxima and minima, and Lagrange's method of undetermined multipliers with their importance. ➤ To understand the basic concepts and uses of vector calculus. ➤ To know about applications of vector calculus. | | |
| Course Outcomes: | | |
| CO1: The student shall understand the partial differentiation, Euler's Theorem on Homogeneous functions. | | |
| CO2 The student will get to know about the maxima and minima of function s of two variables, Lagrange's method of undetermined multipliers. | | |
| CO3: The student will get to know about the basic concepts and uses of vector calculus. | | |
| CO4: The student shall understand the importance and applications of vector calculus like as curl, gradient and divergence. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Partial Differentiation | |
| Unit I | Partial Differentiation:- Partial Derivatives of first order, Partial Derivatives of Higher order, Total derivative, Homogeneous functions, Euler's Theorem on Homogeneous functions, Deductions from Euler's Theorem. | |
| Unit II | Composite Functions:- Differentiation of Composite Functions, Jacobians, Properties of Jacobians, Theorems on Jacobians, Jacobian of Implicit Functions, Functional Relationship, | |
| Unit III | Maxima and minima:- Maxima and minima of functions of Two variables, Conditions for maxima and minima, Necessary condition for existence of maxima and minima, Local and global maxima and minima of a function, Lagrange's method of undetermined multipliers. | |
| Block 2 | Vector Calculus | |
| Unit IV | Operations on Vectors:- Scalar triple product and its geometrical interpretation. Properties of scalar triple product. Reciprocal system of vectors. Properties of the reciprocal system of vectors. Scalar product of four vectors. Vector product of four vectors. | |
| Unit V | Differentiation of a Vector Functions and Gradient:- Scalar and vector point function. Differentiation of a vector functions with respect to scalar. Gradient of a scalar field, geometrical interpretation of gradient, directional derivative, properties of gradient, gradient in polar coordinates. | |

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| Unit VI | Divergence and Curl:- Divergence of a vector point function, Physical interpretation of divergence, Solenoidal vector. Curl of vector point function, Physical interpretation of curl, Irrotational vector, Vector identities, Velocity potential, Laplace operator. |
| Unit VII | Integration of a Vector Function:- Line Integral, Surface Integral, Volume Integral. |
| Unit VIII | Applications: Green's Theorem in a plane, Gauss Divergence Theorem and Stokes's Theorem (Without proof) and their applications. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Kreyszig, E., Advanced Engineering Mathematics, 10th edition. John Wiley & Sons, 2010. 2. Malik, A.K., Mathur, P, Purohit, S.D., A text Book of Engineering Mathematics-1, Manakin Press, 2020. 3. Mujumdar, N. S., Function of Several Variables and Vector Calculus, Nirali publication. | |
| Suggested online link: | |
| <ol style="list-style-type: none"> 1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=ZLCHeZEhCZ8yCri36nSF3A== 2. https://archive.nptel.ac.in/courses/111/105/111105122 3. https://archive.nptel.ac.in/courses/111/104/111104125 | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: | |
| https://onlinecourses.nptel.ac.in/noc23_ma27/preview Integral and Vector Calculus By Prof. Hari Shankar Mahato, IIT Kharagpur. | |

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| Course prerequisites: 10+2 with Mathematics | | |
| Programme: B.Sc. | Year: 2023-24 | Semester: V |
| Subject: MATHEMATICS | | |
| Course Code: DCEMM -109 (N) | Course Title: ABSTRACT ALGEBRA | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the concepts of group theory with their properties. ➤ To learn about the homomorphism, subgroups and cyclic group. ➤ To understand the normal subgroups and symmetric groups. ➤ To learn about the ring, field and ideal with their properties. | | |
| CO1: The student will be able to understand the basic concepts and uses of group with their properties. | | |
| CO2: The student shall understand the importance of homomorphism subgroups and uses of cyclic group. | | |
| CO3: The student will get to know about the normal subgroups and symmetric groups. | | |
| CO4: The student shall understand the applications of ring, field and ideals. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Groups and Subgroups | |
| Unit I | Elementary Group Theory: Definition of a group, abelian groups examples including Z_m , Z_p , U_m the group of n^{th} roots of unity, Hamiltonian group, Klein's four group, Permutation group, Integral power of an element of a group, order of an element of a group. | |
| Unit II | Homomorphism, Subgroups and Cyclic Groups: Subgroups of a group and examples. Homomorphism, isomorphism, Subgroup generated by a subset of a group. Cyclic groups. | |
| Unit III | Coset Decomposition of a Group: Coset decomposition, left coset and right coset of a subgroup of a group. Lagrange theorem. Index of a subgroup. Euler's theorem. Fermat's theorem. | |
| Block 2 | Normal Subgroups and Symmetric Groups | |
| Unit IV | Normal Subgroups and Homomorphisms: Normal subgroups, Centre of a group. Conjugate elements, Normaliser of an element of a group. Kernel of a homomorphism. Direct and inverse image of a subgroup and a normal subgroup under a homomorphism. Quotient groups. | |
| Unit V | Symmetric Groups and Automorphisms: Fundamental theorem of homomorphism of groups, Symmetric group S_n , Cayley's theorem, Cycle's transposition, Decomposition of a permutation, alternating groups A_n . Automorphisms of groups. Inner automorphisms. | |
| Block 3 | Rings and Fields: | |
| Unit VI | Rings and Fields: Ring Definition and examples, elementary property of a ring, zero divisor, Ring with or without zero divisor. Integral domain. Division ring. Field. Homomorphism and isomorphism of Rings, subrings, subfield with examples. Kernel | |

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| | of a homomorphism. |
| Unit VII | Homomorphisms and Embedding of rings: Direct image and inverse image of a subring and a subfield under a homomorphism. Characteristic of a non-zero integral domain. Imbedding of a ring into another ring the field of fractions of an integral domain. |
| Unit VIII | Ideals: Ideals, left ideal and right ideal, principal ideal with example. Prime ideal, maximal ideal, Quotient rings. Fundamental theorem of homomorphism, rings, and field. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. J.B. Fraleigh, Abstract Algebra by J.B. Fraleigh, Published by Narosa publishing House. 2. I.N. Herstein ,Topics in Algebra, Wiley, 2006. 3. Vijay K Khanna & S K Bhambri, Vijay K Khanna (Author), S K Bhambri, Vikash Publishing, 2017. 4. Frank Ayres & Lloyd R. Jaisingh, Schaum's Outline of Abstract Algebra, McGraw hill, 2020. | |
| Suggested online link: | |
| 1. https://archive.nptel.ac.in/courses/111106137 | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

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| Course prerequisites: 10+2 with Mathematics | |
| Programme: B.Sc. | Year: 2023-24 |
| Semester: V | |
| Subject: MATHEMATICS | |
| Course Code: DCEMM -110 (N) | Course Title: Number Theory |
| Course Objectives: | |
| <ul style="list-style-type: none"> ➤ To understand the basics concept of number theory. ➤ To learn about the Chinese Remainder Theorem and Euler's function. ➤ To understand the Gauss theorem, Gauss reciprocity theorem and Quadratic residues for prime-power moduli. ➤ To know about the arithmetic function with their applications in solving real life problem. | |
| Course Outcomes: | |
| CO1: The student will be able to understand about the basics concept of number theory. | |
| CO2: The student shall understand the importance and applications of the Chinese Remainder Theorem and Euler's function. | |
| CO3: The student will get to know about Gauss theorem, Gauss reciprocity theorem and Quadratic residues for prime-power moduli. | |
| CO4: The student shall understand the importance and applications of arithmetic function. | |
| Credits: 2 | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 |
| Block 1 | Basic Introduction of Number Theory |
| Unit I | Analytic Number Theory: Division algorithm, Euclid's algorithm for the greatest common divisor, Prime numbers, fundamental theorem of arithmetic. |
| Unit II | Congruence's: Linear congruences and algorithm to find the solution of Linear congruences, Chinese Remainder Theorem, An extension of Chinese Remainder Theorem (with non-coprime moduli). |
| Unit III | Euler's Function and application: Definition of Euler function, examples and properties, Multiplicative property of Euler's function. |
| Block 2 | Gauss theorem & Applications |
| Unit IV | Quadratic residues of Number Theory: The group of units modulo an integer, primitive roots, Existence of primitive roots, Quadratic congruences, Quadratic residues, Legendre symbol, Euler's criterion. |
| Unit V | Gauss theorem: Gauss lemma, Gauss reciprocity theorem, Quadratic residues for prime-power moduli and arbitrary moduli. |
| Unit VI | Arithmetic Functions and applications: Arithmetic Functions, multiplicative functions and their properties, Mobius function and its properties, Mobius inversion formula and its applications. |
| Suggested Text Book Readings: | |
| 1. Niven, I., Zuckerman, H. S. and Montgomery, H. L. (2003) An Int. to the Theory of Numbers (6th edition) John Wiley and sons, Inc., New York. | |
| 2. Burton, D. M. (2002) Elementary Number Theory (4 th edition) Universal Book Stall, New Delhi. | |
| 3. Balakrishnan, V. K. (1994) Schaum's Outline of Theory and Problems of Combinatorics Including | |

Concepts of Graph Theory, Schaum's Outline.

