



# હૈમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી

NAAC B (2.21) State University

પો.બો.નં.-૨૧, યુનિવર્સિટી રોડ, પાટણ (ઉ.ગુ.) ૩૮૪૨૬૫

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પરિપત્ર નં.-૧૪૫/૨૦૨૫

રાષ્ટ્રીય શિક્ષણ નીતિ-૨૦૨૦

વિષય: વિજ્ઞાન વિદ્યાશાખા હેઠળના સ્નાતક કક્ષાના સેમેસ્ટર-૫ અને ૬ના શૈ.વર્ષ: ૨૦૨૫-૨૬થી ક્રમશઃ અમલમાં આવતા અભ્યાસક્રમ/પરીક્ષા સ્કીમ અંગે.

આ યુનિવર્સિટી સંલગ્ન વિજ્ઞાન વિદ્યાશાખા હેઠળની તમામ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, વિજ્ઞાન વિદ્યાશાખાની તારીખ: ૨૮/૦૪/૨૦૨૫ના રોજ મળેલ સભાના નિર્દિષ્ટ ઠરાવોથી રાષ્ટ્રીય શિક્ષણ નીતિ-૨૦૨૦ અંતર્ગત UGCની Guideline મુજબ વિજ્ઞાન વિદ્યાશાખા હેઠળના નીચેના વિષયોના સ્નાતક કક્ષાના સામેલ પરિશિષ્ટ પ્રમાણેના નવા અભ્યાસક્રમોની અભ્યાસ સમિતિએ કરેલ ભલામણો તથા ડીનશ્રી અને સંબંધિત અભ્યાસ સમિતિના ચેરમેનશ્રી દ્વારા અભ્યાસ સમિતિવતી કરેલ ભલામણો માન.કુલપતિશ્રીએ એકેડેમિક કાઉન્સિલવતી સ્વીકારી શૈક્ષણિક વર્ષ: ૨૦૨૫-૨૬ થી ક્રમશઃ અમલમાં આવે તે રીતે મંજૂર કરેલ છે, જેનો અમલ કરવા સારૂ સંબંધિતોને આ સાથે સામેલ રાખી મોકલવામાં આવે છે.

ક્રમ નં	અભ્યાસક્રમ	ઠરાવ ક્રમાંક	સેમેસ્ટર
૧	બી.એસસી. ભૌતિકશાસ્ત્ર	૦૩	સેમેસ્ટર ૫ અને ૬
૨	બી.એસસી. રસાયણશાસ્ત્ર	૦૪	સેમેસ્ટર ૫ અને ૬
૩	બી.એસસી. વનસ્પતિશાસ્ત્ર	૦૫	સેમેસ્ટર ૫ અને ૬
૪	બી.એસસી. પ્રાણીશાસ્ત્ર	૦૬	સેમેસ્ટર ૫ અને ૬
૫	બી.એસસી. માઈક્રોબાયોલોજી	૦૭	સેમેસ્ટર ૫ અને ૬
૬	બી.એસસી. બાયોટેકનોલોજી	૦૮	સેમેસ્ટર ૫ અને ૬
૭	બી.એસસી. ગણિતશાસ્ત્ર	૦૯	સેમેસ્ટર ૫ અને ૬
૮	બી.એસસી. કોમ્પ્યુટર સાયન્સ	૧૦	સેમેસ્ટર ૫ અને ૬

સદર બાબતની જાણ આપના સ્તરેથી અધ્યાપકશ્રીઓ તથા વિદ્યાર્થીઓને કરવા વિનંતી છે.

નોંધ: (૧) વિદ્યાર્થીઓની જરૂરીયાત માટે પરિપત્રની એક નકલ કોલેજના / ડિપાર્ટમેન્ટના ગ્રંથાલયમાં મૂકવાની રહેશે.

(૨) આ પરિપત્ર યુનિવર્સિટીની વેબસાઇટ [www.ngu.ac.in](http://www.ngu.ac.in) પર પણ ઉપલબ્ધ કરવામાં આવેલ છે. આથી સંબંધિત કોલેજોને ડાઉનલોડ કરી ઉપયોગ કરવા સારૂ જણાવવામાં આવે છે.

બિડાણ: ઉપર મુજબ

નં-એકે/સ.મં.-૨/અક્સ/૨૫૧૧/૨૦૨૫

તારીખ: ૦૮/૦૭/૨૦૨૫

  
કુલસચિવ વતી

નકલ રવાના : જાણ તથા ઘટતી કાર્યવાહી સારૂ.

૧. ડીનશ્રી, વિજ્ઞાન વિદ્યાશાખા તરફ.
૨. વિજ્ઞાન વિદ્યાશાખા હેઠળની કોલેજોના આચાર્યશ્રીઓ તરફ
૩. પરીક્ષા નિયામકશ્રી, હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી પાટણ.
૪. કો-ઓર્ડિનેટરશ્રી- રાષ્ટ્રીય શિક્ષણ નીતિ-૨૦૨૦, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ.
૫. ડાયરેક્ટરશ્રી - IQAC, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ.
૬. ગ્રંથપાલશ્રી, હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી પાટણ.
૭. માન.કુલપતિશ્રી/કુલસચિવશ્રીનું કાર્યાલય હેમચંદ્રાચાર્ય ઉત્તર ગુજરાત યુનિવર્સિટી પાટણ.
૮. સિસ્ટમ એનાલીસ્ટશ્રી, કોમ્પ્યુટર (રીઝલ્ટ સેન્ટર) હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ.
૯. પ્રવેશ પ્ર-શાખા, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ
૧૦. મહેકમ શાખા, હેમ.ઉ.ગુ.યુનિવર્સિટી, પાટણ. (૨ નકલ)

**Hemchandracharya North Gujarat University**

**PATAN-384 265**

**Faculty of Science**

**U.G.(B.Sc.Honours) PHYSICS Programme**

**(with Research/without Research)**

**CBCS :: Semester :: Grading Pattern**



**Curriculum and Credit Framework For SEM V and VI**

**As per UGC Guide line**

**(According to NATIONAL EDUCATION POLICY (NEP)-2020)**

**New Syllabus PHYSICS**

**With effect from June 2025**

**B.Sc. Semesters V & VI Exit Option**

**Submitted on 9<sup>th</sup> APRIL 2025**

## **Introduction:**

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measure staken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching – learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students.

*The National Education Policy (NEP)2020* (here after eferred to as NEP or Policy) recognizes that higher education plays an extremely important role in promoting human as well as societal well-being and in developing India a senvisioned in its Constitution-ademocratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, andjust ice for all. It notes that “given the 21st-century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals”. In accordance with the NEP-2020, the UGC has formulated a new student-centric “Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)” incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options. This will facilitate students to pursue their career path by choosing the subject / field of the irinterest. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

## **NEP–2020:**

NEP, 2020 aim sat a new and forward-looking Vision for India’s Higher Education System. This curriculum framework for the bachelor-level program in PHYSICS is developed keeping in view of the student centric learning pedagogy, which is entirely multidisciplinary outcome-oriented and curiosity-driven.To avoid rote-learning approach and fosterimagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on pragmatist approach where by practical application of theoretical concepts is taught with substantial coverage of practical and field works.

The platform aim sat equipping the graduates with necessary skills for PHYSICS-related careers, careers with general graduate –level aptitude and for higher education in PHYSICS. Augmented in this framework are graduate attributes including critical thinking, basic psychology, scientific reasoning, moral ethical reasoning and soon.

Learning outcomes for the two programmes these frameworks have been developed, learning outcomes for individual courses, pedagogical methods and assessment methods. Looking at all these new concepts and progress, the detailed syllabus of B.Sc. (Honours) – PHYSICS has been designed and decided to be implemented from the academic session from June 2023-24.

## **PROGRAMME SPECIFIC OUTCOMES TO BE ATTAINED AT THE END OF THE PROGRAMME**

According to Guideline of NEP 2020, the Board of Studies in Physics recognizes that curriculum, course content and assessment of scholastic achievements play important roles in shaping education. The committee is

of the view that assessment should support and encourage the broad instructional goals such as basic knowledge of the discipline of Physics including phenomenology, theories and techniques, concepts and general principles. This should also support the ability to ask subjective questions and to obtain its solutions by use of qualitative and quantitative reasoning and by experimental investigation. With this in mind, we aim to provide a firm foundation in every aspect of Physics ranging from a broad spectrum of modern trends in Physics to experimental, computational and mathematical skills of students. Hence, the UG (B.Sc.) syllabi has been framed in such a way that it bridges the gap between the plus two and PG (M.Sc.) levels of Physics by providing a more comprehensive and logical framework in almost all areas of basic Physics.

### **Aims of the the Programme:**

- To make students eligible for Higher Studies and professional courses.
- To develop the skills required together in formation from resources and use them.
- To develop the abilities to read, understand and interpret physical in formation–verbal, mathematical and graphical.
- To provide an intellectually stimulating environment to develop skills and enthusiasms of students to the best of their potential.
- To give needbased education in physics of the highest quality at the undergraduate level.
- To offer courses to the choice of the students.
- To enable students to perform experiments and interpret the results of observation, including an assessment of experimental uncertainties.
- To make students eligible for government job.

### **Objectives of Programme:**

By the end of the Third year (6<sup>th</sup> semester), the students should have attained a common level in basic of physics to complement the core for their future courses and developed their experimental and data analysis skills through experiments at laboratories.

### **OUTLINE OF CHOICE BASED CREDIT SYSTEM**

1. **Major Course (MJDSC):** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a *Major Discipline specific course*.
2. **Minor discipline (MIDSC)** helps a student to gain a broader understanding beyond them as or discipline.
3. **Multidisciplinary Course (MDC):** 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.
4. **Inter disciplinary Course (IDC) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University / Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline /subject of study).
5. **Ability Enhancement Courses (AEC):** Environmental Science, English Communication/MIL Communication are mandatory for all disciplines.
6. **Skill Enhancement Courses (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and /or skill-based instruction.
7. **Value Added Courses (VAC):** These courses may be chosen from a pool of courses designed to provide value –based education course instruction.
8. **Indian knowledge System (IKS):**

The Proposed new courses in chemistry or undergraduate classes are re assigned in accordance to semester / CBCS /Grading system with new education policy. The new course is based on model curriculum of the university grants commission.

### **COURSES/ACTIVITIES UNDER THE PROGRAM:**

1. **Lecture courses:** Courses involving lectures relating to a field or discipline by an expert or qualified personnel in a field of learning, work/ vocation, or professional practice.
2. **Tutorial courses:** Courses involving problem-solving and discussions relating to a field or discipline under the guidance of qualified personnel in a field of learning, work / vocational or professional practice.
3. **Practicum or Laboratory work:** A course requiring students to participate in a project or practical or lab activity that applies previously learned/studied principles/theory related to the chosen field of learning, work/vocation, or professional practice under the supervision of an expert or qualified individual in the field of learning, work/vocation or professional practice
4. **Seminar:** A course requiring students to participate in structured discussion/conversation or debate focused on assigned tasks/readings, current or historical events, or shared experiences guided or led by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.
5. **Internship:** A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.
6. **Studio activities:** Studio activities involve the engagement of students in creative or artistic activities. Every student is engaged in performing a creative activity to obtain a specific outcome. Studio-based activities involve visual- or aesthetic focused experiential work.
7. **Field practice/projects:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity.
8. **Community engagement and service:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity. The curricular component of 'community engagement and service' will involve activities that would expose students to the socio-economic issues in society so that the theoretical learning can be supplemented by actual life experiences to generate solutions to real-life problems.

### **SILENT FEATURES:**

- B.Sc. (Honours) Physics in UG Programme - Semester V and VI shall be offered from the Academic year, June 2025.
- Physics subject like Major, Minor, Skill enhancement (In Sem 5) and Major, Minor and Internship (In Sem 6) in the Universities / Affiliated Colleges shall offer undergraduate programme in Faculty of Science from the Academic year 2025-26.
- A student will have to get enrolled a Discipline Specific Core Course (DSC) depending upon his/her requirement of a degree in the said discipline of study. A student will have a choice of selecting an Ability Enhancement Course (AEC), Skill Enhancement Course (SEC) as well as Value Added Course (VAC) or Indian Knowledge System (IKS) from a pool of courses.
- Each course shall be assigned a specific number of Credits.
- Discipline Specific Core Course (DSC) is the course which should compulsorily be studied by a candidate as a Major and Minor requirement so as to get degree in a said discipline of study.
- There shall be One Major (MDSC) and Minor (MiDSC) Compulsory course (Theory) each with 4 credit in each semester and their practical's each with 4 credit which is grouped in A and B.
- In addition to the Major/Minor, a student will have to choose AEC, SEC as well as VAC/IKS from a pool of courses in both semester V and VI.

- AEC, SEC and IKS(Sem 5), INTERNSHIP(Sem 6) courses shall have to be offered. The credit weight-age for AEC, SEC courses shall be of 2 credit and for internship shall be of 4 credit.
- Each course shall have a unique Course code. The Discipline Specific Core Course, Ability Enhancement Course, Value Added Course, Indian knowledge System (IKS) and Skill Enhancement Course shall be abbreviated respectively as **DSC (Major/Minor), IDC/MDC, AEC, VAC/ IKS and SEC.**
  1. Discipline Specific Core Course **DSC (Major/Minor)**, Practical Discipline Specific Core Course **PDSC**
  2. Inter/Multi-Disciplinary Course **IDC/MDC**
  3. Ability Enhancement Course (Languages) **AEC**
  4. Value Added Course **VAC** or Indian knowledge System **IKS**
  5. Skill Enhancement Course **SEC**
- Each Academic year shall consist of **two** semesters, each of **15 weeks** of teaching equivalent to **90 working days**. The Odd semester period shall be from **July to November** and the Even semester periods shall be from **December to April**.
- The theory course with **4credit** shall be of **60 Hours** (15 weeks x 4credits) duration,
- The theory course with **2credit** shall be of **30 Hours** (15 weeks x 2credits) duration.
- **Practical with 2Credit** shall be of **60 Hours** (15 weeks x 4hours) duration.
- **Practical with 4 Credit** shall be of **120 Hours** (15 weeks x 8hours) duration.
- **Internship with 4 Credit shall be of 120 Hours ( 30 hrs per credit)**

#### **ATTENDANCE:**

The attendance rules as per the norms of Hemchandracharya North Gujarat University, Patan.

#### **MEDIUM OF INSTRUCTION:**

The Medium of Instruction shall be of **Gujarati medium**. Students are free to write answers either in **Gujarati** and/ or **English** language.

#### **TEACHING LEARNING PROCESS:**

Teaching and learning in this programme involve **classroom lectures as well tutorials**. It allows-

- ❖ The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention.
- ❖ Written assignments and projects submitted by students
- ❖ Project - based learning
- ❖ Group discussion
- ❖ Home assignments
- ❖ Quizzes and Class Tests
- ❖ PPT presentations, Seminars, interactive sessions
- ❖ Diversity survey
- ❖ Co-curricular activity etc.
- ❖ Industrial Tour or Field visit

#### **LANGUAGE OF QUESTION PAPER:**

Question paper should be drawn in **Gujarati** language and its **English** version should be given.

#### **EVALUATION METHOD :**

Academic performance in various courses *i.e.* **MJDSC, MIDSC, AEC, VAC/IKS, SEC** and **INTERNSHIP** are to be considered as parameters for assessing the achievement of students in the **PHYSICS** subject. A number of appropriate assessment methods of **PHYSICS** will be used to determine the extent to which students demonstrated desired learning outcomes

**Following assessment methodology should be adopted:**

- Theoral and written examinations (Scheduled and surprise tests),
- Closed-book and open-book tests,
- Problem-solving exercises,
- Practical assignments and laboratory reports,
- Observation of practical skills,
- Individual and group project reports,
- Efficient delivery using seminar presentations,
- Vivavoceinterviewsaremajorlyadoptedassessmentmethodsforthiscurriculum.
- The computerized adaptive testing, literature surveys and evaluations, peer sand self-assessment, out puts formindividual and collaborative work are also other important approaches for assessment purposes.
- A student shall be evaluated through **Comprehensive Continuous Examination (CCE)-(Internal Evaluation)**as well as the **Semester End E xamination (SEE External Evaluation)**.
- The weight- age of CCE shall be 50%, where as the weight-age of the Semester End Examination (SEE) shall be 50%.
- In **Comprehensive Continuous Examination (CCE)/(Internal Evaluation)** assessment is spread through the duration of the course and is to be done by the Teacher teaching the course. BOS of the subjects will decide various criteria and their weight–age for CCA. The assessment is to be done by various means including:
  - Written Tests, MCQs based Tests / Quiz
  - Presentations / Seminars
  - Group discussions / Group activities
  - Assignments etc., Project work/ Field work

Sr No	Assessment	4 Credit Course Marks	2 Credit Course Marks	4 Credit Course Marks
		Theory & Practical	Theory & Practical	Internship (In SEM 6)
1	CCE Comprehensive Continuous Examination (50%) ❖ Classroom and Internal Evaluation	50	25	50
2	SEE Semester End Exam (50%)	50	25	50
Total		100	50	100

- The distribution of **Internal Evaluation CCE** is given as per criteria given below.