Suggested online link:

1. <https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=ZLCHeZEhCZ8yCri36nSF3A==>

This course can be opted as an elective by the students of following subjects: NA

Suggested equivalent online courses (MOOCs) for credit transfer: NA

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| Course prerequisites: 10+2 with Mathematics | |
| Programme: B.Sc. | Year: 2023-24 |
| Semester: V | |
| Subject: MATHEMATICS | |
| Course Code: SBSMM -03(N) | Course Title: Elementary Analysis |
| Course Objectives: | |
| <ul style="list-style-type: none"> ➤ To understand the logical connectives, tautology and quantifiers. ➤ To learn about relation, equivalence relation and mapping with their properties. ➤ To understand the real number system and division in Integers, sequences and infinite series. ➤ To know about the multiple integral and their applications in areas and volume. | |
| Course Outcomes: | |
| CO1: The student will get to know about the concepts of logical connectives, tautology and quantifiers. | |
| CO2: The student shall understand the relations and its types, equivalence relations and mapping. | |
| CO3: The student shall understand the real number system and division in Integers, sequences and infinite series. | |
| CO4: The student will get to know about multiple integral and its applications in finding areas, surface and volumes. | |
| Credits: 4 | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 |
| Block 1 | Language of Mathematics, Relation and Mapping |
| Unit I | Language of Mathematics: Language of Mathematics, Mathematical statements, logical connectives, Tautology, quantifiers. |
| Unit II | Relation: Relations (definition and examples), types of relation, composite of relations, equivalence relation, equivalence class, partition of a set and order relation. |
| Unit III | Mapping: Mapping (definition and examples), types of map, inverse map, composition of maps, direct and Inverse images of a set. |
| Block 2 | Real number system and Division in Integers |
| Unit IV | Real number system: Axiomatic definition of real number system as a complete ordered field. Archimedean principle, relational and irrational density theorem. |
| Unit V | Division in Integers: Division in \mathbb{Z} , Division algorithm, greatest common divisor, and least common multiple. Euclidean algorithm. Prime integers. Fundamental theorem of arithmetic's. |
| Block 3 | Sequence and Infinite Series |
| Unit VI | Sequence of Real Number: Sequences, bounded and unbounded sequences, Subsequence, convergent, divergent and oscillatory sequences. Limit of a sequence. Algebra of convergent sequences, Cauchy's sequences, and Cauchy's criterion for convergence of a sequence. |
| Unit VII | Infinite Series: Partial sums of a series. Convergence and divergence of series. Series of nonnegative terms. Necessary and sufficient condition for convergence. P-series theorem. Comparison tests. D'Alembert's ratio test, Raabe's ratio test, Logarithmic test, Cauchy's condenses test and Root test, Alternating series. |

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| | Leibnitz's theorem. Absolute convergence and conditional convergence of a series. |
| Block 4 | Multiple Integral and Its Applications |
| Unit VIII | Double and Triple integrals, Change of order of integration, surface and volume integration and their applications in areas and volume. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Elementary Analysis: The Theory of Calculus by Kenneth. A. Ross. 2. Sharma and Vashishtha, Real Analysis, Krishna Publication, 2014. 3. S C Malik, Mathematical Analysis, New Age International Publishers, 2017. | |
| Suggested online link: | |
| 1. https://archive.nptel.ac.in/courses/111/105/111105122 | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

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| Course prerequisites: 10+2 with Mathematics | | |
| Programme: B.Sc. | Year: 2023-24 | Semester: VI |
| Subject: MATHEMATICS | | |
| Course Code: DCEMM -112 (N) | Course Title: Advance Analysis | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> ➤ To understand the basics concept of metric space. ➤ To learn about the convergence of function of series and improper integral. ➤ To understand the convergence test, μ-test, Abel's test, Dirichlet's test. ➤ To know about step function, mean value theorem for integrals and Change of variables. | | |
| Course Outcomes: | | |
| CO1: The student will be able to understand the basic concepts and uses of metric spaces with their properties. | | |
| CO2: The student shall understand the importance of convergence of function of series and uses of improper integral. | | |
| CO3: The student will get to know about the convergence, μ , Abel's and Dirichlet's test. | | |
| CO4: The student shall understand the applications of step function, mean value theorem for integrals and Change of variables. | | |
| Credits: 2 | Type of Course: Core | |
| Category of Course | OER | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Metric space, Continuity, Compactness and completeness | |
| Unit I | Metric Space: Metric space (definitions and examples), open and closed balls, interior points, exterior point, and boundary points, limit points. open and closed sets, limit of a sequence in a metric space. Cauchy sequence. | |
| Unit II | Limit and Continuity of Functions: Limit and continuity of a function between metric spaces. Characterization of continuity in terms of open sets, Closed set and closer of a set. | |
| Unit III | Compactness: Compactness of metric space, Bolzano Weierstrass property, Total boundedness, sequentially compact metric spaces and countable compact metric space | |
| Block 2 | Convergence of function of series and Improper Integral | |
| Unit IV | Complete Metric Space: Uniform continuity, Lebesgue number, Complete metric space. | |
| Unit V | Convergence of sequence and series of functions: Point wise and uniform convergence of a sequence and series of a functions, necessary and sufficient condition for a uniform convergence, Weierstrass test, Abels test and Dirichlet's test for uniform convergence, Term by term integration and term by term differentiation. | |
| Unit VI | Improper Integrals: Convergence of improper integrals; Integral over infinite interval with bounded integrands and intervals over finite intervals with unbounded integrals. Necessary and sufficient conditions for such integrals. | |
| Block 3 | Convergence test, Riemann integral | |

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| Unit VII | Convergence Test: Comparison test, μ -test, absolute convergence, convergence of integrals of product of two functions, Abel's test, Dirichlet's test. |
| Unit VIII | Step Functions: Step function and their integrals, upper and lower integrals of a bounded function of one variable (through step functions). Integrable functions, Riemannian condition of integrability. Properties of Integrals of a step functions. |
| Unit IX | Mean Value Theorem: Mean value theorem for integrals, Fundamental theorem of integral calculus. Primitive of a function. Change of variables, second mean value theorem (statements only). |
| Suggested Text Book Readings: | |
| 1. S. Arumugam and A. Thangapandi Issac, Sequences and Series, Edition 2012, New Gamma Publishing House. | |
| 2. K. Chandra Sekhara Rao and K. S. Narayanan, Real Analysis Volume – I, Edition 2008, S. Viswanadhan Printers and Publishing Pvt. Ltd. | |
| 3. M. K. Venkatraman and Manorama Sridhar, Sequence and Series, Edition 2002, The National Publishing Company. | |
| 4. Singh, S. R. & Malik, A. K. Topology, I.K. International Publishing House Pvt. Limited, 2012. | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |

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| Course prerequisites: 10+2 with Mathematics | |
| Programme: B.Sc. | Year: 2023-24 |
| Semester: VI | |
| Subject: MATHEMATICS | |
| Course Code: DCEMM -113 (N) | Course Title: Function of Complex Variables |
| Course Objectives: | |
| <ul style="list-style-type: none"> ➤ To understand the basic concepts of analytic function and Cauchy Riemann equations. ➤ To develop working skills with complex integration, series and singularities. ➤ To acquire basic knowledge about calculus of residues and Evaluation of real definite integrals by contour integration. ➤ To learn the concepts and uses of conformal mapping and Mobius (bilinear) transformation. | |
| Course Outcomes: | |
| CO1: The student will get to know about analytic functions and Cauchy Riemann equations. | |
| CO2: The student shall understand the concept of complex integration, series and singularities. | |
| CO3: The student shall understand the importance and solution procedure of problems related to calculus of residues and Evaluation of real definite integrals by contour integration. | |
| CO4: The student will be able to understand the basic concepts and uses of conformal mapping and Mobius (bilinear) transformation with their applications. | |
| Credits: 2 | Type of Course: Core |
| Category of Course | OER |
| Max. Marks: 100 | Min. Passing Marks: 36 |
| Syllabi framed block wise/unit wise | |
| Block 1 | Complex variables and Power series |
| Unit I | Function of Complex Variable: The concept of a function of a complex variable, Continuous functions, uniform continuity, bounded functions, differentiable and analytic functions, differentiability, analytic or regular functions Cauchy Riemann equations, necessary and sufficient condition for a function to be analytic, construction of analytic function, Milne Thomson method. |
| Unit II | Power Series: The circle of convergence of a power series, power series and analytic functions, the exponential functions, the trigonometric functions, the logarithmic functions. |
| Block 2 | Complex Integration and Expansion of series |
| Unit III | Complex Integration: Jordan Arcs, Rectifiable arcs, contours, Complex integration, integration along a regular Arc, Cauchy theorem, the elementary form of Cauchy theorem, the general form of Cauchy theorem, extension of Cauchy's theorem on contours, defining multiply connected regions, Cauchy integral formula, derivative of an analytic function, Morera's Theorem. |
| Unit IV | Expansion in series and singularities: Taylor series, Cauchy's inequalities, Liouville's theorem, Laurent's series, isolated singularities of an analytic function, the zeros of analytic function, the behaviour of analytic function at isolated singularities, limiting point of zeros or poles, the behaviour of an analytic function near an isolated essential singularity. |

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| Block 3 | The Calculus of Residues (Integration) and Evaluation of real definite integrals by contour integration |
| Unit V | The calculus of Residues: The Residue at a singularity, Residue at infinity, calculation of reduced in some special cases, Cauchy's theorem of Residues, poles and zeros of a Meromorphic function. Rouché's theorem, applications of Rouché's theorem, |
| Unit VI | Evaluation of Definite Integrals by Contour Integration: Jensen's Theorem, Poisson's integral formula, The evaluation of integrals of the type $\int_0^{2\pi} f(\cos \theta, \sin \theta) d\theta$, The evaluation of integrals of the type $\int_{-\infty}^{\infty} f(x) dx$. |
| Block 4 | Conformal Representation |
| Unit VII | Conformal Representation: Mappings by analytic functions, Differentiable arc through a point, conformal mapping, existence of the inverse function, Conformal character and analyticity, mapping by simple functions, super facial magnification, The linear transformation, The Mobius (bilinear) transformation, The transformation $\omega = \frac{1}{z}$, Geometrical inversion, fixed points of a bilinear transformation. |
| Suggested Text Book Readings: | |
| <ol style="list-style-type: none"> 1. Ponnusamy, Foundations of Complex Analysis. 2nd Edition, Narosa Book Publication, 2008. 2. K.P. Gupta, Functions of complex variable, Sixteen Edition, Pragati Prakashan, 2002. 3. J. B. Conway, Functions of One Complex Variable, Narosa Publishing House, New Delhi, 2002. 4. Dennis G. Zill, Complex Analysis, Jones and Bartlett Publishers, 3ed 5. V. Ahlfors, Complex Analysis (Third Edition), McGraw-Hill, 1979. 6. M. Spiegel, J. Schiller, S. Lipschutz, Schaum's Outline of Complex Variables, 2ed (Schaum's Outlines) 7. James W. Brown & R. V. Churchill: Complex variables and applications, McGraw-Hill, 2006. | |
| Suggested online link: | |
| 1. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=ZLCHeZEhCZ8yCri36nSF3A== | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: | |
| https://archive.nptel.ac.in/courses/111/103/111103070/ by Prof. P. A. S. Sree Krishna IIT Guwahati | |

Year: 2023-24
Syllabus of B.Sc Programme: Subject: PHYSICS [UGPHS]

| Year | Sem. | Course Code | Paper Title | Theory/Practical | Credits | Max. Marks | |
|---------------------|------|---|--|------------------|-----------|-------------|--|
| 1 | I | UGPHS -101N | VECTOR, MECHANICS AND GENERAL PHYSICS | Theory | 2 | 100 | |
| | | UGPHS -101P(N) | PRACTICAL WORK | Practical | 2 | 100 | |
| | II | UGPHS -102N | OSCILLATION, WAVES AND ELECTRICAL CIRCUITS | Theory | 2 | 100 | |
| | | UGPHS -102P(N) | PRACTICAL WORK | Practical | 2 | 100 | |
| 2 | III | UGPHS-103N | ELECTROMAGNETISM | Theory | 2 | 100 | |
| | | UGPHS-103P(N) | PRACTICAL WORK | Practical | 2 | 100 | |
| | IV | UGPHS-104N | ANALOG AND DIGITAL ELECTRONICS | Theory | 2 | 100 | |
| | | UGPHS -104P(N) | PRACTICAL WORK | Practical | 2 | 100 | |
| | | SKILL ENHANCEMENT COURSE | | | | | |
| | | SBSPHS-02 | MODERN PHYSICS | Theory | 4 | 100 | |
| 3 | V | Discipline Centric Elective Course | | | | | |
| | | DCEPHS -105N | OPTICS | Theory | 2 | 100 | |
| | | DCEPHS-106N | THERMAL PHYSICS | Theory | 2 | 100 | |
| | | DCEPHS-107P(N) | PRACTICAL WORK | Practical | 2 | 100 | |
| | VI | Discipline Centric Elective Course | | | | | |
| | | DCEPHS -108N | QUANTUM MECHANICS AND SPECTROSCOPY | Theory | 2 | 100 | |
| | | DCEPHS -109N | SOLID STATE PHYSICS AND ADVANCED ELECTRONICS | Theory | 2 | 100 | |
| | | DCEPHS -110P(N) | PRACTICAL WORK | Practical | 2 | 100 | |
| Total Credit | | | | | 32 | 1500 | |

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| Programme: B.Sc. | Year: 1 | Semester: I |
| Subject: Physics | | |
| Course Code: UGPHS -101N | Course Title: Vector, Mechanics and General Physics | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • The course provides the students of core concepts of system of particles, motion, friction, work, energy, planetary and satellite motion. • Some fundamental concept of vector calculus. • The fundamental concepts make the students to find their interest so that they can explore in physics, and they can pursue their higher degree in physics. | | |
| Course Outcomes: | | |
| <p>CO-1 Understand and illustrate various vector calculus method.</p> <p>CO-2 Understand and define the laws involved in mechanics.</p> <p>CO-3 Gain deeper understanding of mechanics and its fundamental concepts.</p> <p>CO-4 Understand the fundamental ideas on conservation of laws.</p> <p>CO-5 Understand objects in space as they are introduced to planetary and Satellite motions</p> | | |
| Credits: 2 | | Type of Course: Core |
| Max. Marks: 100 | | Min. Passing Marks: 36 |
| Block 1 | Vector and mechanics | |
| Unit 1 | <p>Vector analysis</p> <ul style="list-style-type: none"> • Scalar and vector, polar and axial vectors, Concept of tensor. • Dot and cross product of two vectors, scalar and vector triple products • Gradient of scalar, divergence of vector, curl of vector, solenoidal and lamellar vector. • (Line, surface, volume) integral of vectors, Gauss, Stokes and Greens theorem (only statement). • Vector identities (only statement) | |
| Unit 2 | <p>. Dynamics of a particle</p> <ul style="list-style-type: none"> • Force, momentum, impulse. • Work, Power, energy. • Conservative and non-conservative forces. • Work-energy theorem, mechanical energy. • Conservation of momentum and conservation of mechanical energy. • Elastic and inelastic head on collision. | |
| Unit 3 | <p>Angular and rotational motion</p> <ul style="list-style-type: none"> • Equation of motion and fundamental definitions. • Angular momentum, torque, rotational K.E, angular impulse. • Conservation of angular momentum and its applications. • Moment of inertia, radius of gyration, theorem of parallel and perpendicular axes. • Expression for moment of inertia for ring and disc, hollow and solid spheres, hollow and solid cylinder, thin rod and plates (derivation is not required). • Rolling without sliding and sliding without rolling motion, total kinetic | |

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| | <p>energy.</p> <ul style="list-style-type: none"> • Motion of body along inclined plane in both cases. |
| Unit 4 | <p>Dynamics of many particles</p> <ul style="list-style-type: none"> • Centre of mass and centre of gravity of a system • Centre of mass and laboratory frame of reference. • Motion of centre of mass of a system. • Linear momentum, angular momentum, torque, kinetic energy, potential energy, mechanical energy for a system of particles. • Difference between conservation laws (linear momentum, angular momentum, mechanical energy) for a particle and system of particles |
| Unit 5 | <p>Dynamics of rigid body</p> <ul style="list-style-type: none"> • Concept of rigid body and its characteristics. • Equations of rotational motion when the directions of angular momentum coincide and do not coincide with axis of rotation. • Relation between angular momentum, moment of inertia and angular velocity in tensor form. • Moment and product of inertia, inertia tensor. • Precessional motion. |
| Block-II | General Physics |
| Unit 6 | Gravitation |
| | <ul style="list-style-type: none"> • Gravity and gravitation, inertial and gravitational mass. • Variation of gravity with shape and rotation of earth, height and depth from surface of earth. • Gravitational field and potential due to spherical shell and solid sphere. • Gravitational self-energy. • Orbital motion of satellite. • Escape velocity of body. • Communication satellite and weightlessness condition. |
| Unit 7 | <p>Motion under central force</p> <ul style="list-style-type: none"> • Central force and its characteristics. • Reduced mass. Reduction of two body central force problem to one body problem. • Expression for transverse and radial acceleration of a body moving under central force. • Acceleration of planet moving around sun. • Kepler's laws of planetary motion (statement, derivation and applications). • Expression for total energy of earth and condition to different paths. • Newton's law of gravitation from Kepler's law. |
| Unit 08 | <p>Elasticity</p> <ul style="list-style-type: none"> • Kinetic model for solids (F-r and U-r graphs). • Behavior of loaded wire (graphs and definitions). • Poisson ratio, elastic constants and inter-relationship among them. |

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| | <ul style="list-style-type: none"> • Angle of twist and shear. Torsion of cylinder. Torsional rigidity. • Bending of beam, bending moment, geometrical inertia and flexural rigidity. • Centiliver (negligible weight and finite weight), expression for depression. • Elastic potential energy of stressed and twisted wire |
| Unit 9 | <p>Fluid mechanics and viscosity</p> <ul style="list-style-type: none"> • Ideal fluid, critical velocity, stream line and turbulent motion. • Compressible and incompressible fluid, lamellar and nonlamellar motion, steady and variable motion. • Equation of continuity and its significance. • Euler's equation and its application to deduce Bernoulli's equation, Application of Bernoulli's theorem (velocity of efflux, spinning of ball). • Newton's formula for viscous force. Kinematical and dynamical viscosity (CGS, MKS and SI units). • Poiseuille's law (statement, derivation, limitations), Series and parallel combinations of capillaries. • Stokes's law for viscous force, terminal velocity. |
| Unit 10 | <p>Surface tension</p> <ul style="list-style-type: none"> • Adhesive and cohesive force. Shape of meniscus. Angle of contact. • Surface tension, surface energy, unison of small drops and bubbles. • Effect of temperature and impurity on surface tension and angle of contact. • Excess pressure inside air bubble and soap bubble. • Rise and fall of liquid inside capillary. • Importance and application of capillarity. |
| <p>Suggested Text Book Readings:</p> <ul style="list-style-type: none"> • An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill. • Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill. • Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley. • Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning. • Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education • Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons. • University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole. | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| Name of electronic media: e-SLM | Year of incorporation: 2020 |