Components	MAJOR 4 Credit Theory	MI/AEC/SEC 2 Credit Theory
WrittenTest /Weekly Test (2 Test Best out of 3)	20Marks	10Marks
Quiz (2 Test Best out of 3)	10 Marks	---
Active Learning During whole Term	10 Marks	05 Marks
Home Assignments	05Marks	05Marks
Attendance–Regularity in Learning, Written Test and Activity	05Marks	05Marks
Total of CCE	50 Marks	25 Marks

• **SCHEME OF ASSESMENT in CCE and SEE (Uni. Examination) for Each PRACTICAL.**

No.	Nameofthead	Marks for Major		Marks Minor	
		Group A	Group B	Group A	Group B
1.	Understanding and approach to the experiment, circuit lay out, use of apparatus	05 Marks	05 Marks	05 Marks	05 Marks
2.	Tabulation with correct units and accuracy of reading, which is read And noted by the student and verified by examiner.	05 Marks	05 Marks	05 Marks	05 Marks
3.	Oral questions Regarding the experiment (Viva)	07 Marks	07 Marks	07 Marks	07 Marks
4.	Calculations by correct formula and graph with scale.	05 Marks	05 Marks	05 Marks	05 Marks
5.	Accuracy of the results judged by comparing the students results With those supplied by expert assistant who has set the experiment.	01 Marks	01 Marks	01 Marks	01 Marks
6.	Marks for Journal. (Must be produced)	02 Marks	02 Marks	02 Marks	02 Marks
Total		25 Marks	25 Marks	25 Marks	25 Marks

- ❖ There will be **Two Group of Practicals in Major and Minor subject having total credit 4. Each Group of Practical will be of 2 credit.**
- ❖ In Major and Minor subject, total Marks of both Group will be 100. (i) 50 Marks is of CCE and (ii) 50 Marks is of SEE. Students have must attend both group of practical in practical examination.
- ❖ In Minor subject, total marks will be 50 in Sem 6.
- ❖ **For Internship, total marks will be 100, (i) 50 Marks is of CCE and (ii) 50 Marks is of SEE.**

• **Batch Size of Practical:**

**According to Uniform model statues for the Gujarat Public Universities Act-2023, EDUCATION DEPARTMENT – GOVERNMENT OF GUJARAT guideline, The batch size shall be not less than ten and not more than twenty. In B Sc Physics Sem 5 and 6 the batch size in practical must be of 15.**

- The **Semester End Examination** (SEE *External Evaluation*) shall have an assessment based upon following perspective with respect to all the courses:
  - Evaluation with respect to Knowledge,
  - Evaluation with respect to Understanding,
  - Evaluation with respect to Skill,
  - Evaluation with respect to Application and
  - Higher Order Thinking Skills.
- With respect to all the above components, there shall be following types of Questions from each unit of the course.
  - ❖ MCQs/Fill in the blanks / Match the pairs,etc
  - ❖ Short answer questions
  - ❖ Medium answer questions
  - ❖ Long answer questions, Examples /Problems, Short notes etc.

Third Year B Sc Sem V & VI Credit in Theory –Practical Distribution						
Semester	Discipline Specific Core Courses		Ability Enhancement Course (Languages) (2)	VAC/ IKS/ Course (2)	Skill Enhancement / Internship Course (2)	TotalCredit
	Major (12)	Minor (8) OR (4)				
	Theory+ Practical Credit	Theory+ Practical Credit	Credit	Credit	Credit	
	V	8 T + 4 P = 12 [In Practical 2 Credit of Group A and 2 Credit of Group B]	4 T + 4 P = 8 [In Practical 2 Credit of Group A and 2 Credit of Group B]	NA	NA	
VI	8 T + 4 P = 12 [In Practical 2 Credit of Group A and 2 Credit of Group B]	2 T + 2 P = 4 [In Practical 2 Credit of Only One Group]	2 T	NA	4 T (INTERNSHIP)	22

**T = Theory      P = Practical**

### Exam pattern of Theory and Practical Examination in SEM 5, 6 for MAJOR, MINOR subject

For Major Minor Course		
Course	Theory	Practical
Credit	4 + 4 = 8 Credit (Two Theory Papers)	4 Credit (Group A -2 credit and Group B-2 credit)
Teaching Hours / Week	4 + 4 = 8 Hours	8 Hours (Group A - 4 Hours and Group B-4 Hours)
Examination Marks	100 + 100 Marks (For CCE 50+50) (For SEE 50+50)	<b>100 Marks</b> • 50 Marks for <b>Group A Experiment</b> (25 Marks - CCE & 25 Marks - SEE) • 50 Marks for <b>Group B Experiment</b> (25 Marks -CCE & 25 Marks - SEE)
Examination Hours	2.5 Hours (CEE & SEE)	5 Hours (2.5 Hours for each Group)
For AEC		
Course	Theory AEC, SEC	Practical MINOR
Credit	2 Credit	2 Credit
Teaching Hours / Week	2 Hours	4 Hours
Examination Marks	50 Marks (For CCE 25 Marks) (For SEE 25 Marks)	<b>50 Marks</b> 25 Marks - CCE & 25 Marks - SEE
Examination Hours	2.5 Hours (CEE & SEE)	2.5 Hours SEE and CCE

- **CERTIFIED JOURNAL:**

The End of Semester Examination will be conducted by the University. A *certified journal* of the respective practical course **MUST BE PRODUCED** at the time of practical examination by the student.

- It will be compulsory for a candidate to obtain *passing percentage* in both Internal as well as External Evaluation. The passing marks for each course shall be **36%** as decided by concern Board of Studies HNGU in Physics.
- Promotion, Re-Admission and Time for Completion of Course, Procedure for Awarding Grades, Provision for Appeal, etc. as decided by the Hemchandracharya North Gujarat University, Patan.

## **Awarding Certificates, Diplomas and Degrees:**

### **Certificate in Science:**

Students who opt to exit after completion of the first year and have secured 48 credits will be awarded the Certificate in Science with the three disciplines chosen by student in the first year. Thus, for example, if a student of B.Sc. program with Physics as the Major discipline and Maths as the minor disciplines and Chemistry as inter disciplines opts to exit after successful completion of the first year, the student will be awarded "Certificate in Science with Physics, Maths and Chemistry".

### **Diploma of Science:**

Students who opt to exit after completion of the second year and have secured 92 credits will be awarded the Diploma of Science in the principal discipline. Thus, for example, if a student of B.Sc. program with Physics as the Major discipline opts to exit after successful completion of two years, the student will be awarded "Diploma of Science in Physics".

### **Bachelor of Science:**

Students who opts to exit after completion of the third year and have secured 132 credits will be awarded the Bachelor of Science in the Major (principal) discipline.

### **Bachelor of Science (Honors):**

Students of 4-year B.Sc. program who successfully complete 4years, without arigorous research project/ dissertation will be awarded the Bachelor of Science (Honors) in the Major discipline (principal discipline).

### **Bachelor of Science (Honors with Research):**

Students of 4-year B.Sc. program who successfully complete 4 years, with a rigorous research project/dissertation will be awarded the Bachelor of Science (Honors with research) in the Major discipline (principal discipline).

- **Note:** During the preparation of this curriculum, ample care is taken for consideration of the followings:
  - (a) NEP-2020
  - (b) Model curriculum of U.G.C.
  - (c) National Credit Framework Report of UGC,2023
  - (d) Concept of continuous evaluation
  - (e) CGPA (Cumulative Grade Point Average Credit)
  - (f) CBCS(Choice Based Credit System)
  - (g) Semester approach
  - (h) Revised rules and regulation of Hemchandracharya North Gujarat University, Patan.

There shall be coverage of maximum 30% syllabus through online mode of teaching. As per directives of UGC.

Arrangement of credit Distribution Framework for three/four years Honours/Honours with Research Degree Programme with Multiple Entry and Exits options for all the institutions:

<b>OPTION I BACHELOR'S DEGREE WITH HONOURS (WITH RESEARCH)</b>										
NCrF Credit Level	Semester	Major (Core) (68/88)	Minor (Electives) (32)	Multi/Inter-disciplinary (12)	AEC (10)	SEC/ Internship (12)	VAC/ IKS (8)	RP/ OJT	Total Credit/ Sem. (144/176)	Qualification / Certificate
4.5 1 <sup>st</sup> Year	I	8	4	4	2	2 (SEC)	2 (IKS)	-	22	<b>UG Certificate</b>
	II	8	4	4	2	2 (SEC)	2	-	22	
First Year Total Credits		<b>16</b>	<b>8</b>	<b>8</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>-</b>	<b>44</b>	
<b>Exit1: Award of UG certificate in Major course with 44 credits with additional 4credits of Summer Internship in core specific NSQF defined course OR continue with Major and Minor course for next NCrFcredit level</b>										
5.0 2 <sup>nd</sup> Year	III	12	-	4	2	2 (SEC)	2 (IKS)	-	22	<b>UG Diploma</b>
	IV	12	4	-	2	2 (SEC)	2 (VAC)	-	22	
Second Year Total Credits		<b>40</b>	<b>12</b>	<b>12</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>-</b>	<b>88</b>	
<b>Exit 2 : Award of UG Diploma in Major course with 88 credits with additional 4 credits of Summer Internship in core specific NSQF defined course OR continue with Major and Minor course for next NCrF credit level</b>										
5.5 3 <sup>rd</sup> Year	V	12	8	-	-	2 (SEC)	-	-	22	<b>UG Degree</b>
	VI	12	4	-	2	4(Internship)	-	-	22	
Third Year Total Credits		<b>64</b>	<b>24</b>	<b>12</b>	<b>10</b>	<b>14</b>	<b>8</b>	<b>-</b>	<b>132</b>	
<b>Award of UG Degree in Major course with 132 credits and Internship in core discipline OR continue with Major and Minor course for next NCrF credit level</b>										
6.0 4 <sup>th</sup> Year	VII	12	4	-	-	-	-	6 (OJT)	22	<b>UG Honours Degree</b>
	VIII	12	4	-	-	-	-	6 (OJT)	22	
Fourth Year Total Credits		<b>88</b>	<b>32</b>	<b>12</b>	<b>10</b>	<b>14</b>	<b>8</b>	<b>12</b>	<b>176</b>	
<b>Award of UG Honours Degree in Major (without Research)course with total 176 credits</b>										
<b>OPTION II BACHELOR'S DEGREE WITH HONOURS (WITH RESEARCH)</b>										
6.0 4 <sup>th</sup> Year	VII	12	4	-	-	-	-	6 (RP)	22	<b>UG Honours with Research Degree</b>
	VIII	12	4	-	-	-	-	6 (RP)	22	
Fourth Year Total Credits		<b>88</b>	<b>32</b>	<b>12</b>	<b>10</b>	<b>14</b>	<b>8</b>	<b>12</b>	<b>176</b>	
<b>Award of UG Honours with Research Degree in Major course with total 176 credits</b>										

**Abbreviation:** AEC -Ability Enhancement Course,  
NCrF-National Credit Framework  
VAC-Value Added Course,

IKS-Indian Knowledge System,  
OJT-On-the-Job Training,  
SEC-Skills Enhancement Course, RP- Research Project

**General Credit-Subject Structure and Examination Pattern /Marking Scheme of study components along with 22 credits in B.Sc. PHYSICS SEM – 5 and 6 are as below.**

Sr. No.	Course Code	Study Components	Instruction Hrs/week	Examination			Credit	Exam Duration (Hours)
				Internal	Uni. Exam	Total		
<b>SEMESTER– V PROGRAM CODE:SCIUG103</b>								
<b>Theory Course (DSC)</b>								
1	SC23MJDSCPHY501	Major-1:Discipline Specific Core Course (MJDSC)	04	50	50	100	4	02:30
2	SC23MJDSCPHY501A	Major-2: IKS: Discipline Specific Core Course (IKSMJDSC)	04	50	50	100	4	02:30
3	SC23MIDCPHY502	Minor:Discipline Specific Core Course (MiDSC)	04	50	50	100	4	02:30
<b>Practical Course (PDSC)</b>								
4	SC23PMJDSCPHY501	Major:Discipline Specific Core Course (Group A) (PMJDSC Total 4 Credit, 8 hrs/week, Total Marks - 50 CCE + 50 SEE =100)	04	25	25	50	2	2:30
		Major:Discipline Specific Core Course (GroupB)	04	25	25	50	2	2:30
5	SC23PMiDSCPHY502	Minor: Discipline Specific Core Course(Group A) (PMiDSC Total 4 Credit, 8 hrs/week, Total 100 Marks )	04	25	25	50	2	2:30
		Minor: Discipline Specific Core Course (Group B)	04	25	25	50	2	2:30
<b>Skill Enhancement Course</b>								
6	SC23SECPHY506	Skill Enhancement Course (SEC)	02	25	25	50	2	1:30
Total			30	275	275	550	22	

**SEMESTER–VI PROGRAMME CODE : SCIUG103**

Sr. No.	Course Code	Study Components	Instruction Hrs/week	Examination			Credit	Exam Duration (Hours)
				Internal	Uni. Exam	Total		
<b>SEMESTER– VI PROGRAM CODE:SCIUG103</b>								
<b>Theory Course (DSC)</b>								
1	SC23MJDSCPHY601	Major-1:Discipline Specific Core Course (MJDSC)	04	50	50	100	4	02:30
2	SC23MJDSCPHY601A	Major-2:Discipline Specific Core Course (MJDSC)	04	50	50	100	4	02:30
3	SC23MIDCPHY602	Minor:Discipline Specific Core Course (MiDSC)	02	25	25	50	2	02:00
<b>Practical Course (PDSC)</b>								
4	SC23PMJDSCPHY601	Major:Discipline Specific Core Course (Group A) (PMJDSC Total 4 Credit, 8 hrs/week)	04	25	25	50	2	2:30
		Major:Discipline Specific Core Course (GroupB)	04	25	25	50	2	2:30
5	SC23PMiDSCPHY602	Minor: Discipline Specific Core Course (PMiDSC Total 2 Credit, 4 hrs/week)	04	25	25	50	2	2:30
<b>ABILITY ENHANCEMENT COURSE (AEC) - Language</b>								
6	SC23AEC604	Ability Enhancement Course (AEC)	02	25	25	50	2	1:30
<b>INTERNSHIP</b>								
7	SC23INTPHY607	Internship (30Hrs per Credit, Total 4 credit)	120	50	50	100	4	
Total			144	275	275	550	22	

**Course Type, Course Name (Title), Course Code, Credit and Lect. Hrs etc**

<b>Semester V</b>					
Sr No	Course Type	Course Name	Course Code	Credit	Lect Hours
1	Major-1 (T)	Mathematical - Solid State - Plasma Physics, Classical – Quantum - Statistical Mechanics & Electronics	SC23MJDSCPHY501	4	4
2	Major-2 (T)(IKS)	Indian Astronomy, Astro Physics and Contribution of Indian Physicists	SC23MJDSCPHY501A	4	4
3	Major Practical	Laboratory Experiment ( <b>Group A &amp; Group B</b> )	SC23PMJDSCPHY501	4	8
4	Minor - (T)	Modern Physics, Electricity, Electronics Holography and Fiber Optics	SC23MIDCPHY502	4	4
5	Minor Practical	Laboratory Experiment ( <b>Group A &amp; Group B</b> )	SC23PMIDSCPHY502	4	8
6	SEC (T)	Optical Instruments	SC23SECPHY506	2	2
<b>Semester VI</b>					
1	Major-1 (T)	Mathematical Physics, Classical - Quantum Mechanics and Molecular Spectra	SC23MJDSCPHY601	4	4
2	Major-2 (T)	Statistical Mechanics, Solid State Physics, Electrodynamics and Electronics	SC23MJDSCPHY601A	4	4
3	Major Practical	Laboratory Experiment ( <b>Group A &amp; Group B</b> )	SC23PMJDSCPHY601	4	8
4	Minor (T)	Nuclear Physics and Spectroscopy	SC23MIDCPHY602	2	2
5	Minor Practical	Laboratory Experiment	SC23PMIDSCPHY602	2	4
6	AEC (Language)	Ability Enhancement Course (AEC)	SC23AEC604	2	2
7	INTERNSHIP	Internship Related Major Course (30 Hrs per Credit, Total 4 credit)	SC23INTPHY607	4	120

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**B. Sc. PHYSICS :SEMESTER -V**

**TYPE OF COURSE: MAJOR DISCIPLINE SPECIFIC COURSE (THEORY)**

COURSE NAME: MATHEMATICAL-SOLID STATE-PLASMA PHYSICS, CLASSICAL-  
QUANTUM-STATISTICAL MECHANICS & ELECTRONICS

**PROGRAMME CODE: SCIUG103**

**COURSE CODE: SC23MJDSCPHY501**

**(Effective from June 2025 Under NEP-2020)**

Total Credits: 04	THEORY MAJOR	External Marks (SEE) - 50
Teaching Hours per Week: 04		Internal Marks (CCE) - 50
Teaching Hours per Semester: 60		

**Course Objective:**

- To provide concepts of a differential Equations and their various coordinate systems.
- To Give basic knowledge of Mathematical Physics and to Provide deep knowledge of various Differential equation
- To provide various numerical techniques useful for the scientific data analysis.
- To Understands the concept of Langrangian Formulation and Rayleigh's Dissipation Function.
- To study the schrodinger equation, Degeneracy, Eigen value problem and Momentum eigen functions.
- To create awareness about states of Statistical Mechanics, with knowledge of Various type of ensembles.
- To provide an exposure to Drude model, Sommarfeld model, Hall co-efficient.

**Course Outcome:** After the successful completion of the course students will be able to,

- Understands the basic knowledge of various differential equations. various coordinate systems
- Learnt the various numerical techniques useful for the scientific data analysis.
- Solve certain special physical problems regarding mathematical aspects.
- Understands concept of Langrangian Formulation, properties of Rayleigh's Dissipation Function.
- Get sufficient knowledge of schrodinger equation, Degeneracy, Eigen value problem and Momentum eigen functions. Also knows about Physical interpretation of Eigen values, Eigenfunction.
- Create awareness about states of Statistical Mechanics like Macro and Micro states, Get Knowledge of Micro canonical ensemble, canonical ensemble and grand canonical ensemble.
- To provide an exposure to Drude model, Sommarfeld model, Hall co-efficient.