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| Programme: B.Sc. | Year:1 | Semester:2 |
| Subject: Physics | | |
| Course Code: UGPHS-102N | Course Title: Oscillation, Waves and Electrical Circuits | |
| Course Objectives: <ul style="list-style-type: none"> The course provides the students of core concepts of oscillations, waves and electrical circuits. The concepts make the students to find their personal interest, so that they can explore their key personal area in physics and pursue their masters in future. | | |
| Course Outcomes: CO-1 Understand in detail the concepts of oscillations. CO-2 Understand in detail the concepts of waves. CO-3 Recognize basic terms in electrical circuits. CO-4 Apply theorems to construct and solve electrical circuits. CO-5 Ability to design and conduct experiments as well as to analyze and interpret data CO-6 Buildup strong problem-solving skills by effectively formulate a circuit problem into a mathematical problem using circuit laws and theorems. | | |
| Credits:2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Mechanical oscillations | |
| Unit I | Undamped oscillator <ul style="list-style-type: none"> Periodic motion and its classification. Electrical analogous of mechanical quantities. Undamped oscillations and its characteristics, kinematical and dynamical definition of SHM. Derivation of differential equation using energy consideration and its definition. Examples of SHM (mass-spring system, general pendulum compound pendulum, floating cylinder, liquid column in U-tube), effective mass of spring. | |
| Unit II | Damped oscillator <ul style="list-style-type: none"> Damped oscillation and its characteristics, comparison with undamped oscillation. Derivation of differential equation using energy consideration and its solution for heavy, critical and weak damping. Condition for oscillation, frequency of damped oscillation. Relaxation time, energy dissipation, logarithmic decrement, quality factor. | |
| Unit III | Forced oscillator <ul style="list-style-type: none"> Forced oscillations and its examples. Differential equation and steady state solution. Amplitude resonance and velocity resonance, mechanical impedance. Amplitude and velocity resonance frequency, phase difference among position velocity and force. Power absorption and power dissipation. Quality factor, band width, sharpness of resonance. | |

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| Unit IV | <p>Coupled oscillator</p> <ul style="list-style-type: none"> • Nature and condition of Lissajous figures (for 1:1 & 1:2 frequencies). • Normal co-ordinate, degree of freedom, normal modes of vibrations. • Oscillations of two coupled masses. • Oscillation of two coupled pendulums. • Energy of two coupled systems. |
| Block 2 | Waves |
| Unit V | <p>Wave motion</p> <ul style="list-style-type: none"> • Basic definitions, types of propagation, concept of phase. • Expression and properties of plane progressive wave. • Differential equation of wave motions, wave front. • Plane progressive wave in fluid and stretched string. Displacement wave and pressure wave. • Plane progressive wave in stretched string. • Intensity and energy transportation in wave. |
| Unit VI | <p>Waves at boundaries of two media</p> <ul style="list-style-type: none"> • Free and bounded medium. • Specific acoustic impedance, characteristic impedance. • Reflection and transmission coefficient of amplitude at joints of two media/strings. • Reflection and transmission coefficient of energy at joints of two media/strings. • Discussion of results for various conditions of impedance of both media |
| Unit VII | <p>Superposition of waves</p> <ul style="list-style-type: none"> • Principles of superposition (statement, limitations, phenomenon observed). • Reflection of sound waves at free surface and rigid surface. • Stationary waves (formation and characteristics), SWR. • Mode of natural oscillations of stretched string and air column. • Fundamental frequency, harmonics and overtones. • Difference between interference and beats in sound. |
| Block III | Electrical circuits |
| Unit VIII | <p>Transient phenomenon and galvanometer</p> <ul style="list-style-type: none"> • Transient state and steady state, Time constant. • Transient response LR, CR, LC and LCR circuits. • Theory of moving coil galvanometer (dead beat and ballistic), critical resistance and damping. • Sensitivity (current, charge and voltage) of moving coil galvanometer. • Applications to measurement of high resistance by leakage method. |
| Unit IX | <p>Alternating current</p> <ul style="list-style-type: none"> • J-Operator and phasor notations, reactance, impedance, susceptance, admittance. • Instantons, Peak, RMS and Average value of alternating voltage and current, Form factor. • Angle of lag and lead, wattful and wattless current, average power |

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| | <p>consumed (active, reactive and apparent), power factor.</p> <ul style="list-style-type: none"> • Phasor and vector diagram of CR, LR, LCR series, LCR parallel, LR in series with C in parallel circuits. • Parallel and series resonance, sharpness of resonance, Quality factor, Bandwidth Resonance frequency. |
| Unit X | <p>Network analysis (For both AC and DC)</p> <ul style="list-style-type: none"> • Circuit elements and various networks circuits. • T and π networks and their equivalence. • Kirchoff's current and voltage laws. Mesh and nodal analysis of electrical circuits. (Matrices and determinant methods). • Concept of constant current and constant voltage source. Thevenin and Norton's theorem. • Maximum power transfer theorem, superposition theorem, reciprocity theorem. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill. 2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill 3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press. 4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill 5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons. 6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill | |
| <p>This course can be opted as an elective by the students of following subjects: NA</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: NA</p> | |
| <p>Electronic media and other digital components in the curriculum:</p> | |
| <p>Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| Name of electronic media: e-SLM | Year of incorporation: 2020 |

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| Programme: B.Sc. | Year: 2 nd | Semester: 3 rd |
| Subject: Physics | | |
| Course Code: UGPHS-103N | Course Title: Electromagnetism | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To make students understand the electrostatic fields, potential, and capacitance, by applying Coulomb's law and Gauss's law. • To make students understand the magnetostatic fields and inductance by applying Biot Savart's law and Ampere's law to find. • To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications • To impart knowledge on the concepts of Faraday 's law, induced emf and Maxwell 's equation | | |
| Course Outcomes: | | |
| CO1- Understand the basic mathematical concepts related to electromagnetic vector fields. | | |
| CO2- Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density. | | |
| CO3- Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density. | | |
| CO4- Understand the concepts related to Faraday 's law, induced emf and Maxwell 's equations | | |
| CO5- Apply Maxwell 's equations to solutions of problems relating to transmission lines and uniform plane wave propagation. | | |
| Credits: 2 | | Type of Course: Core |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| Block 1 | Electrostatics | |
| | Electric charge, force and fields | |
| Unit I | <ul style="list-style-type: none"> • Concept of charge, Coulomb's law, electric field, electric flux. • Gauss law (statement and derivation, integral and differential form). • Application of Gauss law for charge distribution (linear, cylindrical, spherical). • Coulomb's law from Gauss law. • Electric field due to charged ring, charged infinite rod and charged disc from Coulomb's law. • Laws of electrostatics. | |
| Unit II | . Electric potential and dipole <ul style="list-style-type: none"> • Electric potential and electrostatic potential energy. • Electric fields, potential gradient and their relationship. • Electrostatic self-energy (conducting and dielectric sphere). • Electric potential due to spherical charge distribution (hollow and solid), graphical representation. • Electric dipole and its behavior in uniform and non-uniform electric field. • Electric field and potential due to electric dipole at a point in Cartesian and polar coordinates. • Force between two electric dipoles. | |

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| Unit III | <p>Dielectrics</p> <ul style="list-style-type: none"> • Capacitor and its capacity, principle of capacitor, energy stored in field of capacitor. • Capacity of partially filled parallel plate capacitor, expression for induced charge. • Effect of dielectrics slab introduced inside plates of charged capacitor when its remains connected with battery and when it is disconnected from battery. • Spherical plates capacitor and cylindrical plates capacitor. • Change in electrical properties when N small charged drops coalesce to form a large drop. • Three electric vectors (D, E, P), dielectric constant, dielectric strength, electrical susceptibility. • Polarization, surface and volume charge density, Gauss law in dielectrics. • Macroscopic and microscopic properties of dielectrics. Clausius – Mossotte formula. |
| Block 2 | Magnetostatics |
| Unit IV | <p>Electric current and magnetic fields</p> <ul style="list-style-type: none"> • Electric current and current density. Ohm's law and Joule's law, drift velocity. • Magnetic field around stationary charge, moving charge and current carrying conductor. • Biot-Savart law and its application to straight conductor, circular loop, solenoid and toriod carrying current. • Magnetic field due to moving charge, Lorentz force • Force between two current carrying conductor and two moving charges. • Cyclotron (principle, construction, working, limitations and modification), Betatron. |
| Unit V | <p>. Laws of magnetostatics</p> <ul style="list-style-type: none"> • Lines of forces, Gauss law in magnetostatics. • Ampere circuital law (statement and derivation), its applications to current carrying rod (hollow and solid). • Inconsistency of Ampere circuital law with equation of continuity. • Modification of Ampere circuital law by Maxwell with introducing concepts of displacement currents and its importance. Comparison of displacement current and conduction current. • Vector potential and its expression due to straight conductor and circular loop. • Derivation of magnetic flux density using vector potential for circular loop. |
| Unit VI | <p>Magnetic materials</p> <ul style="list-style-type: none"> • Magnetic properties (magnetic flux density B, magnetizing field H, intensity of magnetization I_m, susceptibility, relative and absolute permeability). • Magnetization, cycle of magnetization, hysteresis loop, retentivity, residual magnetism. • Three magnetic vectors (B, H, I_m), three magnetic currents (free, bound and |