**Syllabus**

UnitNo.	Content	Credit	Lect. Hrs 60
Unit-1	<p><b>MATHEMATICAL PHYSICS:</b></p> <p><b>(a) Differential Equations :</b> Some partial differential Equations Physics(2.1), The method of separation of variables(2.2A), Separation of Helmholtz equation in Cartesian Coordinates (2.2B), Separation of Helmholtz equation in spherical polar Coordinates(2.2C), Separation of Helmholtz equation in cylindrical coordinates(2.2D), Laplace's equation in various coordinate systems(2.2E), Choice of Coordinate system an seprability of a partial differential equation(2.3) <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>(b) Second order differential Equations :</b> Ordinary and singular points (3.1). Series solution around and ordinary point (3.2) <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference :</b> Mathematical Physics by P. K. Chatopadhyay, New age international publishers. (Second Edition). {For b &amp; c}</p> <p><b>CLASSICAL MECHANICS:</b></p> <p><b>Lagrangian Formulation:</b> Constraints(8.1), generalized coordinates(8.2), D'alembert's principle(8.3), Lagrange's equations(8.4), A general expression for kinetic energy(8.5), Symmetries and the laws of conservation(8.6), Cyclic or ignorable coordinates(8.7), Velocity dependent potential of electromagnetic field(8.8), Rayleigh's Dissipation Function(8.9) <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference:</b> Introduction to Classical Mechanics by Takawale and Puranik. McGraw Hill education (India) private limited.</p>	1	15

Unit-II	<p><b>QUANTUM MECHANICS:</b>  <b>General formalism of Wave Mechanics :</b> The Schrodinger equation and Probability interaction for N-particle system (3.1), The fundamental postulates of wave mechanics (3.2), The Adjoint of an operator and self Adjointness, (3.3), The Eigen value Problem; Degeneracy (3.4), Eigenvalues and Eigen Functions of Self-Adjoint Operators (3.5), The Dirac Delta Function (3.6), Observables: Completeness and Normalization of Eigen Functions (3.7), Closure (3.8), Physical Interpretation of Eigen values, Eigenfunction and expansion Coefficients (3.9), Momentum Eigenfunctions : wave Functions in Momentum Space (3.10), Uncertainty Principle (3.11) <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference :</b> A text book of Quantum Mechanics by P.M. Mathews and K. Venkateshan, McGraw Hill education (India) private limited.2nd Edition</p> <p><b>SOLID STATE PHYSICS</b>  <b>Free Electron Theory of Metals:</b> The Drude Model (6.1), Electrical Conductivity of Metals (6.1.1), Thermal Conductivity of Metals (6.1.2), Lorentz Modification of the Drude Model (6.2), The Fermi-Dirac (F.D.) Distribution Function (6.3), The Sommerfeld Model (6.4), Density of States(6.4.1), The Free Electron Gas at 0° K (6.4.2), Energy Of Electron at 0° K (6.4.3), The Electron Heat Capacity ( 6.5), The Sommerfeld Theory of Conduction in Metals (6.6), The Hall Co-efficient(RH) (6.6.1).Mathiessen’s Rule (6.7).  <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference:</b> Elements of Solid State Physics by J.P. Srivastava, PHI New Delhi 2006 (2nd Edition)</p>	1	15
Unit-III	<p><b>STATISTICAL MECHANICS:</b>  <b>(a) Microscopic &amp; Macroscopic States:</b>Microscopic states (4.1) Macroscopic States (4.2) Phase Space (4.3) <math>\mu</math>-Space (4.4), <math>\tau</math>-Space, (4.5)  <b>(b) Statistical ensemble:</b> Micro canonical ensemble(5.1), canonical ensemble(5.2),Alternative method for the derivation of canonical distribution(5.3) Mean Value and Fluctuations(5.4), Grand canonical ensemble(5.5), Alternative derivation of Grand canonical distribution(5.6), Fluctuations in the number of particle of a system in a grand canonical distribution(5.7), Reduction of Gibb’s distribution to maxwell’s and Boltzman distribution(5.8), Barometric formula (5.9), Experimental verification of the Boltzman distribution(5.10) <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference :</b>Fundamentals of Statistical Mechanics 2nd edition by B B LAUD, New Age International Publishers</p> <p><b>PLASMA PHYSICS:</b>  <b>Characteristics of a Plasma in a Magnetic Field:</b>  Description of Plasma as a Gas Mixture (3.1), Properties of Plasma in Magnetic Field (3.2), Force on Plasma in Magnetic Field (3.3), Current in Magnetised Plasma (3.4), Diffusion in a Magnetic Field (3.5), Collisions in Fully Ionized Magneto-Plasma (3.6), Pinch Effect (3.7), Oscillations and Waves in The Plasma (3.8), Plasma Frequency (3.8.1),  <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference:</b> Elements of Plasma Physics by S. N. Goswami New Central Book Agency (P). Ltd. Calcutta.reprint2011.</p>	1	15
Unit-IV	<p style="text-align: center;"><b>ELECTRONICS</b></p> <p><b>(a) Basic Transistor Amplifiers:</b>  Current and Voltage amplifiers (6,10), Common Emitter Amplifiers with Emitter Resistor (6.11), Simplified Common Emitter Hybrid Model (6.12), (6.12.1, 6.12.2), Effect of An Emitter Bypass Capacitor in low frequency Response (6.13)  <b>(b) Multistage Amplifiers :</b>  Multistage Transistor Amplifiers (General) (7.1), Terms used in Multistage Transistor Amplifiers (7.1.1), R-C- coupled Amplifiers (7.2), Middle Frequency Range (7.2a), Low Frequency Range and Lower Cut-off Frequency (7.2b) Transformer Coupled Amplifiers (7.4, a, b), Direct coupled Amplifiers (7.5), Effect of cascading on Band width (7.6).  <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference :</b>Hand Book of Electronics by Gupta and Kumar. 46th revised Edition 2019</p>	1	15

### **: Further Reading – Other References:**

1. Mathematical Physics by B.D.Gupta.
2. Mathematical Physics by H.K.Dass.
3. Classical Mechanics, by Goldstein. Narosa Publishing House, NewDelhi.
4. Classical Mechanics by YasvantWaghmare.
5. Classical Mechanics by N. C. Rana and P. S .Joag,THM
6. Quantum Mechanics by Ghatak and Loknathan, The Macmillan Company of India Limited
7. Quantum Mechanics by Fschwabi, Narosa Publishing House, NewDelhi.
8. Quantum Mechanics by John, L. Powell and B.Crasemann.
9. Quantum Mechanics by Schiff
10. Solid State Physics by C. Kittel. John Willy and Sons.
11. Solid State Physics by Saxena. PragatiPrakashan.
12. Solid State Physics by C. M.Kachhawa.
13. Solid State Physics by S O Pillai
14. Statistical Mechanics and Properties of Matter by E.S.R. GopalMcMillan Co. of India Ltd.
15. Statistical Mechanics by B K Agarwal – Melvin Eisner, New Age Inte.Publication
16. Introduction to Plasma Physics by F.F.Chen. Plenum Press.
17. Plasma Physics by S. N. Sen, PragatiPrakashan, Meerut

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

## B. Sc. PHYSICS : SEMESTER – V

TYPE OF COURSE: **IKS** MAJOR DISCIPLINE SPECIFIC THEORY COURSE

COURSE NAME: **INDIAN ASTRONOMY, ASTRO PHYSICS AND  
CONTRIBUTION OF INDIAN PHYSICISTS**

PROGRAMME CODE: SCIUG103

COURSE CODE: SC23MJDSCPHY501A

(Effective from June 2025 Under NEP–2020)

Total Credits:04	THEORY MAJOR (IKS)	External Marks - 50
Teaching Hours per Week: 04		Internal Marks - 50
Teaching Hours per Semester: 60		

### Course Objective:

- To gain comprehensive knowledge and understanding of theoretical principles and experimental findings in Physics and its different subfields like Indian astronomy.
- To understand the Astrophysics and astronomical instruments
- To develop knowledge about magnitudes, motions and distances of star.
- To aware about Contribution of Indian Physicists

- **Course Outcome:** After the successful completion of the course students will be able to Understanding of,
- The development of astronomy from Vedic times to the recent times, The basic concepts of celestial sphere.
- The different coordinate system, Celestial longitude and latitude, Right ascension, azimuth, altitude and equinox, The Zodiac systems
- Knowledge about magnitudes, motions and distances of star.
- Contribution of Dr C V Raman, Chandrasekhar, J. C. Bose's, N. S. Satya Murthy, Homi Bhabha, Megnath Saha, S.N Bose, Dr Vikram Sarabhai, Manali Kallat Vainu Bappu.

### Syllabus

UnitNo.	Content	Credit	Lect. Hrs 60
Unit-1	<p><b>INDIAN ASTRONOMY:</b></p> <p><b>Historical Introduction:</b> Introduction, Ancient Indian Astronomy, The Vedic Period and Vedangajyotisa, Siddhanta, Aryabhata I, Astronomers after Aryabhata, Contents of the Siddhantas, Continuity in Astronomical Tradition.</p> <p><b>Celestial Sphere:</b> Introduction, Diurnal Motion of Celestial Bodies, Motion of Celestial Bodies Relative to Stars, Celestial Horizon, Meridian, Polar Star and Directions, Zodiac and Constellations, Equator and Poles, Latitude of a place and Altitude of Polar Star, Ecliptic and the Equinoxes.</p> <p><b>Co-ordinate Systems:</b> Introduction, Ecliptic System, Equatorial System, Horizontal System, Meridian System, Phenomenon of Precession of Equinoxes, Ancient Indian References to the Precession, Effects of Precession on Celestial Longitude, Tropical and Sidereal Longitudes.</p> <p><b>Rasi and Nakshatra Systems:</b> Zodiac and Rasis. <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Referenc:</b></p> <ol style="list-style-type: none"> <li>1. S. BalachandraRao, Indian astronomy: An introduction. Distributed by Orient Longman Ltd, 2000. Articles: 1.1 to 1.8, 2.1 to 2.9, 3.1 to 3.9, 4.1</li> <li>2. The Story of Aastronomy in India by Chander Mohan, 2015.</li> <li>3. Indian Astronomy, A Sourcebook, B. V. Subbarayappa, K. V. Sarma.</li> </ol>	1	15
	<p><b>TIME, CALENDARS AND INDIAN PANCHANGA:</b></p> <p><b>Time in Indian Astronomy:</b> Introduction, Civil day and Sidereal day, Solar year and Civil calendar, Solar month and Lunar</p>		

Unit-II	<p>month, Lunar year, Adhikmasa and Ksayamasa, Yuga system, Indian eras, Time on a microcosmic scale</p> <p><b>Calendars and Indian Panchanga:</b> Introduction, Gregorian calendar, Hindu calendar, Indian calendar and Panchanga, What is Panchanga, Tithi, Naksatra, Yoga, Karan, Vara</p> <p><b>Reference Book:</b></p> <ol style="list-style-type: none"> <li>1. S. BalachandraRao, Indian astronomy: An introduction. Distributed by Orient Longman Ltd, 2000. Articles: 5.1 to 5.10, 6.1 to 6.11</li> <li>2. The Story of Astronomy in India by Chander Mohan, 2015.</li> <li>3. Indian Astronomy, A Sourcebook, B. V. Subbarayappa, K. V. Sarma.</li> </ol>	1	15
Unit-III	<p><b>ASTROPHYSICS:</b> <b>Astronomical Instruments:</b> Light and properties, The Earth's atmosphere and the electromagnetic radiation, Optical telescopes, Radio telescopes, The Hubble space telescope, Astronomical spectro graphs, Photographic photometry</p> <p><b>Magnitudes, Motions and Distances of Star:</b> Stellar magnitude sequence, Absolute magnitude and distance modulus, The bolometric magnitude, Different magnitude standards: The UBV system and six colour photometry, Radiometric magnitudes, The colour index of a star, Luminosities of stars, Stellar parallax (Trigonometric) and the units of stellar distances, Stellar positions: The stellar coordinates, Stellar motions</p> <p><b>Reference:</b> An Introduction to Astro physics by Baidyanath Basu, Tanuka Chattopadhyay and Sudhindra Nath Biswas, 2nd edition, PHI Learning private limited. Articles: 1.1 to 1.7; 3.1 to 3.10</p>	1	15
Unit-IV	<p><b>Contribution of Indian Physicists:</b></p> <p><b>(a)</b> Raman's work on various musical instruments, Raman's work on magneto hydrodynamic, Chandrasekha Limit, J. C. Bose's work on electromagnetic waves, N. S. Satya Murthy's Work on Superconducting Magnets, Homi Bhabha's Work, Megnath Saha's Contribution, S.N Bose's contribution. Dr Vikram sarabhai's contribution, Manali Kallat Vainu Bappu's contribution and Wilson Bappu Effect.</p> <p><b>(b)</b> Introduction and Activity of Various well known Indian Institute regarding Physics – PRL, ISRO, TIFR, IITs, IISc, RRI, SINP, IASC, IISST- Thiruvananthpuram, IPR, IUCAA</p> <ol style="list-style-type: none"> <li>1. Raman and his effect by G. Venkataraman, University press.</li> <li>2. Chandrasekhar and his limit by G. Venkataraman, University press Reference: Internet Archives on relevant topics.</li> <li>3. Visit Official website of concern institute for reference <b>{For (b)}</b></li> </ol>	1	15

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

## B. Sc. PHYSICS : SEMESTER -V

TYPE OF COURSE: MINOR DISCIPLINE SPECIFIC COURSE (THEORY)  
 COURSE NAME: MODERN PHYSICS, ELECTRICITY, ELECTRONICS  
 HOLOGRAPHY AND FIBER OPTICS

PROGRAMME CODE: SCIUG103

COURSE CODE: SC23MIDSCPHY502

(Effective from June 2025 Under NEP-2020)

Total Credits:04 Teaching Hours per Week: 04 Teaching Hours per Semester: 60	THEORY MINOR	External Marks (SEE) - 50 Internal Marks (CCE) - 50
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<p><b>Course Objective:</b> To provide concepts of aspecial theory of relativity.</p> <ul style="list-style-type: none"> <li>• To Give basic knowledge of various elementary particles.</li> <li>• To Understands the concept of various network transformations and To study the Thyristors and Optoelectronic Devices.</li> <li>• To obtain a deep knowledge of principle of holography and hologram and To provide experimental knowledge of Recording of Holograms</li> <li>• To develop knowledge of various type of holography and To learn the fiber optical system and fiber optics.</li> <li>• To get sufficient knowledge about Characteristics of the Fibre Optic Communication System</li> </ul>
<p><b>Course Outcome:</b> After the successful completion of the course students will be able to</p> <ul style="list-style-type: none"> <li>• Understands the concept of a special theory of relativity and its various aspects.</li> <li>• Get sufficient knowledge of Leptons, Hadrons, Neutrino, Antineutrino, Quarks etc.</li> <li>• Understands the concept of various network transformations &amp; Will studies about Thyristors and Optoelectronic Devices.</li> <li>• Principle of holography and hologram.</li> <li>• Get sufficient experimental knowledge of Recording of Holograms and develop skills of it.</li> <li>• fiber optical system, fiber optics and Merits of Optical Fibres</li> <li>• Characteristics of the Fibre Optic Communication System and also about of Disadvantages of Fiber Optics.</li> </ul>

### Syllabus

UnitNo.	Content	Credit	Lect. Hrs 60
Unit-1	<p><b>RELATIVITY AND PARTICLE PHYSICS:</b></p> <p><b>(a) Special Theory Relativity:</b> Newtonian Relativity(14.1), Michelson-Morley experiment(14.2), Special theory of relativity(14.3), Lorentz Transformation(14.4), Consequences of Lorentz Transformation(14.5) - (a) Relativity of simultaneity (b) Lorentz-fitz Gerald length Contraction (c) Time dilation, Addition of Velocities (14.6), Variation of mass with Velocity(14.7) Mass- energy relation (14.8)</p> <p style="text-align: right;"><i>Related Examples, Problems, MCQ &amp; Short Questions</i></p> <p><b>(b)Elementary Particles:</b>                      Interaction and Particles (13.1), Leptons and Hadrons (13.1.1), Leptons (13.2), Neutrino and Antineutrino (13.2.1), Other Leptons (13.2.3), Hadrons (13.3), Quarks (13.5)</p> <p style="text-align: right;"><i>Related Examples, Problems, MCQ &amp; Short Questions</i></p> <p><b>Basic Reference:</b></p> <p>(1) Introduction to Classical Mechanics by R G Takwale&amp; P S Puranik McGrawHill Education (India) Private Limited <b>{For (a)}</b></p> <p>(2) Concepts of Modern Physics by Arthur Beiser, S. Mahajan, S R Choudhury {For c} (Seventh Edition) McGraw Hill Education <b>{For (b)}</b></p>	1	15

Unit-II	<p><b>ELECTRICITY AND POWER ELECTRONICS:</b></p> <p><b>(a) Network Transformations:</b> Principle of duality (1.3), Reduction of Complicated network (1.4), Conversions between T and <math>\pi</math> sections (1.5), The bridged-T network (1.6), The Lattice Network (1.7), The Reciprocity theorem (1.9), The compensation theorem (1.12), Driving point impedance, transfer impedance (1.14), The parallel-T network (1.17). <i>Related Examples, Problems, MCQ &amp; Short Questions</i></p> <p><b>(b) Thyristors and Optoelectronic Devices :</b> Introduction to Thyristors, Triac (2.51), Diac (2.52), Introduction to Optoelectronic Devices (3.1), LDR (Light Dependent Resistor) or PhotoConductive Cell (3.2), Applications of LDR (3.3), Photo-Transistor (3.5), Photovoltaic or Solar Cells: construction, working, Characteristic and Efficiency of Solar cell(3.6), Lasers (3.8), Laser Action (3.9), Spontaneous and Stimulated Emission Probabilities and Condition of Population Inversion (3.10), P-N Junction Laser Diode (3.11). <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference :</b> (1) <i>Networks, Lines and Fields</i> by J. D. Ryder Prentice Hall. <b>{For (a)}</b> (2) <i>Hand Book of Electronics</i> by Gupta and Kumar, 46th revised Edition 2019. <b>{For (b)}</b></p>	1	15
Unit-III	<p><b>HOLOGRAPHY:</b></p> <p><b>Holography:</b>Introduction (23.1), Principle of Holography (23.2), Recording of the hologram (23.2.1), Reconstruction of the image (23.1.2),coaxial holography (23.3), off-axis holography (23.4), Theory (23.5), Holograms (23.6), Orthoscopic and pseudoscopic images (23.6.1), Holography and Photography (23.6.2) Important properties of Hologram (23.7), Classification of holograms (23.8), Applications (23.9), Medical application (23.10) <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference:</b> <i>A Textbook of Optics</i> by Dr.N.Subrahmanyam, Brijlal and Dr. M. N. Avadhanulu (as per UGC Model syllabus,25th revise addition 2012, reprint 2018) (S. Chand Co.)</p>	1	15
Unit-IV	<p><b>FIBER OPTICS:</b></p> <p><b>Fiber Optics:</b>Introduction (24.1), Optical Fibre (24.2), Necessity of cladding(24.2.1),Optical Fibre System (24.2.2), Optical fiber cable (24.2.3), Total Internal Reflection (24.3), Propagation of Light Through and Optical Fibre (24.4),Critical angle of Propagation (24.4.1), Acceptance angle (24.4.2), Fraction of refractive index (24.5), Numerical aperture(24.6), Skip distance and number of total internal reflections (24.7), Classification of optical fibres (24.10), Types of Optical Fibre (24.11), (24.11.1, 24.11.2, 24.11.3), V-Number (Normalize frequency)(24.13), Losses in Optical Fibre (24.15), Attenuation (24.15.1), Bandwidth (24.17), Characteristics of the Fibres (24.18), Fibre Optic Communication System (24.21), Merits of Optical Fibres (24.22), Disadvantages (24.22.1). <i>Related Examples, Problems &amp; Short Questions</i></p> <p><b>Basic Reference:</b> <i>A Textbook of Optics</i> by Dr.N.Subrahmanyam, Brijlal and Dr. M. N.Avadhanulu (as per UGC Model syllabus,25th revise addition 2012, reprint 2018) (S. Chand Co.)</p>	1	15

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

## B. Sc. PHYSICS :SEMESTER -V

TYPE OF COURSE: SKILL ENHANCEMENT COURSE (SEC) - THEORY

COURSE NAME: OPTICAL INSTRUMENTS

PROGRAMME CODE: SCIUG103

COURSE CODE: SC23SECPHY506

(Effective from June 2025 Under NEP-2020)

Total Credits:02	THEORY SEC	External Marks (SEE) - 25
Teaching Hours per Week: 02Teaching Hours per Semester: 30		Internal Marks (CCE) - 25

### Course Objective:

- To gain deep knowledge of principle, construction, working process of M I.
- To provide hands on experimental aspect to measurement of wavelength and determination of thickness of thin transparent sheet as well as refractive index.
- To develop knowledge of B.C. as well as CRO and usage of it.
- To learn the usage of GM counter and working function of it.

**Course Outcome:** After the successful completion of the course students will be able to Understanding of,

- Principle, construction, working process of M I.
- The technique of measurement of wavelength and determination of thickness of thin transparent sheet as well as refractive index.
- The principle, working function and usage of B.C. as well as CRO.
- The usage of GM counter and working function of it.

### Syllabus

UnitNo.	Content	Credit	Lect. Hrs 30
Unit-1	<p><b>Michelson's Interferometer</b> (15.7) Principle, Construction, Working, Circular fringes, Localized fringes, White light fringes, Visibility of fringes(15.7.1 to 15.7.7), Applications of Michelson Interferometer (15.8)-Measurement of wavelength, Determination of difference in the wavelengths of two waves, Thickness of a thin transparent sheet, Determination of the refractive index (15.8.1 to 15.8.4)</p> <p><b>Babinet Compensator</b> (20.21):Construction (20.21.1), Production of polarized light (20.21.2), analysis of elliptically polarized light (20.21.3).</p> <p style="text-align: center;"><i>Related Examples, Problems &amp; Short Questions</i></p>	1	15
Unit-II	<p><b>C.R.O.:</b>CR Tube (3.5), Electrostatic Deflection Sensitivity (3.5.1), Magnetic Deflection Sensitivity (3.5.2), CRT connections (3.5.3), Uses of C.R.O.(3.5.4)</p> <p><b>G. M. Counter:</b> Principle, Construction, Working, Dead time, recovery time, True counting rate, Efficiency of counting, Quenching of G M counter, Operation and testing of G.M. counter, Plateau, Applications of GMC, Advantages and limitations of GMC.</p> <p><b>Basic references:</b></p> <ol style="list-style-type: none"> <li>1. A Textbook of Optics by Dr. N. Subrahmanyam, Brijlal&amp;Dr.M. N.Avadhanulu, S.Chand <b>{for M.I, B.C.}</b></li> <li>2. Hand Book of Electronics by Gupta and Kumar. 30th revised Edition 2002. <b>{for CRO}</b></li> <li>3. Refresher Course in Physics Vol-III, S. Chand &amp; Co. Ltd.(7th edition-2006) <b>{for GMC, Ch-28}</b></li> </ol>	1	15

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

## B.Sc. PHYSICS - SEMESTER –V (PRACTICAL COURSE)

TYPE OF COURSE: MAJOR DISCIPLINE SPECIFIC PRACTICAL COURSE

COURSE NAME: MAJOR PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: SCIUG103 COURSE CODE: SC23PMJDSCPHY501

(Effective from June 2025 Under NEP–2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
Major Discipline Core Course Practical (PMJDSC)	2 (Group A) and 2 (Group B) (Total 4 Credit)	25 CCE + 25 SEE =50 (For Both Group)	SC24PMJDSCPHY501
<b>Teaching Hours</b> Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

### LABORATORY EXPERIMENT COURSE: (PMJDSC - Major) GROUP A

1. Acceleration due to gravity (g) using Kater's pendulum (with MOVABLE knife edges)
2. Determination of Thermal conductivity 'K' of a rubber tube.
3. G.M. Counter (Plateau Characteristics) .
4. Goniometer (Determine of Cardinal points)
5. To study absorption spectra of Iodine gas molecule
6. Refractive index ' $\mu$ ' by total internal Reflection method using Gauss eyepiece
7. Determination of wavelength of light by Lloyd's mirror.
8. Resolving power of grating

### LABORATORY EXPERIMENT COURSE: (PMJDSC - Major) GROUP B

1. Comparison of capacity (C1/C2) using method of mixture
2. Measurement of frequency f and phase difference ' $\theta$ ' of a.c wave using CRO
3. Calibration of magnetic field
4. Solenoid Inductor (Fixed Current of Secondary Coil)
5. A study of transistorized Hartley Oscillator using CRO/Wave meter
6. I/P and O/P impedance of a R-C CE amplifier at different frequency using VTVM/CRO
7. A study of Transformer coupled Amplifier using VTVM/CRO (voltage gain frequency response and bandwidth)
8. Study of Diac characteristics

**Course Objective:**

- To gain practical knowledge by applying the experimental method to correlate with the Physics theory.
- To provide hands on experience with equipments such as CRO, GM counter, spectrometer, electronic circuits.
- To learn the usage of electrical and optical systems of various measurements.
- To impart practical knowledge by performing experiments based on the principles of theory courses.
- To provide training how to analyze the experimental data and graphical analysis.
- To develop intellectual communication skills and discuss the basic principles of scientific concepts in the group

**Course Outcome:** By the end of the course, the students will be able to understand..

- The basic principles of Physics related to their courses in the practical way.
- The operational details of CRO, GM counter, spectrometer, electronic circuits etc.
- The experimental design aspects to determine various properties of like gravity, Thermal conductivity, Refractive index, determination of R, analysis of absorption spectra, value of  $e/m$  etc.
- The process to analyze the observations and infer the outcome of the experiments.
- How to analyze the experimental data and graphical analysis.

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

## B.Sc. PHYSICS - SEMESTER –V (PRACTICAL COURSE)

TYPE OF COURSE: MINOR DISCIPLINE SPECIFIC PRACTICAL COURSE  
COURSE NAME: MINOR PRACTICAL COURSE (LABORATORY EXPERIMENTS)

PROGRAMME CODE: SCIUG103 COURSE CODE: SC23PMIDSCPHY502

(Effective from June 2025 Under NEP–2020)

TYPE OF COURSE	CREDIT	Marks	COURSE CODE
<b>Minor</b> Discipline Core Course Practical (PMiDSC)	2 (Group A) and 2 (Group B) (Total 4 Credit)	25 CCE + 25 SEE =50 (For Both Group)	SC24PMiDSCPHY502
<b>Teaching Hours</b> Teaching Hours per Week: 08 Hours for 4 Credit practical (120 Hours per Semester) Teaching Hours per Week: 04 Hours for 2 Credit practical (60 Hours per Semester)			

### LABORATORY EXPERIMENT COURSE: GROUP A (PMiDSC - Minor)

1. Calibration of CRO and Applications of CRO
2. Numerical analysis newton' Forward and backward interpolation formula.
3. Determination radius of curvature given convex lens by Optical lever
4. To determination of 'L<sub>0</sub>' 'R' and 'a' for resonance pendulum .
5. To determine unknown wave length of light 'λ' Using Hartzman formula
6. To find out the refractive index of ordinary and extraordinary using dual refraction from Calcite prism
7. Numerical analysis Jacobi interaction methods.

### LABORATORY EXPERIMENT COURSE: GROUP B (PMiDSC - Minor)

1. To Determine resistance of bulb at room temperature using post office box
2. To verify De Morgan's theorems using IC -7400
3. A study of characteristic of JFET & Determination  $\mu$ ,  $r$ , &  $g_m$
4. To study of load line & determination of Q- point for BJT.
5. To Determine absolute value of Capacity using B.G,
6. A study of Input characteristic of UJT
7. To Determine Low Value of 'C' using Schering Bridge.

**“Arise, Awake and Stop not till your GOAL is Reached”.**

**– SWAMI VIVEKANAND**

**PROGRAM CODE: SCIUG102**  
**Syllabus and Scheme of Examination**  
for  
**Semester-V and Semester -VI of B.Sc. Honors**  
**Chemistry**

Four-year Graduate Honors Program in Chemistry  
Under NEP 2020

Submitted

to



*Hemchandracharya North Gujarat University, Patan*

Under

**Choice Based Credit System**

**Implemented w. e. f June 2025**

Submitted on October 2024

## **PREAMBLE**

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching-learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students.

The National Education Policy (NEP) 2020 (hereafter referred to as NEP or Policy) recognizes that higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. It notes that “given the 21st -century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals”. In accordance with the NEP 2020, the UGC has formulated a new student-centric “Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)” incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options. This will facilitate students to pursue their career path by choosing the subject/field of their interest. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce a uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

## **CHOICE BASED CREDIT SYSTEM (CBCS):**

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in

evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

### **OUTLINE OF CHOICE BASED CREDIT SYSTEM**

- 1. Major Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Major Discipline specific course.
- 2. Minor discipline** helps a student to gain a broader understanding beyond the major discipline.
- 3. Multidisciplinary Course (MDC):** 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.
- 4. Interdisciplinary Course (IDC) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).
- 5. Ability Enhancement Courses (AEC):** Environmental Science, English Communication/MIL Communication are mandatory for all disciplines.
- 6. Skill Enhancement Courses (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.
- 7. Value Added Courses (SEC):** These courses may be chosen from a pool of courses designed to provide value-based education courses instruction.

The Proposed new courses in chemistry for undergraduate classes are reassigned in accordance to semester/CBCS/Grading system with new education policy. The new course is based on model curriculum of the university grants commission.

### **COURSES/ACTIVITIES UNDER THE PROGRAM**

- 1. Lecture courses:** Courses involving lectures relating to a field or discipline by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.
- 2. Tutorial courses:** Courses involving problem-solving and discussions relating to a field or discipline under the guidance of qualified personnel in a field of learning, work/vocation, or professional practice.
- 3. Practicum or Laboratory work:** A course requiring students to participate in a project or practical or lab activity that applies previously learned/studied principles/theory related to the chosen field of learning, work/vocation, or professional practice under the supervision of an expert or qualified individual in the field of learning, work/vocation or professional practice

4. **Seminar:** A course requiring students to participate in structured discussion/conversation or debate focused on assigned tasks/readings, current or historical events, or shared experiences guided or led by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.
5. **Internship:** A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.
6. **Studio activities:** Studio activities involve the engagement of students in creative or artistic activities. Every student is engaged in performing a creative activity to obtain a specific outcome. Studio-based activities involve visual- or aesthetic focused experiential work.
7. **Field practice/projects:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity.
8. **Community engagement and service:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity. The curricular component of ‘community engagement and service’ will involve activities that would expose students to the socio-economic issues in society so that the theoretical learning’s can be supplemented by actual life experiences to generate solutions to real-life problems.

### **Objectives of Program**

1. Recognizing, identifying, and fostering the unique capabilities of each student to promote her/his holistic development.
2. To meet the growing demand of specialization and advanced courses in applied science.
3. To redesign the courses the special emphasis on local requirements, environment, to link the courses with requirements of the industries and research.
4. Flexibility for learners to move from one institution to another to enable them to have multi and/or interdisciplinary learning.
5. Flexibility to switch to alternative modes of learning (offline, ODL, and Online learning, and hybrid modes of learning)

6. To prepare students for National level entrance test like NET/SLET/JRF and other competitive exams.

## **General Information and Rules for Semester I to VIII**

### **B.Sc. Honors (Chemistry) with Research or Without Research**

1. The medium of instruction will be English or/ & Gujarati, question papers will be set in English and Gujarati but answers in examinations will either in English or Gujarati.
2. Passing standard: As per the revised rules and regulations of Hemchandracharya North Gujarat University, Patan.
3. Viva voce will be part practical examination and it will be pertaining to theory as well as practicals studied during end semester examination.
3. The Certificate will be awarded in major course i.e. chemistry after completion of 01 Year with 44credits and successful completion of 04 credit vocational course during summer vacation of first year if he/she wants to exit the course.
4. The Diploma will be awarded in the in major course i.e.in chemistry after completion of 02 Years with 88 credits and successful completion of 04 credit vocational course during summer vacation of second year if he/she wants to exit the course.
5. The B. Sc. degree will be awarded in the in major course i.e.in chemistry after completion of 03 Years with 132 credits.
6. The B. Sc. degree with honors with research or without research will be awarded in the in major course i.e. chemistry after completion of 04 Years with 176 credits with research or without research.
7. The college/ Department will run B. Sc. Honors course with honors or without research or both with prior permission of university.
8. Each student is required to complete all theory papers and practicals as specified in each semester. These will include Major Discipline specific course (MJDSC), Minor Discipline specific course (MIDSC), Multidisciplinary/ Inter disciplinary course (MDC/ IDC), Ability enhancement course (AEC), Value added course (VAC), skill enhancement courses (SEC) and practicals.
9. The choice for paper in Minor Discipline specific course (MIDSC), Multidisciplinary/ Inter disciplinary course (MDC/ IDC), Value added course (VAC), skill enhancement courses (SEC) is left to the student.
10. There will be weightage for continuous comprehensive evaluation (CCE) and & weightage to semester End examination (SEE) in Major Discipline specific course (MJDSC), Minor Discipline specific course (MIDSC), Multidisciplinary/ Inter disciplinary course (MDC/ IDC), Ability enhancement course (AEC), Value added course (VAC), skill enhancement courses (SEC) and practicals.

The CCE for each semester shall done as per the continuous evaluation process. For 50 marks following activities are to be performed.

I. Activity for continuous comprehensive evaluation	Marks (out of 50)
(Major Theory)	
(a) Test of theory (Minimum 05)	25
(b) Assignment/ Quiz	10
(c) Group Discussion/ Seminar	05
(d) Problem solving	05
(e) Attendance	05
II. Activity for continuous comprehensive evaluation	Marks (out of 25)
(Minor/ Skill/Multi/ Interdisciplinary Theory)	
(a) Test of theory (Minimum 03)	15
(b) Group Discussion/ Seminar	05
(c) Attendance	05
III. Activity for continuous comprehensive evaluation	Marks (out of 50)
(Major Practical's)	
(a) Internal practical exam Group A	15
(b) Internal practical exam Group B	15
(c) Journal/ Practical Report (Certified)	10(5+5)
(d) Viva voce	10(5+5)
IV. Activity for continuous comprehensive evaluation	Marks (out of 25)
(Minor/ Multi/ Interdisciplinary Practical's)	
(a) Internal practical exam	15
(b) Journal/ Practical Report (Certified)	05
(c) Viva voce	05

11. Continuous evaluation activities for Sem I, II, III, IV and VI will be as per rule 10 (I to IV). Since in Sem V, minor is having 04 credits, it's internal evaluation will be as per I & III of rule 10.
12. There shall be coverage of maximum 30% syllabus through online mode of teaching. As per directives of UGC.
13. Students should be encouraged to use electronic media to complete the course.
14. For each semester in I<sup>st</sup> year, there will be 550 marks per semester and for completion of **certificate Program** at the time of exit, the total marks will be given out of 1200 (1100+100). The cumulative grade will be given as per university rules.
15. For each semester in II<sup>nd</sup> year, there will be 550 marks per semester, for both semester III and IV. At end of II<sup>nd</sup> year for completion of **Diploma Program** at the time of exit, the total marks will be given out of 2300 (1100+1100+100). The cumulative grade will be given as per university rules.
16. For each semester in III<sup>rd</sup> year, there will be 550 marks per semester, for both semester V and VI. At end of III<sup>rd</sup> year for completion of **B. Sc. Degree Program** at the time of exit, the total marks will be given out of 3300 (1100+1100+1100). The cumulative grade will be given as per university rules.
17. In third year in Sixth semester, internship of 04 credits (100marks) is compulsory for completion of B. Sc. Degree program as part of Sem 6.