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| | <p>total).</p> <ul style="list-style-type: none"> • Curl of intensity of magnetization. |
| Block III | Electromagnetic Phenomenon |
| Unit VII | <p>Electromagnetic induction</p> <ul style="list-style-type: none"> • Faraday's law of electromagnetic induction (statement, integral form, differential form) and analogy with Newton's laws of motion in mechanics. • Condition for existence and depending factors of induced charge, induced voltage, induced current and induced power. • Dynamic induced EMF and derivation of its expression, • Self and mutual induction and inductance, static induced EMF (self and mutual). • Reciprocity theorem and Neuman's relation. • Relation between self and mutual inductance of two coupled coils, energy of coupled circuits. • Transformer and its equivalent circuit, condition for ideal transformer (expression for efficiency and voltage gain), transformer losses. |
| BLOCK IV | Electromagnetic Theory |
| Unit VIII | <p>Fundamental equations</p> <ul style="list-style-type: none"> • Four Maxwell's equations (statement and physical significance). • Maxwell's equations and features of their general plane wave solution in source free space. • Maxwell's equations and features of their general plane wave solution in simple dielectrics. • Differential equation and velocity for electromagnetic waves in source free space and dielectric medium. • Characteristics of electromagnetic waves, impedance, refractive index. • Skin depth and its importance. |
| Unit IX | <p>Energy and momentum of an electromagnetic wave</p> <ul style="list-style-type: none"> • Differential equation of plane electromagnetic waves in conducting media and its solution. • Behavior and property of electromagnetic waves for good dielectric and good conductors. • Poynting theorem (statement and derivation). • Expression for electromagnetic energy density. • Momentum density vector and its importance • Maxwell's stress tensor (statement and derivation). |
| Unit X | <p>Fresnel's equation</p> <ul style="list-style-type: none"> • Boundary conditions at discontinuity for D, E, B and H. • Reflection and refraction at normal and oblique incidence of electric vectors perpendicular to boundary. • Reflection and refraction at normal and oblique incidence of electric |

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| | vectors parallel to boundary. <ul style="list-style-type: none"> • Total internal reflection, Brewster's law, degree of polarization. • Plane wave propagation in plasma and its properties (qualitative), metallic reflection. • Elementary theory of dispersion. |
| Suggested Text Book Readings: <ol style="list-style-type: none"> 1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education 2. Electricity & Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press 3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House. 4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole. 5. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings. | |
| This course can be opted as an elective by the students of following subjects: NA | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents | |
| Name of electronic media: e-SLM | Year of incorporation: 2021 |

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| Programme: B.Sc. | Year: 2 nd | Semester: 4 th |
| Subject: PHYSICS | | |
| Course Code: UGPHS -104N | Course Title: Analog and Digital Electronics | |
| Course Objectives: <ul style="list-style-type: none"> • This course helps the students to gain basic ideas of the construction and working of electronic devices and circuits. • The aim of this course is to make students acquire knowledge about Boolean algebra, logic Circuits. | | |
| Course Outcomes: CO-1- Be familiar with the basic concepts of construction and working of electronic devices and Bipolar junction transistor. CO-2- Apply the knowledge to understand the working of amplifiers and oscillators CO-3- Apply the knowledge to understand the working of special types of Diodes CO-4- Apply the principles of feedback in amplifiers and oscillators CO-5- Understand the concepts and techniques in digital electronics. CO-6- Understand various number systems and their importance in digital designing. CO-7- Analyze and construct various digital circuits. CO-8- Design combination and sequential circuits. | | |
| Credits: 2 | Type of Course: Core | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi framed block wise/unit wise) | | |

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| Block 1 | Electron devices |
| Unit I | <p>Semi-conductor physics</p> <ul style="list-style-type: none"> • Band theory of solids and classification of solids on its basis. Intrinsic and extrinsic (n-type,p-type) semiconductors. • Conductivity, mobility, drifts motion and diffusion motion of free electron and holes. • p-n junction (formation of depletion region and potential barrier). • Forward and reverse biasing of p-n junction, forward and reverse current. • Diode equation and characteristics, static and dynamics resistance, knee voltage. • Breakdown mechanism (Zener and Avalanche), transition and storage capacitance. • Zener diode (statement, characteristics and comparison with p-n junction). • Zener diode as voltage regulation (circuit and analysis). |
| Unit II | <p>Power supply</p> <ul style="list-style-type: none"> • Non regulated and regulated power supply. • Circuit and mathematical analysis of rectifier (HWR, FWR and BR). • Ripple factor, rectification constant, voltage regulation and efficiency of rectifier. • Filtering by RL, RC and LC circuit (only qualitative). • Photonics device LED (principles and applications). • Photodiode and photo transistor, photoconductivity. • Solar cell (principle, construction, working and characteristics). |
| Unit III | <p>Bipolar junction transistor</p> <ul style="list-style-type: none"> • NPN and PNP transistor and their action. • Types of configurations, region of operation, thermal runaway. • Characteristics and parameters of CE, CB and CC configuration of transistor. • Emitter efficiency, base transport ratio and current gain in CB configuration. • Leakage current, hybrid parameters. • Transistor biasing and their merits & demerits, thermal stability. • DC and AC current gains in all three configurations of transistors and their inter-relationship of transistors. |
| Unit IV | <p>Unipolar transistors</p> <ul style="list-style-type: none"> • FET (construction, classification, symbol, principle of operation). • Internal and external biasing of FET. Fundamental definition related with FET. • Characteristics and parameter of FET. • Comparison of FET with BJT. • MOSFET (enhancement and depletion mode), construction, symbol and working. • NMOS and PMOS, CMOS as switch, BJT as switch. • Storage and transition time (definition and importance). • Schottky diode and Schottky transistors (statement, symbol and importance). |
| Block 2 | Electronic circuits |
| Unit V | <p>Amplification</p> <ul style="list-style-type: none"> • Introduction to different gains (impedance, current, voltage and power). • Small signal hybrid equivalent circuits of transistor in three configurations. • Inter-relationship among hybrid parameters in CE, CB, and CC configuration of transistors. |

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| | <ul style="list-style-type: none"> • Importance of voltage divider biasing of transistor, operating points. • DC and AC load lines (statement and analysis). • Classification of amplifiers on the basis of coupling, range of operations, uses and frequency. |
| Unit VI | <p>Voltage and power amplifier</p> <ul style="list-style-type: none"> • RC coupled amplifier (single and multistage), components and their functions. • Analysis of frequency (low, medium and high) response curve with the help of equivalent circuits. • Push-pull amplifier (characteristics, advantages and disadvantages). • Single and double tuned amplifier (characteristics and importance). • Audio and radio frequency amplifier (characteristics and importance) |
| Unit VII | <p>Oscillator</p> <ul style="list-style-type: none"> • Feedback amplifier (positive and negative), open and closed loop gains. • Merits and demerits of negative feedback amplifier over positive amplifier. • Barkhausen criterion for sustained oscillation (statement and proof). • Component of oscillator and their functions • Tuned collector, Hartely and Colpit oscillator (circuit and working). • RC oscillator, phase shift oscillator and Wiens bridge oscillator. • Crystal oscillator. |
| Block III | Digital Electronics |
| Unit VIII | <p>Number system and codes</p> <ul style="list-style-type: none"> • Number system (decimal, binary octal and hexa-decimal), radix. • Rules for interconversion of one number system into other number systems. • 1s and 2s compliments of binary numbers. Binary arithmetic's. • Different types of codes (BCD code, Excess 3 codes, Grey code, ASCII code, EBICDIC code and error code). |
| Unit IX | <p>Boolean algebra and logic gates</p> <ul style="list-style-type: none"> • Boolean algebra and its features • Logic gates (Switching circuit, Truth table, Venn diagram, Boolean function). • Primary gates (AND, OR, NOT) and their representation using p-n diodes & transistors. • Universal gates (NAND, NOR) and realization of other gates using these. • Exclusive gates (XOR, XNOR), equivalent and non-equivalent gates, characteristics and XOR-laws, XNOR-laws. • AND-OR, OR-AND, NAND-NAND, NOR-NOR realization of Boolean expression. |
| Unit X | <p>Boolean Theorems and combinational logics</p> <ul style="list-style-type: none"> • De-Morgan's laws, commutative laws, associative laws, distributive laws, absorptive laws of Boolean algebra. • Dual and compliment of Boolean function. • Minterms, maxterms, SOP form, POS form of Boolean functions. • Minterms and maxterms are conjugate to each other. • Karnaugh's mapping and its representation (for 2, 3 and 4 variables) in terms of |

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| | minterms and maxterms. <ul style="list-style-type: none"> • Simplification and Boolean expression by Boolean laws and K-mapping. • Half and full adder, half and full subtractor. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. 2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall. 3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning 4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill 5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall 6. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer 7. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India 8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India | |
| <p>This course can be opted as an elective by the students of following subjects:NA</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: NA</p> | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation: 2021</p> |