18. **Note:** During the preparation of this curriculum, ample care is taken for consideration of the following
- (a) NEP 2020
  - (b) Model curriculum of U.G.C.
  - (c) National Credit Framework Report of UGC, 2023
  - (d) Concept of continuous evaluation
  - (e) CGPA (Cumulative Grade Point Average Credit)
  - (f) CBCS (Choice Based Credit System)
  - (g) Semester approach
  - (h) Revised rules and regulation of Hemchandracharya North Gujarat University, Patan.
  - (i) KCG Standard Operating Procedure, August 2023
19. For internal remuneration, four hours of Practical's should be considered equivalent to two hours of theory.
20. For conducting practical's, batch size should be with Minimum 10 students and should not exceed more than 20 as per circular by education department under Gujarat public act 2023 on January 20, 2024.
21. There will be only one day examination with three examiners for practical course of 04 credits and half day for 02 credits practical course for Sem5 and Sem6.
22. To complete the UG degree program, in Sem-VI student has to do internship with local industry (Government or Private or Micro, small, or Medium) or local Government organization (municipal corporation or Jilla panchayat or municipalities), or Reputed institutions or laboratories. To provide opportunities to students in experiential learning, every student has to undergo 4 credit internship of 120 hours. Evaluation of internship will be done by internal and external examiners as per the rules decided by the university.

**A. Common Formula for Setting Question Papers for Major Discipline**

**Specific course**

Time: 2.30 Hours

Total Marks: 50

**Theory Examination Pattern**

Que. No: 1	Write any Two out of Three Questions	Unit I	13 Marks
Que. No: 2	Write any Two out of Three Questions	Unit II	12 Marks
Que. No: 3	Write any Two out of Three Questions	Unit III	13 Marks
Que. No: 4	Write any Two out of Three Questions	Unit IV	12 Marks

**B. Common Formula for Setting Question Papers for Minor/ Multi/Inter disciplinary Courses**

Time: 2.00 Hours

Total Marks: 25

**Theory Examination Pattern**

Que. No: 1	Write any Two out of Three Questions	Unit I	08 Marks
Que. No: 2	Write any Two out of Three Questions	Unit II	08 Marks
Que. No: 3	Write any three Small relevant Questions	Unit I, II	09 Marks

**C. Common Formula for Setting Question Papers for Value added/ Skill Enhancement Courses**

Time: 2.00 Hours

Total Marks: 25

**Theory Examination Pattern**

Que. No: 1	Write any Two out of Three Questions	Unit I	08 Marks
Que. No: 2	Write any Two out of Three Questions	Unit II	08 Marks
Que. No: 3	Write any three Small relevant Questions	Unit I, II	09 arks

**D. Common Formula for External Practical Examination  
(For Sem- I, II, III, IV & VI)**

Sr. no.	Details	Marks Major Course		Marks (MI/MDC)
		Group A	Group B	
1	Experiment (do any one)	15	15	15
2	Viva	05	05	05
3	Certified Journal	05	05	05
4	Total	25	25	25
5	time	2.30 Hr.	2.30 Hr.	2.30Hr

**E. Common Formula for External Practical Examination  
(Only For Sem- V)**

Sr. no.	Details	Marks Minor Course	
		Group A	Group B
1	Experiment (do any one)	15	15
2	Viva	05	05
3	Certified Journal	05	05
4	Total	25	25
5	time	2.30 Hr.	2.30 Hr.

Semester	Type Of Course Opted	Course Name	Course Code	Credits	Examination			Total Marks
					Internal	External	Examination Hours	
I	Major Discipline Specific course MJDCS	Fundamentals of Chemistry- I	SC23MJDCSCHE101	4	50	50	2.30	100
	Minor Discipline Specific course MIDSC	To be Selected– I Basic chemistry -1	SC23MIDSCCHE102	2	25	25	2.00	50
	Multi/Inter disciplinary Course MDC/IDC	To be Selected (General chemistry-I/ Agricultural chemistry)	SC23MDCCHE103/ SC23MDCCHE103A	2	25	25	2.00	50
	Ability Enhancement Courses AEC	To be Selected ( From languages)	SC23AECACHE104	2	25	25	2.00	50
	Value Added course VAC	To be Selected ( pollution and environment Protection law)	SC23VACACHE105	2	25	25	2.00	50
	Skill Enhancement Course SEC	To be selected SEC-I Analytical chemistry-1 or SEC-2 Soil analysis or	SC23SECCHE106/ SC23SECCHE106A/ SC23SECCHE106B	2	25	25	2.00	50
	Practical's Major Discipline Specific course MJDCS Practical's Minor Discipline Specific course MIDSC Practical's Multi/Inter Disciplinary Course MDC/IDC	PMJDC Practical -I Lab Group A & Group B PMIDC Practical-II Lab PMDC/PIDC Practical-III Lab	SC23PMJDCSCHE101	4	50	50	5	100
			SC23PMIDSCCHE102	2	25	25	2.30	50
SC23PMDCACHE103			2	25	25	2.30	50	
<b>Total Credits of Semester – I</b>				<b>22</b>	<b>275</b>	<b>275</b>		<b>550</b>

<b>II</b>	<b>Major Discipline Specific course</b> MJDSC	<b>Fundamentals of Chemistry- II</b>	<b>SC23MJDSCCHE201</b>	<b>4</b>	<b>50</b>	<b>50</b>	<b>2.30</b>	<b>100</b>
	<b>Minor Discipline Specific course</b> MIDSC	<b>To be Selected– II Basics of chemistry -II</b>	<b>SC23MIDSCCHE202</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.00</b>	<b>50</b>
	<b>Multi/Inter disciplinary Course</b> MDC/IDC	<b>To be Selected (General chemistry -II/ Climate change and Pollution)</b>	<b>SC23MDDSCCHE203/ SC23MJDSCCHE203A</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.00</b>	<b>50</b>
	<b>Ability Enhancement Courses</b> AEC	<b>To be Selected (From languages)</b>	<b>SC23AECACHE204</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.00</b>	<b>50</b>
	<b>Value Added course VAC</b>	<b>To be Selected (VAC II- Ethics in chemistry)</b>	<b>SC23VACACHE205</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.00</b>	<b>50</b>
	<b>Skill Enhancement Course SEC</b>	<b>To be Selected SEC-1 Analytical chemistry II or SEC-2 Food analysis or SEC-3 Store management or SEC-4 Water Quality Assessment</b>	<b>SC23SECCHE206/ SC23SECCHE206A/ SC23SECCCHE206B/ SC23SECCCHE206C</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.00</b>	<b>50</b>
	<b>Practical Major Discipline Specific course, MJDSC</b>	<b>PMJDC Practical -I Lab Group A &amp; Group B</b>	<b>SC23PMJDSCCHE201</b>	<b>4</b>	<b>50</b>	<b>50</b>	<b>5</b>	<b>100</b>
	<b>Practical Minor Discipline Specific course, MIDSC</b>	<b>PMIDC Practical-II Lab</b>	<b>SC23PMIDSCCHE202</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.30</b>	<b>50</b>
<b>Practical Multi/Inter Disciplinary Course, MDC/IDC</b>	<b>PMDC/ IDC Practical-III Lab</b>	<b>SC23PMDCACHE203</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.30</b>	<b>50</b>	
<b>Total Credits of Semester - II</b>				<b>22</b>	<b>275</b>	<b>275</b>		<b>550</b>

Semester	Type Of Course Opted	Course Name	Course Code	Credits	Examination			Total Marks
					Internal	External	Examination Hours	
III	Major Discipline Specific course MJDS-C-I	Basic of Chemistry- I	SC23MJDS-C-CHE301	4	50	50	2.30	100
	Major Discipline Specific course MJDS-C-II	Basic chemistry -II	SC23MID-S-CHE301A	4	50	50	2.30	100
	Major Discipline Specific course MJDS-C-III Practical's	PMJDC Practical -I & II Lab Group A & Group B	SC23PMJDS-C-CHE301	4	50	50	2.30	100
	Multi/Inter disciplinary Course MDC/IDC	Simplified chemistry-I  PMDC/PIDC Practical- Lab	SC23MDC-CHE303	2	25	25	2.00	50
				2	25	25	2.00	50
	Ability Enhancement Courses AEC	To be Selected ( From languages)	SC23AEC-CHE304	2	25	25	2.00	50
	Indian Knowledge System IKS	To be Selected ( Basics of IKS)	SC23IKS-CHE305	2	25	25	2.00	50
	Skill Enhancement Course SEC	To be selected SEC-I Environmental Pollution or SEC-2 Metallurgical chemistry	SC23SEC-CHE306/ SC23SEC-CHE306A	2	25	25	2.00	50
	<b>Total Credits of Semester - III</b>				<b>22</b>	<b>275</b>	<b>275</b>	

IV	Major Discipline Specific course MJDSC -1	Basic Chemistry- III	SC23MJDSCCHE401	4	50	50	2.30	100
	Major Discipline Specific course MJDSC-II	Basic Chemistry- IV	SC23MJDSCCHE401A	4	50	50	2.30	100
	Major Discipline Specific course MJDSC -1II Practicals	PMJDC Practical -I & II Lab Group A & Group B	SC23PMJDSCCHE401	4	50	50	2.30	100
	Minor Discipline Specific course MIDSC	To be Selected Simplified chemistry -II	SC23MIDSCCHE402	2	25	25	2.00	50
	Minor Discipline Specific course MIDSC Practicals	PMIDC Practical-I Lab	SC23PMIDSCCHE402	2	25	25	2.00	50
	Ability Enhancement Courses AEC	To be Selected ( From languages)	SC23AECACHE404	2	25	25	2.00	50
	Value Added course VAC	To be Selected (VAC Bhartiya Science & Technology)	SC23VACCHE405	2	25	25	2.00	50
	Skill Enhancement Course SEC	To be Selected SEC-1 Green chemistry or SEC-2 Ceramics	SC23SECCHE406/ SC23SECCHE406A	2	25	25	2.00	50
Total Credits of Semester - IV			22	275	275		550	

Semester	Type Of Course Opted	Course Name	Course Code	Credits	Examination			Total Marks
					Internal	External	Examination Hours	
V	Major Discipline Specific course MJDC-	Fundamentals of Chemistry III	SC23MJDCSCHE501	4	50	50	2.30	100
	Major Discipline Specific course MJDC-	Ancient Indian Chemistry	SC23MJDCSCHE501A	4	50	50	2.30	100
	Practicals Major Discipline Specific course MJDC	PMJDC Practical -III Lab Group A & Group B	SC23PMJDCSCHE501B	4	50	50	5	100
	Minor Discipline Specific course MIDSC	Simplified Chemistry II	SC23MIDSCCHE502	4	50	50	2.30	100
	Practicals Minor Discipline Specific course MIDSC	PMIDC Practical-III Lab Group A & Group B	SC23PMIDSCCHE502A	4	50	50	5	100
	Skill Enhancement Course SEC	To be selected Term Symbol and d <sup>1</sup> -d <sup>9</sup> Spectra (SEC-1) Polymer Chemistry (SEC-2) Medicinal Chemistry (SEC-3)	SC23SECHE506	2	25	25	2.00	50
			SC23SECHE506A					
SC23SECHE506B								
Total Credits of Semester-V				22	275	275		550

<b>VI</b>	<b>Major Discipline Specific course MJDSC</b>	<b>Fundamentals of Chemistry- IV</b>	<b>SC23MJDSCCHE601</b>	<b>4</b>	<b>50</b>	<b>50</b>	<b>2.30</b>	<b>100</b>
	<b>Major Discipline Specific course MJDSC</b>	<b>Fundamentals of Chemistry-V</b>	<b>SC23MJDSCCHE601A</b>	<b>4</b>	<b>50</b>	<b>50</b>	<b>2.30</b>	<b>100</b>
	<b>Practical Major Discipline Specific course, MJDSC Practical</b>	<b>PMJDC Practical -III Lab Group A &amp; Group B</b>	<b>SC23PMJDSCCHE601B</b>	<b>4</b>	<b>50</b>	<b>50</b>	<b>5</b>	<b>100</b>
	<b>Minor Discipline Specific course MIDSC</b>	<b>Bioinorganic and Organic Chemistry</b>	<b>SC23MIDSCCHE602</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.00</b>	<b>50</b>
	<b>Minor Discipline Specific course, MIDSC</b>	<b>PMIDC Practical-III Lab</b>	<b>SC23PMIDSCCHE602A</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.30</b>	<b>50</b>
	<b>Ability Enhancement Courses AEC</b>	<b>To be Selected (From Basket) )</b>	<b>SC23AECHE603</b>	<b>2</b>	<b>25</b>	<b>25</b>	<b>2.00</b>	<b>50</b>
	<b>Internship</b>	<b>Trainee - Chemist</b>	<b>SC23INTCHE607</b>	<b>4</b>	<b>50</b>	<b>50</b>		<b>100</b>
	<b>Total Credits of Semester-VI</b>			<b>22</b>	<b>275</b>	<b>275</b>		<b>550</b>

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Course Name: B. Sc. Chemistry Semester: V

PROGRAM CODE: SCIUG102

COURSE CODE: SC23MJDSCCHE501

Type of course: Major Discipline Specific course

Name of course: Fundamentals of Chemistry III (Major-1)

Total Marks: 100

Effective from June 2025 Under NEP 2020

<b>Total Credits:</b> <b>04</b>	Teaching Hours per Week: 04	Theory	External 50 Marks
	Teaching Hours per Semester: 60		Internal 50 Marks

### Course Objectives:

1. To understand the core concepts of electro motive force.
2. To understand physical chemistry concepts of Nucleophilic Substitution Reaction
3. To know about the Volumetric titrations and calculations for Acid Base Titration.
4. To study about the Symmetry group elements & symmetry operations.

### Course Outcome:

1. Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in, physical and analytical chemistry.
2. Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behaviors in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.
3. Students will be able to design and carry out scientific experiments as well as accurately record and analyse the results of such experiments.
4. Students will be skilled in problem solving approach, creative thinking and analytical reasoning as applied to scientific problems.
5. To know about the Volumetric titrations and calculations for estimation.

Unit	Topic	Credit	Hours
1	<b>Electro Motive Force</b> Introduction of Terms - Oxidation, Reduction, Redox, Anode, Cathode - Electrode, Half cell - Oxidation & Reduction Potential - Electro Chemical Series - Nernst Equation Without Transference with Transference Verification of Concentration cell and it's EMF equation. Electrolyte concentration cell Concentration cell without transference, Concentration cell with	1	15

	<p>transference  Electrode concentration cell  Liquid -Liquid junction potential  Application of EMF measurements  Determination of  -Solubility product of sparingly soluble salt  -Stability constant of complex  -Equilibrium constant  -pH  -Ionic constant of water  -Dissociation constant of weak acid,  Numerical</p>		
2	<p><b>Nucleophilic Substitution Reaction</b>  The reaction mechanism  Mechanism of SN<sup>1</sup> and SN<sup>2</sup> reactions  Stereochemistry of reaction SN<sup>1</sup> and SN<sup>2</sup> reactions  Relative reactivity in substitution  Solvent effect variation at carbon site  Relative leaving group activity  Neighbouring group participation  Competitive reactions. Elimination E<sup>1</sup>, E<sup>2</sup> and E<sup>1</sup>cb mechanisms</p>	1	15
3	<p><b>Acid Base Titration</b>  Construction of titration curves (Neutralization of weak acid by strong base and weak base by strong acid only)  Neutralization of polyprotic acid (Dibasic and tribasic acid only) by strong base  Analysis of Soda Ash  Indicators, Mechanism of Indicators  Gran's plot  Buffer Solution, buffer level, types of buffers, buffer range &amp; buffer capacity  Numerical</p>	1	15
4	<p><b>Symmetry</b>  Symmetry elements &amp; symmetry operations  Multiplications of symmetry operations  Multiplication table for C<sub>2v</sub>, C<sub>3v</sub>, C<sub>2h</sub> point groups only  Classification of schoenflies point groups  Determination of schoenflie point groups notations  Symmetry &amp; optical activity  Symmetry property of orbital's for C<sub>2v</sub>, C<sub>3v</sub>, C<sub>2h</sub> point groups</p>	1	15

**Suggested books:**

1. Chemical application of group theory by F.A. Cotton
2. Chemical bonding and introduction by K.C. Patel, R.D. Patel and Raval
3. Application of group theory to chemistry by Bhattacharya
4. Symmetry in chemistry by Jafle and Orchin 9 4–2013
5. Advance inorganic chemistry by cotton & Wilkinson
6. Basic principles of spectroscopy by R. Chand
7. Organic chemistry Vol. 1 by S.M. Mukherji, S.P. Shingh, Kapoor
8. Spectroscopy organic compounds VI<sup>th</sup> edition by P.S. kalsi
9. Organic chemistry by Morrison and Boyd
10. Spectrometric identification of organic compounds IV<sup>th</sup> edition by Silverstain, Basslerand Morrill.
11. Application of absorption spectroscopy of organic compounds by John R. Dyer
12. Spectroscopic method in organic chemistry V<sup>th</sup> edition by Dudley H. Williams & Ian Fleming
13. Physical methods for chemist Ruwssell S. Drago
14. Organic spectroscopy by Williams & Kemp
15. Organic spectroscopy by V.R. Dani
16. Qualitative Analysis R.A. Day & A.L. Underwood
17. Analytical Chemistry G.D. Christain
18. Fundamentals of Analytical Chem istry D.A. Skoog, D.M. West &F.J. Holler
19. Principals of Analytical Chemistry J.H. Kennedy
20. Analytical Chemistry – Principals & Techniques L.G. Hargis

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Course Name: B.Sc. Chemistry Semester: -V

PROGRAM CODE: SCIUG102  
COURSECODE:SC23MJDSCCHE501

Type of course: Major Discipline Specific IKS course

Name of course: Ancient Indian Chemistry (Major-2)

Total Marks:100

Effective from June 2025 Under NEP2020

<b>TotalCredits:</b> <b>04</b>	Teaching Hours per Week:04	Theory	External50 Marks
	Teaching Hours per Semester:60		Internal50Marks

### Course Objectives:

1. To understand and appreciate Indian contribution to chemical sciences. .
2. To understand ancient Indian metallurgy and compare with present system.
3. To appreciate the contribution of Indian chemist sir P. C. in chemicals sciences and industrial chemistry.
4. To acknowledge the contribution of Raman effect ny indian lobel laurette Dr. C. V. Raman.
5. To know about extraction of various fragrances in ancient India.