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| Programme: B.Sc. | Year:2 nd | Semester:4 th |
| Subject: PHYSICS | | |
| Course Code: SBSPHS-02 | Course Title: MODERN PHYSICS | |
| Course Objectives: The aim of this course is to make the students learn and discuss about the Modern Physics. | | |
| Course Outcomes: CO-1 Understand the concept of Reference point. CO-2 Understands the concept of Special and General theories of relativity. CO-3 To establish a relationship between mass and energy. CO-4 Describe the series of spectra and know Frank-Hertz experiment | | |
| Credits: 4 | Type of Course: Skill Enhancement Course | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi framed block wise/unit wise) | | |
| Block I | Special Theory of Relativity | |
| Unit I | Emergence of special relativity: <ul style="list-style-type: none"> • Frame of reference (inertial and non-inertial), Events (simultaneous, colocal and coincidence) • Centripetal force, centrifugal force, and Coriolis force. • Classical relativity, Galilean variant and Galilean in-variant. • Compatibility of electromagnetism with principle of relativity and mechanics. • Michel Jon-Morley experiment-significance of negative result. • Postulates of special theory of relativity. | |
| Unit II | Relativistic kinematics: <ul style="list-style-type: none"> • Lorentz transformations (statements and derivation). • Relativity of simultaneity and length contraction. • Relativity of co locality and time dilation. • Experimental verification of length contraction and time dilation. • Relativistic transformation of velocity, resultant of two successive Lorentz transformations. • Relativistic velocity addition theorem (statement, derivations and applications). • Aberration of stars (statement, derivation and comparison with classical result). • Relativistic Doppler effect (statement, derivation and discussion of result). | |
| Unit III | Relativistic dynamics: <ul style="list-style-type: none"> • Non-relativistic and relativistic particles. • Einstein's mass and energy equivalence relation, relativistic kinetics energy. • Variation of mass with velocity (only qualitative) and its importance. • Fundamental equations of relativistic motion, longitudinal and transverse mass. • Momentum and energy transformation equations. • Minkowski time space diagram and its applications. | |

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| Block II | Atomic Physics |
| Unit IV | <p>Atomic models:</p> <ul style="list-style-type: none"> Bohr's theory of hydrogen like atoms, Bohr radius, Sommerfeld fine structure constant, Rydberg & Rydberg Constant, Binding energy. Spectral series of hydrogen atom, H_{α}, H_{β}, H_{γ}, H Balmer lines Reduced mass, effect of nuclear motion, isotopic shift, Ground, Excited and ionized state, emission and absorption spectra Excitation, resonance and ionization potential, ionization energy of atom Bohr's correspondence principle (statement, proof and importance) Qualitative discussion of sommerfeld atom model. |
| Unit V | <p>X-Ray spectra</p> <ul style="list-style-type: none"> Production of X-rays (qualitative discussion of Roentgen tube and Coolidge tube) Properties and application of X-rays Continuous and characteristic X-rays, Bremsstrahlung radiation Continuous and line X-ray spectra (K-series, L-series, M-series) Duane-Hunt's law, cutoff frequency and cutoff wavelength, Moseley's law (statement, derivation and applications), absorption edge Comparison of optical and X-rays spectra |
| Unit VI | <p>Atomic structure:</p> <ul style="list-style-type: none"> Vector atom model (need, statement and importance) Space quantization, concept of electron spin and quantum numbers Stern-Gerlach experiment (principal theory and importance of results) Magnetic moment of atom, Bohr magneton, Gyro magnetic ratio, Larmor precession and frequency Intensity rules, selection rules, spectral terms, sodium D_1 and D_2 lines, Fine structure of Halines, Coupling scheme (L-S and j-j), spectra of alkali and alkaline earth elements. |
| Unit VII | <p>Dualism nature:</p> <ul style="list-style-type: none"> Planck's quantum theory and Einstein modifications, Photon and its characteristics Photoelectric effect (statements laws and mathematical explanation), quantum efficiency Compton effect (statement and explanation, expression for Compton shift and recoil energy), Dualism in nature, de-Broglie hypothesis, matter waves and its importance. Comparison of matter waves with electromagnetic waves and mechanical waves Davisson-Germen experiment (principle, working and importance of result) Wave packet, phase velocity and group velocity, wave and particle velocity, relation among them Uncertainty principle (statement, significance and application) |
| Block III | Nuclear physics |
| Unit VIII | <p>Radioactivity:</p> <ul style="list-style-type: none"> Natural and artificial radioactivity, emission of alpha particle, electron, positron and gamma particles |

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| | <ul style="list-style-type: none"> • Size of nucleus, classification of nuclei (isotopes, isobars, isotones, isomers and isodiapheres). • Radioactive series, successive radioactive decay, radioactive equilibrium • Earth dating and carbon dating, artificial nuclear transmutation • Discovery of neutrons and radioisotope in everyday life • Nuclear force and its Yukawa (Meson) theory. |
| Unit IX | <p>Nuclear energy:</p> <ul style="list-style-type: none"> • Mass defect, packing fraction, binding energy, specific binding energy, • Binding energy curve, explanation of nuclear fission, nuclear fusion and release of nuclear energy, • Kinematics of nuclear reaction, Q-value of reactions • Bohr's-Wheeler model, activation and excitation energy, normal and enriched Uranium, • Liquid drop model, semi-empirical mass formula, • Shell model, magic number, collective model |
| Unit X | <p>Elementary particles</p> <ul style="list-style-type: none"> • Classification of elementary particles on the basis of mass, spin and interaction, • Particles and anti-particles. • Process of annihilation and process of production of matters, • Quantum number (Lepton number, Baryon number, iso-spin number, hyper charge number, strange number) • Conservation laws and concept of Quarks. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008). 2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998). 3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004). 4. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press 5. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons 6. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi 7. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004). 8. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000). | |
| <p>This course can be opted as an elective by the students of following subjects: NA</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: NA</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation: 2021</p> |

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| Programme: B.Sc. | Year:3 rd | Semester:5 th |
| Subject: PHYSICS | | |
| Course Code: DCEPHS-105N | Course Title: OPTICS | |
| Course Objectives: <ul style="list-style-type: none"> The aim of this course is to make the students learn and discuss about the Optics and their related experiments. Students also correlate them with the corresponding theory, through the standard set of experiments . | | |
| Course Outcomes: CO-1 Student will learn basics of Optics. CO-2. To impart basics knowledge of laser and holography CO-3. Student will familiar with nature of light. | | |
| Credits:2 | Type of Course: ELECTIVE | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi should be framed block wise/unit wise; No of blocks and units may change) | | |
| Block 1 | Geometrical and Quantum optics | |
| Unit I | Co-axial system of lenses <ul style="list-style-type: none"> Cardinal points (focal points, principal points and nodal points). Analytical methods for analysis of cardinal points. Matrix methods for analysis of cardinal points. Equivalent lens, problems on combination of thin lenses. Eye pieces (Ramsdon and Huygens), Ray diagram and characteristics, merits and demerits. Aplanatic points and its importance | |
| Unit II | Laser and holography: <ul style="list-style-type: none"> Coherence (Temporal and Spatial) Stimulated and spontaneous emission, Einstein co-efficient and their inter-relationship Basic idea about laser and its components, pumping and population inversion Comparison of laser light and ordinary light Ruby laser, Helium-Neon laser, semiconductor laser and their applications Holography and hologram, comparison of hologram with photography. Recording and reconstruction of hologram and its applications | |
| Unit III | . Fiber optics <ul style="list-style-type: none"> Constructions and materials used in optical fibers, Principle of fiber optics and propagation of light in optical fiber, Advantages and disadvantages of optical fiber communication Numerical aperture, acceptance angle, V-parameters, meridional and skew rays' analysis Types of fibers (SIF, GIF, Single mode and multimode), fiber profile. Phase index and group index in optical fiber, slowest and fastest mode of propagation inoptical fibers, Attenuation and dispersion in optical fibers parameter (attenuation loss, | |

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| | <p>dispersion)</p> <ul style="list-style-type: none"> • Qualitative discussion of coupler, splices and connector. |
| Block 2 | CONCEPT OF LIGHT |
| Unit IV | <p>Nature of light:</p> <ul style="list-style-type: none"> • Statement, merits and demerits of Newton's corpuscular theory, Huygens longitudinal wave's theory and Fresnel transverse wave theory. • Huygens principle and its explanation, laws of reflection and refraction. • Electromagnetic wave theory (statement, consequences and limitations) • Fermat's principles (statement and applications). • Perception of light (human vision, color vision and color receptor) • Scattering of light and its importance |
| Unit V | <p>Concept of polarization:</p> <ul style="list-style-type: none"> • Cause and concept of polarization, plane of vibration and plane of polarization • Un-polarized light and types of polarized light (linear, circular and elliptical). • Plane polarized light by reflection and refraction, Brewster's law, piles of plates • Plane polarized light by selective absorption (dichroism) and double reflection (E & Orays), birefringence. • Polarizer and analyzer, Nicol prism, law of Malus • Huygens theory of double reflection by uniaxial crystal, negative and positive crystal, optic axis • Superposition of two plane polarized lights along mutually perpendicular directions. |
| Unit VI | <p>Detection of polarized light:</p> <ul style="list-style-type: none"> • Retardation plates (quarter and half wave plates), features and applications. • Production and detection of elliptically and circularly polarized light • Analysis of different polarized light. • Babinet compensator (principle, theory, application). • Optical rotation and specific rotation, optical activity • Fresnel theory of optical rotation. • Polarimeters (Half Shade and Biquartz), their merits and demerits. |
| Block III | Interference and diffraction |
| Unit VII | <p>Concept of interference</p> <ul style="list-style-type: none"> • Statement and essential conditions for observation of interference • Constructive and destructive interference, shape of fringes, visibility of fringes • Young's double slit experiment, shift in fringes pattern due to thin sheet of transparent material. • Fresnel biprism, Fresnel bimirror, non-localized fringes. • Lloyds single mirrors, achromatic fringes. • Formation of coherent sources due to division of wave front in above devices and comparison of their fringe pattern. • Fringes pattern with white light. |