### Course Outcome:

1. Students will have firm faith in our knowledge systems.
2. Students will appreciate the central role of chemistry in uplifting our society for centuries.
3. Students will be able to understand and earlier methods of design/ synthesis/extraction of new components and compare these with present systems.
4. Students will be more motivated and believe in our indegenious sytems and get skilled in problem solving approach, critical thinking and analytical reasoning to have answers to social problems.
5. Students will know about Tradtional fragrances and their cultural, spiritual, and medicinal role.

Unit	Topic	Credit	Hours
1	<b>Indian traditional metallurgy</b> <ul style="list-style-type: none"><li>• Overview of Indian metallurgical tradition</li><li>• Vedic Metallurgy of Copper, Iron, Zinc, Gold and Silver</li><li>• Chemistry of Modern Alloy (mild Steel and Stainless steel, and German silver) and Ores (Gold, Silver, Iron, Aluminum Chemistry of Ashok Stambh</li><li>• Techniques of Manufacturing Coins in Ancient India and in present times, Types of Historical Coins</li><li>• Matels used in Ayurveda, Material and process, Rasayan and Bhasam</li></ul>	1	15

2	<p><b>P. C. Ray's philosophy of chemical sciences</b></p> <ul style="list-style-type: none"> <li>• Ray's Synthesis of sulphur compounds including long chain species, and comparison with modern methods,</li> <li>• Ray's Synthesis of condensed heptacyclic c</li> <li>• Ray's Synthesis Thioketones and applications of thioketones.</li> </ul> <p>Discovery of Mercurous Nitrite (<math>\text{Hg}_2(\text{NO}_2)_2</math>): Experimental methods used and Significance and applications. Comparison of mercurous nitrite with mercuric nitrate.</p> <ul style="list-style-type: none"> <li>• Organic and inorganic nitrites</li> <li>• Philosophy for nationalism and education, Influence on future generations of chemists in India, Creation of a research culture in Indian universities</li> <li>• Relevance of Ray's methods in modern inorganic and industrial chemistry</li> <li>• Study of Nitrites and Hyponitrites of Alkali and Alkaline Earth Metals</li> </ul> <p>Development of stable chemical compounds and their crystal structures</p>	1	15
3	<p><b>Raman Spectroscopy</b></p> <ul style="list-style-type: none"> <li>• History and discovery, Contribution of Dr. C.V. Raman and his team in the Raman Effect</li> <li>• Basic principles: Raman effect, elastic and inelastic scattering of light.</li> <li>• Molecular vibrations and energy levels</li> <li>• Selection rules in Raman spectroscopy</li> <li>• Stokes and Anti-Stokes lines</li> <li>• Polarizability and Raman activity</li> <li>• Examples of 03 compounds which are Raman active</li> <li>• Role in promoting ancient science in India</li> <li>• Raman's philosophy and views on science and society</li> <li>• Influence on future generations of scientists</li> </ul>	1	15
4	<p><b>Chemical Background of Fragrance in India</b></p> <ul style="list-style-type: none"> <li>• Importance of fragrance in Indian culture: Ayurveda, rituals, and cosmetics</li> <li>• Ancient texts on perfumery (e.g., <i>Charaka Samhita</i>, <i>Brihat Samhita</i>)</li> <li>• Role of perfumers in Mughal and post-Mughal India</li> <li>• Use of natural ingredients: sandalwood, rose, jasmine, vetiver, kewda</li> <li>• Traditional methods of extraction: Hydro distillation (Deg Bhapka system) and Steam distillation in Kannauj (Attar capital of India)</li> <li>• Modern Distillation Methods in Fragrance: Extraction Supercritical Fluid Extraction (SFE), Molecular Distillation (Short-Path Distillation) and Microwave-Assisted Extraction (MAE)</li> <li>• Development of attars and natural perfumes</li> </ul>	1	15

**Books Suggested:**

1. Vedic Metallurgy: Unveiling The Ancient Technology Kindle Edition  
By Ashutosh Dandekar , Akhilesh Joshi , Indraja Dandekar
2. Ancient India Metallurgy (Theory and Practice), By Ashoka K. Mishra
3. Life And Experiences Of A Bengali Chemist (2 Volumes) , By Prafulla Chandra Ray
4. The Fragrance Of India, By Doris Potter
5. Perfumery And Kindred Arts by R. S. Cristiani
6. "Practical Raman Spectroscopy: An Introduction" by Peter Vandenabeele,
7. "Introductory Raman Spectroscopy" by John R. Ferraro, Kazuo Nakamoto, and Chris W. Brown,
8. "Modern Raman Spectroscopy: A Practical Approach" by Ewen Smith and Geoff Dent.

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Course Name: B. Sc. Chemistry Semester: V

PROGRAM CODE: SCIUG102  
COURSE CODE: SC23PMJDSCCHE501B

Type of course: Practical Major Discipline Specific Course

Name of course: Practical's for Fundamentals of Chemistry III ( Major-3)

Total Marks: 100

Effective from June 2025 Under NEP 2020

## Group-A

<b>Total Credits:</b> <b>02</b>	Teaching Hours per Week: 04	Practical	External 25 Marks
	Teaching Hours per Semester: 60		Internal 25 Marks
	Minimum No. of. Practical to be Performed:12(Twelve)		

## Group-B

<b>Total Credits:</b> <b>02</b>	Teaching Hours per Week: 04	Practical	External 25 Marks
	Teaching Hours per Semester: 60		Internal 25 Marks
	Minimum No. of. Practical to be Performed:12(Twelve)		

### Course Objectives:

1. To Identify the organic components.
2. Preparation of solutions and their standardization.

### Course Outcome:

1. Students will gain a comprehensive knowledge and skills in standardizations, hands on instruments, Separation techniques and Preparation of solutions for carrying out reactions.

Type	Topic
1	Organic Practical (Any 08 Binary Mixtures)
2	Inorganic Practical (Any 4 Alloy & Any 4 Preparation )
3	Physical Practical (Any 08)

Group	Practicals	Practicals	Marks
A	Organic -08	Inorganic-04(Alloy)	25
B	Physical-08	Inorganic-04(Preparation)	25

**Note:** Certified Practical Journal is Compulsory for Practical Examination

This syllabus is to be completed by assigning four laboratory session per week, each of three periods. The number of students in the laboratory batch should not exceed ten(10) the medium of instruction will be English in laboratory course.

**Batch distribution (for maximum 30 students and 3 Examiners)  
[Maximum 10 students per each Examiner]**

Sr. No	Topic	Credit	Hours
Group-A	<p><b>Organic Qualitative Analysis:</b></p> <p><b>(i) Qualitative Analysis (Minimum 08)</b>                      Analysis of an organic mixture containing two components using water, NaHCO<sub>3</sub>, NaOH, HCl as a solvent for Separation /or using distillation process for separation and identification with the suitable chemical tests and preparation of suitable derivatives.  <b>Soluble Components:-</b> Oxalic Acid, Succinic Acid, Resorcinol, Urea, Thiourea                      (Give water soluble compounds only in solid + solid mixture and water soluble components should not give with same natured compound's mixture)                      Separation of two components from Mixture Such as....                      Solid-Solid -----Mixture (Both are Water insoluble Or One is water soluble)                      Solid- Liquid----- Mixture (Solid is water insoluble)                      Liquid-Liquid-----Mixture                      [Liquid component must be neutral in nature]</p>	1	30
	<p><b>(ii) Gravimetric Estimation for Single Constituents. (Any 4 (Four))</b>                      1) Gravimetric Estimation of Ni as Ni(DMG)<sub>2</sub>                      2) Gravimetric Estimation of Zn as Zinc Ammonium Phosphate                      3) Gravimetric Estimation of Al as Al<sub>2</sub>O<sub>3</sub>                      4) Gravimetric Estimation of Fe as Fe<sub>2</sub>O<sub>3</sub>                      5) Gravimetric Estimation of Ba as BaSO<sub>4</sub>                      6) Gravimetric Estimation of SO<sub>4</sub> as BaSO<sub>4</sub></p>	1	30
Group-B	<p><b>(i) Inorganic Preparation. (Any 4 (Four))</b>                      1) Preparation of Hexathiourea-pyridine Nitrate                      2) Preparation of Tetraamminecopper Sulphate                      3) Preparation of CuCl                      4) Preparation of Potassium Tri-Oxalato Chromate                      5) Preparation of Mohr's salt [FeSO<sub>4</sub>.(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>.6H<sub>2</sub>O]                      6) Preparation of Potash Alum. [K<sub>2</sub>SO<sub>4</sub>.Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.18H<sub>2</sub>O]</p>	1	30
	<p><b>(ii) Physical Chemistry practical (Any Eight (08))</b>  <b>[A] Instruments:</b>                      1. To Determine the Normality and Amount of each acid in given mixture of XN (HCl + CH<sub>3</sub>COOH) by PH metric titration using 0.09 N to 0.12 N NaOH.                      2. To Determine the Normality and Amount of each acid in given mixture of XN (HCl + CH<sub>3</sub>COOH) by Potentiometry titration using 0.09 N to 0.12 N NaOH.</p>	1	30

	<p>3. To Determine the Normality and Amount of each acid in given mixture of XN (HCl + CH<sub>3</sub>COOH) by Conductometry titration using 0.09 N to 0.12 N NaOH.</p> <p>4. To Determine the Solubility &amp; Solubility product of Sparingly Soluble salt PbSO<sub>4</sub> by Conductometric.</p> <p>5. Determine the Concentration of Mn<sup>+2</sup> ions and Cr<sup>+3</sup> ions in in a given mixture of (K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> + KMnO<sub>4</sub>).</p> <p>6. To Determine the Amount of Nickel in the given unknown solution by Colorimetric method.</p> <p><b>[B] Chemical Kinetics &amp; viscosity:</b></p> <p>7. To determine the order of reaction between K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> and KI.</p> <p>8. To determine the order of reaction between H<sub>2</sub>O<sub>2</sub> and HI.</p> <p>9. To determine the molecular weight of high polymer by viscosity method.</p>		
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**Reference Books:**

- 1) Advanced Practical Physical Chemistry, PB : J B Yadav
- 2) Organic practical mann & saunders
- 3) Vogel's Textbook of Quantitative Chemical Analysis
- 4) Elementary practical organic chemistry Arthur I Vogel
- 5) Practical organic chemistry pragati prakhan
- 6) A Textbook of Qualitative Chemical Analysis (Arthur I Vogel)

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Course Name: B. Sc. Chemistry Semester: V

PROGRAM CODE: SCIUG102  
COURSE CODE: SC23MIDSCCHE502

Type of course: Minor Discipline Specific Course

Name of course: Simplified of Chemistry II (Minor-1)

Total Marks: 100

Effective from June 2025 Under NEP 2020

<b>Total Credits:</b> <b>04</b>	Teaching Hours per Week: 04	Theory	External 50 Marks
	Teaching Hours per Semester: 60		Internal 50 Marks

### Course Objectives:

1. To understand the core concepts of Corrosion.
2. To understand Organic chemistry concepts of Carbohydrate.
3. To know about the Colloidal State and preparation and application of Colloidal materials.
4. To know about the Colloidal State and preparation and application of Colloidal materials.

### Course Outcome:

1. Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in, inorganic and physical chemistry.
2. Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behaviors in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and Medicine.
3. Students will be able to design and carry out scientific experiments as well as accurately record and analyse the results of such experiments.
4. Students will be skilled in problem solving approach, critical thinking and analytical reasoning as applied to scientific problems.
5. To know about the Volumetric titrations and calculations for estimation.

Unit	Topic	Credit	Hours
1	Water Technology <ul style="list-style-type: none"><li>• Introduction,</li><li>• sources of water,</li><li>• types of impurities in water, Physical impurities and Chemical impurities and Biological impurities</li><li>• hardness of water, temporary and permanent hardness, units of hardness, disadvantages of hard water In domestic use and In Industrial use. Estimation of hardness by EDTA method.</li><li>• Determination of Alkalinity and Acidity of a water sample. Determination of the Chloride content in water</li><li>• Treatment of water for domestic purpose.</li><li>• Removal of suspended impurities.</li><li>• Boiler troubles</li><li>• Estimation of dissolved oxygen.</li></ul>	1	15

	<ul style="list-style-type: none"> <li>Softening methods: Internal treatment, external treatment; zeolite process, ion exchange process, desalination of brackish water - reverse osmosis.</li> </ul>		
2	<b>Carbohydrate</b> <ul style="list-style-type: none"> <li>Carbohydrate Introduction of Disaccharides</li> <li>Structure determination of Sucrose</li> <li>Structure determination of Maltose</li> <li>Structure determination of Lactose</li> <li>Structure determination of Cellobiose</li> </ul>	1	15
3A	<b>Surface Chemistry -Adsorption</b> <ul style="list-style-type: none"> <li>Adsorption by solids,</li> <li>Chemisorption</li> <li>applications of adsorption</li> <li>Adsorption of gases by solids</li> <li>Factors influencing adsorption</li> <li>The Freundlich adsorption isotherm</li> <li>The Langmuir theory of adsorption</li> <li>The BET theory of multilayer adsorption</li> <li>Derivation of BET equation.</li> <li>Types of adsorption isotherms.</li> <li>Adsorption from solution - The Gibbs adsorption isotherm.</li> </ul>	1	15
3B	<b>The Nernst Distribution Law</b> Nernst Distribution Law Thermodynamic derivation of Nernst Distribution Law Association of the solute in one of the solvents Dissociation of the solute in one of the solvents Solute enters into chemical combination with one of the solvents Applications of the Nernst distribution law Study of complex ions Solvent extraction		
4	<b>Electro analytical techniques</b> <b>Potentiometry</b> <ul style="list-style-type: none"> <li>The scope of potentiometric titrations, Precipitation and neutralization titrations, Graphical method including Gran's plot for selecting end point, Differential titration, Dead stop titration, Ion selective Electrode, various types of Ion selective Electrodes and applications of Ion selective electrodes.</li> </ul> <b>pH metry</b> <ul style="list-style-type: none"> <li>Introduction pH metry- types of indicator electrodes and reference electrodes.</li> </ul> <b>Conductometry</b> <ul style="list-style-type: none"> <li>Introduction, Principle, determination of end point using Conductometric titrations.</li> <li>Strong acid against strong base</li> <li>Weak acid against strong base</li> <li>Strong acid against weak base</li> <li>Precipitation titrations (AgNO<sub>3</sub> against KCl)</li> <li>Application of Conductometric titrations.</li> <li>Advantages and disadvantages of Conductometric titrations.</li> </ul>	1	15

**Books Suggested (Inorganic Chemistry):**

1. Valence and molecular structure by Cartmell and Flower.
2. Text book of Inorganic Chemistry by Durent and Durent.
3. Inorganic Chemistry by S. Chand.
4. Advance Inorganic Chemistry Vol-II SatyaPrakash (S.Chand)
5. Concise Inorganic chemistry by J.D.Lee.
6. Metallic Corrosion By M.N. Desai
7. Advance Inorganic Chemistry J.E. Huhee.

**(Organic Chemistry):**

1. Analytical Chemistry: Gary D. Christian, 6th Edition; Wiley & Sons
2. Fundamentals of Analytical Chemistry: D. A. Skoog, D. M. West and F. J. Holler, 9<sup>th</sup> Edition, Cengage Learning.
3. Instrumental Methods of analysis: (CBS) H.H. Willard, L.L. Mirrit, J.A. Dean
4. Instrumental Methods of Inorganic Analysis: A.I. Vogel, ELBS
5. The principals of ion-selective electrodes and membrane transport: W.E.Morf  
Principles of Instrumental Analysis: Douglas A. Skoog., F. James Holler, Stanley R. Crouch, Cengage Learning; 6<sup>th</sup> Edition.

**(Physical Chemistry):**

1. Advance Physical Chemistry by Gurdeepraj.
2. Physical Chemistry (Question and Answer) by R. N. Madan, G.D. Tuli, S. Chand.
3. Principal of Physical Chemistry by Puri, Sharma, Pathania.
4. Chemical Thermodynamics by R.P. Rastogi and R.R. Mishra.
5. Physical chemistry by atkins.
6. Essentials of Physical Chemistry by B. S. Bahal, ArunBahal, G.D.Tuli,
7. Physical Chemistry by P.W. Atkins, 5<sup>th</sup>edn, Oxford 1994 7<sup>th</sup> edn-2002.
8. Physical Chemistry by R.A. Albern and R.J.Silby, John Wiley 1995.
9. Physical Chemistry by G.H. Barrow, 5<sup>th</sup>edn, Mac Graw Hill, 1988, 6<sup>th</sup>edn, 1996.
10. Physical Chemistry by W.J. Moore, 4<sup>th</sup>edn, Orient Longmans 1969.

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Course Name: B. Sc. Chemistry

Semester: V

PROGRAM CODE: SCIUG102

COURSE CODE: SC23PMIDSCCHE502A

Type of course: Practical Minor Discipline Specific Course

Name of course: Practical's for simplified chemistry III (Minor-2)

Total Marks: 100

Effective from June 2025 Under NEP 2020

## Group-A

<b>Total Credits:</b> <b>02</b>	Teaching Hours per Week: 04	Practical's	External 25 Marks
	Teaching Hours per Semester: 60		Internal 25 Marks
	Minimum No. of. Practical to be Performed: 09 (Nine)		

## Group-B

<b>Total Credits:</b> <b>02</b>	Teaching Hours per Week: 04	Practical's	External 25 Marks
	Teaching Hours per Semester: 60		Internal 25 Marks
	Minimum No. of. Practical to be Performed:09 (Nine)		

### Course Objectives:

1. To identify the organic, inorganic components.
2. Preparation of solutions and their standardization.

### Course Outcome:

1. Students will gain a comprehensive knowledge and skills in standardization, hands on instruments and preparation of solutions for carrying out reactions.

Type	Topic
1	Inorganic Practicals(Any 5)
2	Organic Practicals (Any 04 Preparation & Any 03 Estimation)
3	Physical Practicals (Any 06)

Group	Practicals	Practicals	Marks
A	Inorganic-5	Organic -any 04(Preparation)	25
B	Physical-6	Organic - 03(Estimation)	25

Sr. No	Topic	Credit	Hours
Group-A	<b>(1) Inorganic Quantitative analysis: (Minimum 05)</b> <b>Water Analysis: (Any 04)</b> <ol style="list-style-type: none"> <li>Determine amount of Carbonate, Bicarbonate, and pH</li> <li>Determine amount of Calcium, Magnesium and Conductance</li> <li>Determine amount of Sulphate, TDS and Conductance</li> <li>Determine amount of Chloride, TDS and pH</li> <li>Determine amount of Total Hardness of water sample.</li> </ol>	1	30
	<b>Colorimetry Estimation (Any 02)</b> <ol style="list-style-type: none"> <li>Determine amount of Ni from Unknown Solution.</li> <li>Determine amount of Cu from Unknown Solution.</li> <li>Determine amount of Fe from Unknown Solution.</li> </ol> <b>Paper Chromatography (Any 01)</b> <ol style="list-style-type: none"> <li>Determine Rf value of Cu, Pb and Cd metals solution.</li> <li>Determine Rf value of Co, Ni, Zn metals solutions</li> </ol> <b>(2) Organic Preparations (Minimum 04)</b> <ol style="list-style-type: none"> <li>Preparation of Schiff base (Benzylideneaniline from Aniline &amp; Benzaldehyde) (Arthur I Vogel)</li> <li>Preparation of Dibenzal acetone from Benzaldehyde and Acetone (Arthur I Vogel)</li> <li>Preparation of Aniline from Acetanilide. (Green Chemistry method)</li> <li>Preparation of Acetanilide from Aniline. 5) Preparation of m-Nitro aniline from m-Dinitrobenzene.</li> <li>Preparation of Aspirin from Salicylic acid</li> </ol>	1	30
Group-B	<b>(1) Organic Estimation:</b> <b>Estimation of functional groups (Any 03)</b> <ol style="list-style-type: none"> <li>Estimation of Amide</li> <li>Estimation of Ascorbic acid</li> <li>Estimation of Aspirin</li> <li>Estimation of Phenol</li> </ol>	1	30
	<b>(2) Physical Practical: (Any 06)</b> <ol style="list-style-type: none"> <li>To study the adsorption of animal charcoal on acetic acid with different volume of acid.</li> <li>To study the adsorption of animal charcoal on acetic acid with different contact time.</li> <li>To study the distribution of benzoic acid between water and benzene and determine the partition coefficient.</li> <li>To Determine the Normality and Amount of given solution XN KI by Potentiometry titration using 0.1 N KMnO<sub>4</sub>.</li> </ol>	1	30

	<ol style="list-style-type: none"> <li>5. To Determine the Normality, amount and slandered oxidation potential of <math>\text{Fe}^{+2}/\text{Fe}^{+3}</math> by potentiometric titration using 0.1N <math>\text{K}_2\text{Cr}_2\text{O}_7</math>.</li> <li>6. To Determine the Normality and Amount of <math>\text{NH}_4\text{OH}</math> by PH metric titration using 0.1 N HCl.</li> <li>7. To Determine the Normality and Amount of each base in given mixture of XN <math>\text{NaOH}+\text{NH}_4\text{OH}</math> by PH metric titration using 0.1 N HCl.</li> <li>8. To Determine the Normality and Amount of XN <math>\text{NH}_4\text{OH}</math> by conductometric titration using 0.1 N HCl.</li> <li>9. To Determine the Normality and Amount of each base in given mixture of XN <math>\text{NaOH}+\text{NH}_4\text{OH}</math> by conductometric titration using 0.1 N HCl.</li> </ol>		
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### Reference Books:

- 1) Advanced Practical Physical Chemistry Practical, by J B Yadav
- 2) Organic practical Mann & Saunders
- 3) Vogel's Textbook of Quantitative Chemical Analysis
- 4) Elementary practical Organic Chemistry Arthur I Vogel
- 5) Practical Organic Chemistry Pragati prakhan
- 6) A Textbook of Qualitative Chemical Analysis (Arthur I Vogel)
- 7) Comprehensive Practical Organic Chemistry (Preparation & Quantitative Analysis)  
V.K. Ahluwalia, Renu Aggarwal

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Course Name: B. Sc. Chemistry Semester: V

PROGRAM CODE: SCIUG102  
COURSE CODE: SC23SECHE506

Type of course: Skill Enhancement Course SEC

Name of course: Term Symbol and  $d^1-d^9$  Spectra (SEC-1)

Total Marks: 50

Effective from June 2025 Under NEP 2020

<b>Total Credits:</b> <b>02</b>	Teaching Hours per Week: 02	Theory	External 25 Marks
	Teaching Hours per Semester: 30		Internal 25 Marks

### Course Objectives:

1. To understand the basic concepts of Term symbols.
2. To study about the Microstates for d-d transitions elements & basic rules for Oh and Td complexes.

### Course Outcome:

1. Students will have a firm foundation in the fundamentals and application of current Chemical and scientific theories including those in, inorganic chemistry.
2. Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behaviors in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and Medicine.
3. Students will be able to design and carry out scientific experiments as well as accurately record and analyse the results of such experiments.
4. Students will be skilled in problem solving approach, critical thinking and analytical reasoning as applied to scientific problems.
5. To know about the term symbol. This is useful in CSIR NET & GSET Examination.

Unit	Topic	Credit	Hours
1	<b>Term Symbol</b> Electronic Spectra -Emission and Absorption Spectra. Electron Transitions L-S ,J-J coupling Determination of spectroscopic state Term symbols for $d^2$ and $p^2$ configuration by pigeon hole diagram.	1	15
2	<b><math>d^1-d^9</math> Spectra</b> Determination of Ground state terms by Hund's rules. Microstates Russel-Saunders states in Oh and Td crystal fields. Selection rules for d-d transitions. Orgel energy level diagrams of Oh and Td complexes	1	15

### Reference Book: (Inorganic chemistry)

1. Advance inorganic chemistry by Cotton & Wilkinson
2. Chemical application of group theory by F.A. Cotton
3. Application of group theory to chemistry by Bhattacharya

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Course Name: B. Sc. Chemistry Semester: V

PROGRAM CODE: SCIUG102

COURSE CODE: SC23SECICHE506A

Type of course: Skill Enhancement course SEC

Name of course: Polymer Chemistry (SEC-2)

Total Marks: 50

Effective from June 2025 Under NEP 2020

<b>Total Credits:</b> 02	Teaching Hours per Week: 02	Theory	External 25 Marks
	Teaching Hours per Semester: 30		Internal 25 Marks

### Course Objectives:

1. To understand the basic concepts of Polymer
2. To study about the preparation of various type of polymer & Calculate Molecular weight methods of Polymers.

### Course Outcome:

1. Students will have a firm foundation in the fundamentals and application of current Chemical and scientific theories including those in, physical chemistry.
2. Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and Medicine.
3. Students will be able to design and carry out scientific experiments as well as accurately record and analyse the results of such experiments.
4. Students will be skilled in problem solving approach, critical thinking and analytical reasoning as applied to scientific problems.
5. To know about the polymer. This is useful in CSIR NET & GSET Examination.

Unit	Topic	Credit	Hours
1	<b>Polymers – 1</b> Introduction Classification and Nomenclature of polymers Isomerism of polymers Chain growth polymerization - Introduction Mechanism of free-radical, Cationic and Anionic polymerization Mechanism and Kinetics polycondensation	1	15
2	<b>Polymers - 2</b> Polymerization Techniques Concept of Averages - Number average molecular weight - Weight average molecular weight - Viscosity average molecular weight Molecular weight and Degree of polymerization. Methods for determination of molecular weight Membrane Osmometry, Viscometry and Light Scattering	1	15

**Reference Books:**

1. Principles of polymers Science by P. Bahadur and N.V. Sastry.(Second Edition )
2. Polymer Science by V.R. Gowariker, N.V. Vashwanathan and Jaydev Shreedhar.

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

Course Name: B. Sc. Chemistry Semester: V

PROGRAM CODE: SCIUG102

COURSE CODE: SC23SECICHE506B

Type of course: Skill Enhancement course SEC

Name of course: Medicinal Chemistry (SEC-3)

Total Marks: 50

Effective from June 2025 Under NEP 2020

<b>Total Credits:</b> 02	Teaching Hours per Week: 02	Theory	External 25 Marks
	Teaching Hours per Semester: 30		Internal 25 Marks

### Course Objectives:

1. To understand the core concepts of Nomenclature of drug, classification of drug and an important terminology of Medicinal Chemistry
2. To study about the drug design, drug receptor and drug administration.

### Course Outcome:

1. Students will have a firm foundation in the fundamentals and application of current Chemical and scientific theories including those in, medicinal chemistry.
2. Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and Medicine.
3. Students will be able to design and carry out scientific experiments as well as accurately record and analyse the results of such experiments.
4. Students will be skilled in problem solving approach, critical thinking and analytical reasoning as applied to scientific problems.
5. To know about the medicinal chemistry. This is useful in CSIR NET & GSET Examination.

Unit	Topic	Credit	Hours
1	<b>Medicinal Chemistry-1</b> Introduction of Medicinal Chemistry History of Medicinal Chemistry Some important terminology of Medicinal Chemistry Nomenclature of Drug Basic classification of Drug Difference between Drug and Medicine	1	15
2	<b>Medicinal Chemistry-2</b> Introduction Pharmacopeias Basic concept of Drug Design Basic concept of Drug & Receptor Interaction Routes of Drug Administration Adverse effect of drug & minimization of adverse effect	1	15

**Reference Book:**

1. Adhunik Sanshlesit Ausodho nu Rasayan by Dr. Anamik Shah
2. Sanshlesit Ausodho nu Rasayan by Dr. J. P. Trivedi & Dr. K. A. Thakar
3. Medicinal Chemistry (sixth edition) Ashutoshkar New Age international publishers
4. Medicinal Chemistry Alkagupta A pragatiprakashan
5. Organic Pharmaceutical Chemistry G R Chatwal Himalaya publication house.
6. A Text book of Medicinal chemistry V Algaswamy
7. Medicinal Chemistry Vol-1Kandareddy Girija A Pragatiprakashan

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

PATAN - 384 265

NAAC "B" (2.21) State University



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## FACULTY OF SCIENCE

### B.Sc. (Honours) BOTANY

(With Research/without Research)

SCIUG103

### Semesters: V and VI

(with multiple entry & exit option)

## DEGREE SYLLABUS

Curriculum as per UGC Guideline

Framed according to National Education Policy (NEP) - 2020

With effect from June - 2025 (and thereafter)

*Handwritten signature/initials*

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY**

**PATAN - 384 265**

**NAAC "B" (2.21) State University**



## **B.Sc. (Honours) Botany Programme**

**(With Research/without Research)**

**SCIUG103**

**NEP-2020**

**With effect from June - 2025 (and thereafter)**

**FACULTY OF SCIENCE**

**Subject: BOTANY**

**B. Sc. Semesters: V**

**Total Pages: 01 to 48**

**Submitted on**

**Date: 9<sup>th</sup> April 2025(Wednesday)**

*Handwritten signature*

# HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC "B" (2.21) State University

PATAN - 384 265



## BOARD OF STUDIES (BOS) IN BOTANY

**References:** No. AK/AxS/2125/2020 Dt. 28/08/2020.  
No. AK/AxS/2315/2020 Dt. 04/09/2020.  
No. AK/AxS/3006/2020 Dt. 01/10/2020.  
No./KCG/NEP/2024-25/1368 Dt. 29/09/2023.

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*N. Patel*

**B.Sc. Semester V Courses :: BOTANY ::**

SEMESTER: FIFTH	TYPES OF THE COURSES	PAPER NO.	PROGRAMME CODE	TITLE OF THE COURSE	CREDITS (T=TEACHING P=PRACTICAL)
	MAJOR THEORY (credits: 4)	VII	SCIUG103	ECOLOGY AND PLANT SYSTEMATICS (SC23MJDSCBOT501)	4T
	IKS MAJOR THEORY (credits: 4)	VIII		ANCIENT INDIAN BOTANY: A LIVING TRADITION (SC23MJDSCBOT501AIKS)	4T
	MAJOR PRACTICAL (credits: 4)	VII		ECOLOGY AND PLANT SYSTEMATICS (SC23PMJDSCBOT501)	4P
	MINOR THEORY (credits: 4)	IV		PLANT MORPHOLOGY, INSTRUMENTATION AND METHODOLOGY (SC23MiDSCBOT502)	4T
	MINOR PRACTICAL (credits: 4)	IV		PLANT MORPHOLOGY, INSTRUMENTATION AND METHODOLOGY (SC23PMiDSCBOT502)	4P
	SKILL ENHANCEMENT THEORY (credits: 2)	V		NURSERY AND GARDENING (SC23SECBOT506)	2T

*Noted*

**B.Sc. Semester VI Courses :: BOTANY ::**

SEMESTER: SIXTH	TYPES OF THE COURSES	PAPER NO.	PROGRAMME CODE	TITLE (COURSE CODE)	CREDITS (T=TEACHING P=PRACTICAL)
	MAJOR THEORY (credits: 4+4)	IX	SCIUG103	PLANT BIOTECHNOLOGY AND REPRODUCTIVE BIOLOGY (SC23MJDSCBOT601)	4T
		X		PLANT METABOLISM AND PHYSIOLOGY (SC23MJDSCBOT601A)	4T
	MAJOR PRACTICAL (GROUP A & B) (credits: 2+2)	IX		PLANT BIOTECHNOLOGY AND REPRODUCTIVE BIOLOGY (SC23PMJDSCBOT601)	2P
		X		PLANT METABOLISM AND PHYSIOLOGY (SC23PMJDSCBOT601A)	2P
	MINOR THEORY (credits: 2)	V		PLANT METABOLISM (SC23MiDSCBOT602)	2T
	MINOR PRACTICAL (credits: 2)	V		PLANT METABOLISM (SC23PMiDSCBOT602)	2P
	ABILITY ENHANCEMENT THEORY (credits: 2)	IV		FROM POOL OF COURSE (Language) (SC23AECBOT604)	2T
	INTERNSHIP (credits: 4)	I		INTERNSHIP (SC23INTBOT607)	4

*N. S. Patel*

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**SEMESTER: V**  
**SUMMARY OF THE PROGRAMME**

<b>SYLLABUS DURATION</b>	<b>SEMESTER PATTERN I.E., SIX MONTHS (single major)</b>
<b>THEORY</b>	
<b>No. of Discipline Specific Major Core Courses (MJDCS) &amp; IKS Major Core Courses (IKSDCS)</b>	<b>01/Semester</b>
<i>Credits per Discipline Specific Major Core Course (MJDCS) &amp; IKS Major Core Courses (IKSDCS)</i>	<b>04</b>
<i>Total credits for Discipline Core Major Course (MJDCS) &amp; IKS Major Core Courses (IKSDCS)</i>	<b>04/Semester</b>
<i>Theory lectures per Discipline Major Core Course (MJDCS) &amp; IKS Major Core Courses (IKSDCS)</i>	<b>04/week</b>
<b>No. of Minor Disciplinary Courses (MiDCS)</b>	<b>01/Semester</b>
<b>No. of Skill Enhancement Courses (SEC)</b>	<b>01/Semester</b>
<i>Credits per Minor Disciplinary Courses (MiDC) &amp; Credits per Skill Enhancement Courses (SEC)</i>	<b>04 02</b>
<i>Total credits for Minor Disciplinary Courses (MiDCS) &amp; Total credits for Skill Enhancement Courses (SEC)</i>	<b>04/Semester 02/Semester</b>
<i>Theory lectures per Minor Disciplinary Courses (MiDCS) &amp; Theory lectures per Skill Enhancement Courses (SEC)</i>	<b>04/week 02/week</b>
<b>PRACTICAL</b>	
<b>No. of Practical courses per Discipline Specific Major Core Courses (MJDCS)(GROUP A+GROUP B)</b>	<b>01 (in each semester)</b>
Credits per Practical course	<b>04</b>
Total Credits of Practical course	<b>04/Semester</b>
Total Practical lectures	<b>08/week/ batch</b>
No. of Practical course (in Uni. Exam.)	<b>01/Semester</b>
<b>No. of Practical courses per Minor Disciplinary Courses (MiDCS)</b>	<b>01 (in each semester)</b>
Credits per Practical course	<b>04</b>
Total Credits of Practical course	<b>04/Semester</b>
Total Practical lectures	<b>08/week/ batch</b>
No. of Practical course (in Uni. Exam.)	<b>01/Semester</b>
<b>EVALUATION</b>	
<b>Examination (including Preparation - week)</b>	<b>5</b>
No. of Days per week	<b>6</b>
Week (days) available for Teaching	<b>15 (90)</b>
Duration of each lecture (minutes)	<b>55</b>
No. of students/batch	<i>As per approval of AC and Exam. Unit</i>

*As per approval of AC and Exam. Unit*

**Framed according to National Education Policy (NEP) - 2020**

**Under Choice Based Credit System-Semester-Grading System pattern**

**UG (B. Sc.) Programme in Botany**

**Semester-V and VI**

**PREAMBLE:**

Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. The upgradation of undergraduate programmes in the line of NEP, 2020 will play an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. A holistic and multidisciplinary education would aim to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess. Such changes will further result in learning outcome based curriculum in order to maximize the benefits of the newly designed curriculum. The learning outcome based curriculum in general and in Botany in particular will definitely help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. It is pertinent to mention here that the purpose of education is to develop an integrated personality of the individual and the educational system provides all knowledge and skills to the learner for this.