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| Unit VIII | <p>Interference by division of amplitudes</p> <ul style="list-style-type: none"> • Stokes analysis of phase change on reflection • Color in thin films (parallel and Wedge shaped) due to white light. • Newton's rings (principle, theory and applications) • Haidenger fringes, localized fringes. • Michelson interferometer (principle and working), conditions for different shape of fringes, comparison with Newton's ring fringes • Febry-Perot interferometer, intensity distribution, coefficient of finesse, visibility of fringes, sharpness of fringes, superiority over Michelson interferometer fringes, • L-G plates |
| Unit IX | <p>Fresnel diffraction</p> <ul style="list-style-type: none"> • Difference between interference and diffraction. • Classification of diffraction and their conditions. • Fresnel construction of half period's zones, rectilinear propagation of light. • Diffraction at straight edge and circular aperture. • Zone plate and its comparison with convex lens • Cornu's spiral (theory, applications and merit) |
| Unit X | <p>Fraunhoffer diffraction:</p> <ul style="list-style-type: none"> • Single slit fraunhoffer diffraction (theory and graph for maxima and minima) • Double slit fraunhoffer diffraction (theory and importance), missing spectra. • Plane diffraction grating (principle and analysis), condition for absent spectra • Grating spectra and prism spectra. • Concave diffraction grating (theory and types), superiority over plane grating. • Rayleigh criterion of resolution, limits of resolution of eye. • Resolving power of Grating, Prism, Telescope, and Microscope. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill.71 2. LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill 3. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books 4. Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier. 5. Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer. 6. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd. 7. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd. 8. Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: Optics nptel course - https://youtu.be/U2Qhpa2Zmm4</p> | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| Name of electronic media: e-SLM | Year of incorporation: 2022 |

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| Programme: B.Sc. | Year: 3 rd | Semester: 5 th |
| Subject: PHYSICS | | |
| Course Code: DCEPHS-106N | Course Title: THERMAL PHYSICS | |
| Course Objectives: The aim of this course is to make the students learn and discuss about the Thermodynamics. | | |
| Course Outcomes: CO-1 Student will learn basics of Thermodynamics. CO-2. To impart basics knowledge of laws of Thermodynamics. CO-3. Student will be familiar with term Entropy. CO-4 Students will understand Thermodynamic relations. | | |
| Credits: 2 | Type of Course: ELECTIVE | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi should be framed block wise/unit wise; No of blocks and units may change) | | |
| Block 1 | Thermodynamics | |
| | Fundamental of thermodynamics | |
| Unit I | <ul style="list-style-type: none"> • Thermodynamic systems, thermodynamic variables. • Thermodynamic equilibrium (thermal, mechanical and chemical). • Equation of state, equation of constraints. • Zeroth law of thermodynamics, concept of temperature. • Macroscopic and microscopic variables, extensive and intensive variables. • Quasi-static and non-quasi-static processes. reversible and irreversible processes. • Conditions for reversibility. | |
| Unit II | First law of thermodynamics <ul style="list-style-type: none"> • Expression for thermal work done. Types of work done. • Point function and path function. • Internal energy and enthalpy both as point function. • First law of thermodynamics (statement, derivation, limitations and applications). • Degrees of freedom, atomic heat ratio, Mayer's relation. • Processes (cyclic, isobaric, isochoric, isothermal and adiabatic). • P-V indicator diagram and its importance. | |
| Unit III | Second law of thermodynamics <ul style="list-style-type: none"> • Need of second law. • Carnot cycle (P-V and T-S diagram). • Carnot heat engine and Refrigerator. • Thermal efficiency and coefficient of performance. • Carnot theorems (statement, proof and significance). • Clausius & Kelvin statement of Second law and their equivalence. • Absolute scale of temperature and its comparison with perfect gas scale of temperature. | |
| Unit IV | Entropy <ul style="list-style-type: none"> • Entropy (need, statement and characteristics). • Clausius theorem and Clausius inequality of entropy. | |

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| | <ul style="list-style-type: none"> • Change of entropy (in mixing, for change of state and for perfect gas). • Available and non-available energy, ordered and disordered state. • The principle of increase of entropy and degradation of energy. • Consistency of Clausius & Kelvin statement with definition of second law in terms of entropy. |
| Block 2 | Thermodynamic relations |
| Unit V | Maxwell's relations <ul style="list-style-type: none"> • Reciprocal theorem and reciprocity theorem in thermodynamics • Maxwell's relations (statement, significance and derivation from laws of thermodynamics). • Thermodynamic potentials (statement, significance and applications). • TdS equations (statement, proof and applications). • Heat capacity equations in different forms. • Atomic heat ratio. |
| Unit VI | Phase Transition <ul style="list-style-type: none"> • First order phase transitions and its characteristics. Clausius Clapeyron equations. • Second order phase transition and its characteristics. Ehrenfest equations. • First and second latent heat equations from Maxwell's relation, effect of pressure on meltingpoint of solids and boiling point of liquids. • Joule's expansion, Joule's coefficient, Energy equation. • Free expansion and conservation of internal energy in it. • Change of entropy in isothermal irreversible process. |
| Unit VII | Third law of thermodynamics <ul style="list-style-type: none"> • Joule's Thomson expansion, conservation of enthalpy. • Enthalpy equation, Joule-Kelvin coefficient, inversion curve. • Different methods of coolings, liquefaction of gas, adiabatic demagnetization. • Comparison of Joule-Thomson expansion with Joule expansion and adiabatic expansion. • Throttling process, change of entropy in an irreversible adiabatic process. • Third law of thermodynamics and its consequences. • Statistical Mechanics: Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Phase space - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics. |
| Block III | Heat |
| Unit VIII | Kinetic Theory of Gases <ul style="list-style-type: none"> • Perfect gas equation and conditions for its validity to real gas. • Comparison of ideal gas and real gas. Vander Waal equation of state, Vander Waal constants. • Andrews experiment on CO₂, critical state, gas and vapors. • Critical constants (statement and inter-relationship). • Mean free path (qualitative) and its applications. • Transport phenomenon in gases (viscosity, thermal conductivity and self |

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| | <p>diffusion, derivation of expressions for each and their inter-relationship).</p> <ul style="list-style-type: none"> • Brownian's motions and its features. |
| Unit IX | <p>Conduction and convection</p> <ul style="list-style-type: none"> • Modes of transfer of heat. • Steady and variable states. Thermal conductivity, Thermal diffusivity. • Temperature gradient, heat flow through combination of slabs, thermal resistance. • Formation of ice layer and its consequences. • Fourier equation of heat. Discussion of results for exposed and covered rods, Ingen-Hause experiment. • Periodic flow of heat (qualitative) and its applications. • Natural and forced convection (qualitative). |
| Unit X | <p>Radiation</p> <ul style="list-style-type: none"> • Radiant energy, black body radiation, white radiation. Reflectivity, absorptivity and transmittivity. • Kirchoff's law for radiation, (statement, derivation, significance and applications). • Stefan-Boltzman law (statement and derivation), Stefan's constant, Newton's law of cooling. • Average energy of quantum oscillator and classical oscillator. Number of modes per unit volume in frequency range. • Planck's law for radiations (need, statement and derivation), ultraviolet catastrophe. • Derivation of classical laws (Stefan's, Wien's displacement, Wien's fifth power, Rayleigh-Jean) from Planck's law. • Spectrum of black body radiations at different temperatures. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill. 2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1958, Indian Press 3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill 4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer. 5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa. 6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press | |
| <p>This course can be opted as an elective by the students of following subjects: NA</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: Thermal Physics: Nptel https://youtu.be/iSjKPeyoXYU</p> | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/Other electronic and digital contents</p> | |
| Name of electronic media: e-SLM | Year of incorporation: 2022 |

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| Programme: B.Sc. | Year:3 rd | Semester:6 th |
| Subject: PHYSICS | | |
| Course Code: DCEPHS-108N | Course Title: QUANTUM MECHANICS AND SPECTROSCOPY | |
| Course Objectives: | | |
| <ul style="list-style-type: none"> • To provide basics knowledge of Quantum mechanics. • To make the students familiar with the Schrodinger's equation. | | |
| Course Outcomes: | | |
| CO-1 Student will learn basics concepts of quantum mechanics. | | |
| CO-2 students will be able to understand the various operators used to represents dynamic variables | | |
| CO-3 The eigen values and eigen functions of linear harmonic oscillator | | |
| CO-4 Hydrogen atom will help students to understand the behaviors of microscopic systems. | | |
| Credits: 2 | Type of Course: Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi should be framed block wise/unit wise; No of blocks and units may change) | | |
| Block 1 | Wave mechanics | |
| Unit I | Basic concept: | |
| | <ul style="list-style-type: none"> • Need of quantum theory and quantum mechanics • Fundamental equation of wave mechanics and its representation in various forms • Wave function and its interpretation by Max-Born and Schrodinger • Separation of variables, stationary states • Probability density and probability current density • Equation of continuity | |
| Unit II | Condition of wave function: | |
| | <ul style="list-style-type: none"> • Normalizable and unnormalizable wave function • Condition for normalized, orthogonal, ortho normal and complete wave function • Expectation values of thermo dynamical variables • Dirac-Delta function and Kronecker delta function • Non-degenerate states and degenerate state • Ehenfest theorem (statement, derivation and significance). | |
| Unit III | Operator algebra | |
| | <ul style="list-style-type: none"> • Concept of operator, null operator, inverse operator, operator algebra • Operator in quantum mechanics (position, momentum, energy velocity, kinetic energy and angular momentum) • Physical operators (Linear, Hermitian, parity and their properties) • Commutator and non-commutator operators, simultaneous wave function and uncertainty relation • Eigen function, Eigen values and Eigen values equations • Commutator rules among components of orbital angular momentum, momentum, position, L^2. • Ladder operates (L_+ and L_-), commutator rules amongst L_+, L_-, L_z and L^2. | |

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| Block 2 | Applications of Schrodinger's equation |
| Unit IV | <p>One- and three-dimensional problems</p> <ul style="list-style-type: none"> • Free particles, particle in box. • Potential steps, potential barrier(tunneling), • Potential well of infinite depth and finite depth. • Harmonic oscillator (classical and quantum), series solution. • Eigen values and Eigen function of harmonic oscillator, Hermite polynomial • Zero-point energy and parity of oscillator. |
| Unit V | <p>Spherically symmetric systems:</p> <ul style="list-style-type: none"> • Spherically symmetric potential, components of angular momentum in polar coordinate • Spherical harmonics and their orthogonality Legendre Polynomial, • Schrödinger equations for rotator with free axis and its series solutions • Schrödinger quatim for hydrogen atom, solution of r-equation, θ-equation, ϕ equation, Eigenfunction and Eigen values of hydrogen atom, Bhoris radius • Degeneracy and quantum number of hydrogen atoms • Comparison of Schrödinger atomic model with Bohr's atomic models. |
| Block III | Identical particles and perturbation |
| Unit VI | <p>Identical particles</p> <ul style="list-style-type: none"> • Distinguishable and indistinguishable particles. • Symmetric and anti-symmetric wave functions • Concept of spin and spin angular momentum • Pauli spin matrices (definition, commutation, anti-commutation), spin wave function • Exchange operator, exchange degeneracy • Equation of motion, condition for constant motion. • Pauli exclusion principle (statement and importance) |
| Unit VII | <p>Approximation methods:</p> <ul style="list-style-type: none"> • Born-approximation (statement and application) • Variation methods (statement and application) • Perturbation method (time independent and time dependent) • Time independent perturbation (non-degenerate and degenerate, first order and second order correction) • Application of perturbation theory to helium atom, ortho and para helium. • Application of perturbation theory to anharmonic oscillator, comparison of harmonic and anharmonic oscillator |
| Unit VIII | <p>Atomic spectra:</p> <ul style="list-style-type: none"> • Lande-g factor (statement and derivation) • Shift in energy of atom when placed in magnetic field • Zeeman effect (statement and classification) • Classical and quantum theory of normal and anomalous Zeeman effect, Paschen Back effect |

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| | <ul style="list-style-type: none"> • Zeeman pattern for sodium lines and other various transitions Stark effect and its characteristics |
| Block IV | Molecular spectroscopy Unit |
| Unit IX | Types of spectroscopies: <ul style="list-style-type: none"> • Electronic, Rotational, Vibrational and Rotational-vibrational spectroscopy • Selection rules, energy and frequency of vibrational spectra • Selection rules, energy and frequency of Rotational spectra • Raman effect, stokes and anti-stokes lines (quantum and classical explanation) • Infrared spectroscopy • Fluorescence and phosphorescence spectroscopy |
| Unit X | Techniques of spectroscopy: <ul style="list-style-type: none"> • Electronic spectra, • Electronic transitions • Frank-Condon principle • Singlet and triplet states • Fine structure and hyper fine structure • NMR (principle and importance) • ESR (principle and importance) |
| Suggested Text Book Readings: <ol style="list-style-type: none"> 1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill 2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley. 3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill. 4. Quantum Mechanics, G. Aruldas, 2nd Edn. 2002, PHI Learning of India. 5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning. 6. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer 7. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press | |
| Suggested equivalent online courses (MOOCs) for credit transfer: NA | |
| Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/Other electronic and digital contents | |
| Name of electronic media: e-SLM | Year of incorporation: 2022 |

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| Programme: B.Sc. | Year:3 rd | Semester:6 th |
| Subject: PHYSICS | | |
| Course Code: DCEPHS-109N | Course Title: SOLID STATE PHYSICS AND ADVANCED ELECTRONICS | |
| Course Objectives: The aim of this course is to make the students learn and discuss about the basic's concepts of solids and Advanced electronics. | | |
| Course Outcomes: CO-1: Understand the knowledge of Crystal and its structure. CO-2: Students will be able to understand Advanced analog electronics. CO-3: Students will be able to understand Advance digital electronics. | | |
| Credits: 2 | Type of Course: Elective | |
| Max. Marks: 100 | Min. Passing Marks: 36 | |
| (Syllabi should be framed block wise/unit wise; No of blocks and units may change) | | |
| Block 1 | Basic concepts of solids | |
| Unit I | Crystal and its structure <ul style="list-style-type: none"> • Crystalline and amorphous state of solids, liquid crystal and its characteristics (qualitative). • Simple crystal structure (SC, FCC, BCC). • Unit cell and Bravais lattice. • Classification of lattices and types of crystals on the basis of Bravais lattice. • Direct and reciprocal lattice, Miller indices and planes. • X-ray diffraction, Bragg's law. • Generalized Hooke's law for Anisotropic body, elastic constants of cubic crystals | |
| Unit II | Band theory of solids <ul style="list-style-type: none"> • Need of free electron quantum theory • Sommerfeld Fermi model band theory. • One dimensional motion of electron in periodic potential (Bloch theorem).\ • Kronning-Penny model (features and its importance). • Fermi surface, effective mass of charge carriers (electron and holes). • Concentration in semiconductors. • Hall effect (qualitative). | |
| Unit III | Lattice vibrations <ul style="list-style-type: none"> • Interatomic force and classification of solids. • Lattice energy of ionic crystals. • Vibration of monoatomic and diatomic linear chain, acoustic and optical modes, phonon. • Thermal capacity of solids, classical theory of specific heats (Dulong and Petit's law). • Experimental results and need of quantum theory of specific heat of solids. • Einstein's theory of specific heats (need, statement, assumptions, derivations and limitations). • Debye theory of specific heats (need, statement, assumptions, derivations and limitations). | |

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| | <ul style="list-style-type: none"> • Concept of Einstein's temperature and Debye temperature. |
| Unit IV | <p>Magnetism and superconductivity</p> <ul style="list-style-type: none"> • Comparison of features of diamagnetic and paramagnetic materials with examples. Curie law and Curie Weiss law. • Classical and quantum theory of diamagnetism and paramagnetism. • Qualitative discussion of ferromagnetism, anti-ferromagnetism and ferrimagnetism. • Superconductivity and its characteristics, magnetic behavior of superconductor. • Meisner's effect, BCS theory (qualitative). • Types of superconductors (examples, properties and applications). • Josephson effect, quantum Hall effect. |
| Block 2 | Advanced analog electronics |
| Unit V | <p>Different modes of operations.</p> <ul style="list-style-type: none"> • Eber's moll model for PNP and NPN transistors. • Expressions for various currents and voltage. • Saturation parameters and its importance. • Conditions for cut off mode, saturation mode, inverse mode and active mode. • Comparison among all modes of operations. |
| Unit VI | <p>Transmission and reception</p> <ul style="list-style-type: none"> • Basic elements of radio communication systems. • Requirements of transmitter, medium and receiver. • Modulation (need, types and statements). • Analysis of AM, FM and PM, modulation index. • Frequency spectrum and power in modulations. • Circuit of modulator. • Demodulation (need and statements). • Circuit for demodulator. |
| Unit VII | <p>Operational amplifier</p> <ul style="list-style-type: none"> • OP-amplifier (symbol, number code, power supply and characteristics). • Input-output relationship, input-offset and output offset voltage. • Differential input and output resistance. • Common mode rejection ratio, output current, power consumption, slew rate gain-bandwidth product. • Characteristics of OP- amplifier, comparators and detector. • Inverting and non-inverting amplifier. • Differentiator and basic integrator. |
| Block III | Advance digital electronics |
| Unit VIII | <p>Logic families</p> <ul style="list-style-type: none"> • Introduction and classification of logic families. • Input and output characteristics. • Fan-in and fan-out. • Noise margin and noise immunity. • Rise and fall time. |

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| | <ul style="list-style-type: none"> • RTL (circuit, analysis and applications). • DTL (circuit, analysis and applications). • TTL (circuit, analysis and applications), totem-pol. • Comparison of RTL, DTL and TTL. |
| Unit IX | Sequential circuits <ul style="list-style-type: none"> • Difference from combinational circuit. • Flip-flops (RS, D, JK) master slave. • Register (function and types). • Counter (function and types). • Memory (function and types). • Convertors (A/D and D/A). |
| Unit X | Integrated circuits and devices <ul style="list-style-type: none"> • Introduction of integrated circuit and its comparison with discrete circuits. • Classification of IC on the basis of construction and operation. • Monolithic IC (basics structure and fabrication). • Cathode ray oscilloscope (principle, construction, block diagram, working and application). • Multimeter (principle, types, construction and function). • Ultrasonics (production, detection, velocity measurements and applications), Hypersonic and ultrasonics. |
| <p>Suggested Text Book Readings:</p> <ol style="list-style-type: none"> 1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd. 2. Elements of Solid-State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India 3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill 4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning 5. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer 6. Elementary Solid-State Physics, 1/e M. Ali Omar, 1999, Pearson India 7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications 8. Digital Principles and Applications, A.P. Malvino, D.P. Leach and Saha, 7th Ed., 2011, Tata McGraw Hill 9. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd. 10. OP-AMP & Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd. | |
| <p>This course can be opted as an elective by the students of following subjects:NA</p> | |
| <p>Suggested equivalent online courses (MOOCs) for credit transfer: NA</p> | |
| <p>Electronic media and other digital components in the curriculum: Choose any one or more than: e-SLM/ Other electronic and digital contents</p> | |
| <p>Name of electronic media: e-SLM</p> | <p>Year of incorporation: 2022</p> |