The template as developed has the provision of ensuring the integrated personality of the students in terms of providing opportunity for exposure to the students towards core courses, discipline specific courses, generic elective courses, ability enhancement courses and skill enhancement courses with special focus on technical, communication and subject specific skills through practical and other innovative transactional modes to develop their employability skills. The template of learning outcome based framework has categorically mentioned very well defined expected outcomes for the programme like core competency, communication skills, critical thinking, affective skills, problem-solving, analytical, reasoning, research-skills, teamwork, digital literacy, moral and ethical awareness, leadership readiness and so on along with very specific learning course outcomes at the starting of each course. Therefore, this template on Learning Outcomes based Curriculum Framework (LOCF) for B.Sc. with Botany/ Botany Honours under the University will be in the line of NEP, 2020 – more

flexible, multi-disciplinary, holistic and will definitely be a landmark in the field of outcome based curriculum construction.

Today plant science is a fusion of the traditional components with the modern aspects of biochemistry, molecular biology and biotechnology. Over the years, plant science (Botany) has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. With global recognition of the need for conservation, field plant biologists have contributed significantly in assessing plant diversity. Taxonomists have explored newer dimensions for the classification of plants. New insights have been gained in functional and structural aspects of plant development by utilizing novel tools and techniques for botanical research. Challenging areas of teaching and research have emerged in ecology and reproductive biology. Concern for ever increasing pollution and climate change is at its highest than ever before. Keeping these advancements in view, a revision of the curriculum at the undergraduate level is perfectly timed. From the beginning of the session, the Botany students across Indian Universities shall have the benefit of a balanced, carefully-crafted course structure taking care of different aspects of plant science, namely plant diversity, physiology, biochemistry, molecular biology, reproduction, anatomy, taxonomy, ecology, economic botany and the impact of environment on the growth and development of plants. All these aspects have been given due weightage over the six semesters. It is essential for the undergraduate students to acquaint themselves with various tools and techniques for exploring the world of plants up to the sub- cellular level. A paper on this aspect is proposed to provide such an opportunity to the students before they engage themselves with the learning of modern tools and techniques in plant science. Keeping the employment entrepreneurship in mind, applied courses have also been introduced. These courses shall provide the botany students hands on experience and professional inputs. On the whole, the curriculum is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in Botany with the new curriculum will be a complete botanist at Honours level.

#### **NEP-2020:**

NEP, 2020 aims at a new and forward-looking Vision for India's Higher Education System. This curriculum framework for the bachelor-level program in Botany is developed keeping in view of the student centric learning pedagogy, which is entirely multidisciplinary outcome-oriented and curiosity-driven. To avoid rote -learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework

focuses on pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works. The platform aims at equipping the graduates with necessary skills for botany-related careers, careers with general graduate-level aptitude and for higher education in Botany and allied subjects. Augmented in this framework are graduate attributes including critical thinking, basic psychology, scientific reasoning, moral ethical reasoning and so on, qualification descriptors that are specific outcomes pertinent to the discipline of botany, learning outcomes for the two programmes these frameworks have been developed, learning outcomes for individual courses, pedagogical methods and assessment methods. Looking at all these new concepts and progress, the detailed syllabus of B.Sc. (H) – Botany sem. III & IV has been designed and decided to be implemented from the academic session from June 2024-25.

### **APPROACH TO CURRICULUM PLANNING:**

While designing these frameworks, emphasis is given on the objectively measurable teaching-learning outcomes to ensure employability of the graduates. In line with recent trends in education section, these frameworks foster implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e-learning platforms. In addition, the framework pragmatic to the core; it is designed such a way to enable the learners implementing the concepts to address the real world problems. A major emphasis of these frameworks is that the curriculum focuses on issues pertinent to India and also of the west; for example, biodiversity and conservation of endemic and threatened species that are found in India, Indian climatological variables, Indian biodiversity and so on. Above all, these frameworks are holistic and aim to mould responsible Indian citizen who have adequate skills in reflective thinking, rational skepticism, scientific temper, digital literacy and so on such that they are equipped to fight immediate social issues apropos to Indian milieu, including corruption and inequity.

The fundamental premise underlying the learning outcomes-based approach to curriculum planning and development is that higher education qualifications such as a Bachelor's Degree (Hons) programmes are earned and awarded on the basis of (a) demonstrated achievement of outcomes (expressed in terms of knowledge, understanding, skills, attitudes and values) and (b) academic standards expected of graduates of a programme of study.

Learning outcomes-based frameworks in any subject must specify what graduates completing a particular programme of study are (a) expected to know, (b) understand and (c) be able to do at the end of their programme of study. To this extent, LOCF in Botany is committed to

allowing for flexibility and innovation in (i) programme design and syllabi development by higher education institutions (HEIs), (ii) teaching-learning process, (iii) assessment of student learning levels, and (iv) periodic programme review within institutional parameters as well as LOCF guidelines, (v) generating framework(s) of agreed expected graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes. HEIs, on their turn, shall address to the situations of their students by identifying relevant and common outcomes and by developing such outcomes that not only match the specific needs of the students but also expands their outlook and values.

***NATURE AND EXTENT OF BACHELOR'S DEGREE PROGRAMME IN BOTANY (HONOURS):***

A bachelor's degree in Botany with Research or without Research is a 4 year degree course which is divided into 8 semesters.

Sl. No.	NCRF Credit Levels	Type of Award	Stage of Exit	Mandatory Credits to be secured for the Award
1	4.5	Certificate in the Discipline	After successful completion of 1st Year	44
2	5.0	Diploma in the Discipline	After successful completion of 1st and 2nd Years	88
3	5.5	B.Sc. Degree in Botany	After successful completion of 1st, 2nd and 3rd Years	132
4	6.0	B.Sc. (Honours with Research)/ (without Research) in Botany	After successful completion of 1st, 2nd, 3rd and 4th Years	176

A student pursuing 4 years undergraduate programme with research in a specific discipline shall be awarded an appropriate Degree in that discipline on completion of 8th Semester if he/she secures 176 Credits. Similarly, for certificate, diploma and degree, a student needs to fulfil the associated credits. An illustration of credits requirements in relation to the type of award is illustrated as above.

Bachelor's Degree (Honours) is a well-recognized, structured, and specialized graduate level qualification in tertiary, collegiate education. The contents of this degree are determined in terms of knowledge, understanding, qualification, skills, and values that a student intends to acquire to look for professional avenues or move to higher education at the postgraduate level.

Bachelor's Degree (Honours) programmes attract entrants from the secondary level or equivalent, often with subject knowledge that may or may not be directly relevant to the field

of study/profession. Thus, B.Sc. (Honours) Course in Botany aims to equip students to qualify for joining a profession or to provide development opportunities in particular employment settings. Graduates are enabled to enter a variety of jobs or to continue academic study at a higher level.

#### **AIMS:**

1. To transform curriculum into outcome-oriented scenario.
2. To develop the curriculum for fostering discovery-learning.
3. To equip the students in solving the practical problems pertinent to India.
4. To adopt recent pedagogical trends in education including e-learning, flipped class, hybrid learning and MOOCs (Massive Open Online Courses).
5. To mold responsible citizen for nation-building and transforming the country towards the future.
6. To provide an environment that ensures cognitive development of students in a holistic manner. A dialogue about plants and its significance is fostered in this framework, rather than didactic monologues on mere theoretical aspects.
7. To provide the latest subject matter, both theoretical as well as practical, such a way to foster their core competency and discovery learning. A Botany graduate as envisioned in this framework would be sufficiently competent in the field to undertake further discipline-specific studies, as well as to begin domain-related employment.
8. To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.
9. To enable the graduate prepare for national as well as international competitive examinations, especially UGC-CSIR NET and UPSC Civil Services Examination.

#### **PROGRAMME LEARNING OUTCOMES:**

Learning Outcome Curriculum Framework (LOCF) aims to equip students with knowledge, skills, values, attitudes, leadership readiness/qualities and lifelong learning. The fundamental premise of LOCF is to specify what graduates completing a particular programme of study are expected to know, understand and be able to do at the end of their programme of study. Besides this, students will attain various 21st century skills like critical thinking, problem solving, analytic reasoning, cognitive skills, self-directed learning etc.. A note on LOCF for undergraduate education is available on the UGC website [www.ugc.ac.in](http://www.ugc.ac.in). It can serve as

guiding documents for all Universities undertaking the task of curriculum revision and adoption of outcome based approach.

The student graduating with the Degree B.Sc. (Honours) Botany should be able to acquire:

**PO 1: Knowledge:** Students will acquire core competency in the subject Botany, and in allied subject areas. The student will be able to identify major groups of plants and compare the characteristics of lower (e.g. algae and fungi) and higher (angiosperms and gymnosperms) plants.

- Students will be able to use the evidence based comparative botany approach to explain the evolution of organism and understand the genetic diversity on the earth.
- The students will be able to explain various plant processes and functions, metabolism, concepts of gene, genome and how organism's function is influenced at the cell, tissue and organ level.
- Students will be able to understand adaptation, development and behavior of different forms of life.
- The understanding of networked life on earth and tracing the energy pyramids through nutrient flow is expected from the students.
- Students will be able to demonstrate the experimental techniques and methods of their area of specialization in Botany.

**PO 2: Critical Thinking and problem solving ability:** An increased understanding of fundamental concepts and their applications of scientific principles is expected at the end of this course. Students will become critical thinker and acquire problem solving capabilities.

**PO 3: Digitally equipped:** Students will acquire digital skills and integrate the fundamental concepts with modern tools.

**PO 4: Ethical and Psychological strengthening:** Students will also strengthen their ethical and moral values and shall be able to deal with psychological weaknesses.

**PO 5: Team Player:** Students will learn team workmanship in order to serve efficiently institutions, industry and society.

**PO 6: Independent Learner:** Apart from the subject specific skills, generic skills, especially in botany, the program outcome would lead to gain knowledge and skills for further higher studies, competitive examinations and employment. Learning outcomes based curriculum would ensure equal academic standards across the country and broader picture of their competencies. The Bachelor program in Botany and Botany honours may be mono-disciplinary or multidisciplinary.

**PO 7: Analytical ability:** The students will be able to demonstrate the knowledge in understanding research and addressing practical problems. Application of various scientific methods to address different questions by formulating the hypothesis, data collection and critically analyze the data to decipher the degree to which their scientific work supports their hypothesis.

**SALIENT FEATURES:**

- B.Sc. (Honours) Botany in UG programme - **Semester V and VI** shall be offered from the Academic year, June **2025**.
- Botany subject in the Universities/Affiliated Colleges shall offer undergraduate programme in Faculty of Science from the Academic year 2025-26.
- A student will have to get enrolled a **Discipline Specific Core Course (DSC)** depending upon his/her requirement of a degree in the said discipline of study. A student will have a choice of selecting a **IKS-Major Disciplinary Course (IKSDSC), Minor Disciplinary Course (MiDSC), Ability Enhancement Course (AEC), Skill Enhancement Course (SEC)** as well as **Internship. Academic Bank of Credits (ABC)** is an academic service mechanism as a digital/virtual/online entity established and managed by MOE/UGC. This will facilitate students to become its academic account holders and paving the way for seamless student mobility between or within degree-granting Higher Education Institutions (HEIs) through a formal system of credit recognition, credit accumulation, credit transfers and credit redemption to promote distributed teaching- learning from various recognized institutions, approved ODL and other sources to increase their knowledge, capacities and skills. ABC shall be established on the lines of "National Academic Depository" (NAD) as a Special Purpose Vehicle (SPV). It shall have a dynamic website providing all details of ABC, operational mechanism for the use of all stakeholders of higher education.
- Each course shall be assigned a specific number of **Credits**.
- Discipline Specific Core Course (**DSC**) is the course which should compulsorily be studied by a candidate as a Major and Minor requirement so as to get degree in a said discipline of study.
- There shall be a **Major (MJDCS) Compulsory** course (Theory) with **4 credits/major** and their practical with **4 credits**.
- There shall be an **IKS-Major (MJDCS ) Compulsory** course (Theory) with **4 credits/IKS**.

- Two **Minor (MiDSC) Compulsory** course (Theory), with **4 credits** in semester V and their practical's with total **4 credits**.
- One **Minor (MiDSC) Compulsory** course (Theory) with **2 credits** in semester VI and their practical's with **2 credits**.
- **AEC (sem. VI)** and **SEC (sem. V) courses** shall have to be offered. The credit weight-age for **AEC 2 credit**, **SEC 2 credit** course shall be offered.
- **Internship offered in semester VI with 4 credits with 120 hours.** NEP-2020 emphasizes on Vocationalization of Education. A key aspect of the new UG programme is its utility into a real life situation. All students are expected to do Internships/Apprenticeships/OJT in a firm, industry, or organization. Students will be provided the opportunities for do Internships/Apprenticeships/OJT with local industry, business organizations, health, and allied areas, local governments (such as panchayats, and municipalities), local Police Stations, Parliament or elected representatives, media organizations, artists, crafts persons, and a wide range of organizations so that students may engage with the practical side of their learning, which will improve their employability.
- Internship/ Apprenticeship in 6th Semester with 4 credit, it will be counted under Major course and hence internship can be done in major specific courses only.
- The credit weightage for Internship is suggested to be **30 hrs.** per credit if they have only practical exposure or lab-based activities. Accordingly, the students must dedicate required number of hours for the same. The guidelines offer scope for providing hands on learning with classroom experience. In case of field visit or experiential learning, 1 credit is equivalent to **40-45 Hours**. Both HEIs & Industries can decide mutually for the duration of classroom lecture and industry visit.
- **For internship, evaluation and credit frame work, hours strictly follows HNGU rules and regulations.**

### **INTERNSHIP/APPRENTICESHIP/OJT PATHWAY**

**Step 1:** The University/Institute shall decide subjects to be offered or linked with Internship.

The learning outcomes of every subject needs to be defined and mapped.

**Step 2:** Considering the subject and learning outcomes, institute/college should look for concerned industry who shall provide on-job-training/internship to students.

**Step 3:** Exchange a letter of Intent/ MOU with the concerned industry/employer (also called Skill Knowledge Partner) mentioning the assignment to be given to the students, nature of work, duration of work per day, total duration, stipend, and honorarium paid to the students, evaluation, and certification process.

**Step 4:** Assign the industry to the students in lieu with their profile and the requirement of industries

**Step 5:** Evaluation of the students during and at the end of assignment shall be done jointly with industry supervisor and faculty of the Higher Education Institution (HEI).

**Step 6:** Issue of certificate/ Letter of Assignment Completion, based on result of the valuation.

- Each course shall have a unique Course code. The Discipline Specific Core Course, Inter/Multi-Disciplinary Course, Ability Enhancement Course, Value Added Course and Skill Enhancement Course shall be abbreviated respectively as **DSC, MiDSC, AEC, and SEC.**

1. Discipline Specific Core Course DSC- Major (**MJDSC**) & Minor (**MiDSC**)  
Practical Discipline Specific Core Course **PDSC- PMJDSC & PMiDSC.**
2. Discipline Specific Core Course DSC- Indian Knowledge System (**IKS**).
3. Ability Enhancement Course **AEC**
4. Skill Enhancement Course **SEC**

- Each Academic year shall consist of **two** semesters, each of **15 weeks** of teaching equivalent to **90 working days**. The Odd semester period shall be from **July to November** and the Even semester period shall be from **December to April**.
- The theory course with **4 credits** shall be of **60 hrs** (15-week x 4credits) duration and the course with **2 credits** shall be of **30 hrs** (15-week x 2 credits) duration.
- The **Practical** course **with 4 credits** shall be of **120 hrs** (15-week x 8 hours) duration and the **Practical** course **with 2 credits** shall be of **60 hrs** (15-week x 4 hours) duration.

**GENERAL FRAMEWORK:**

- *A general framework for Bachelor of Science (B. Sc.) with Honours programme with Research/without Research shall be as follows:*

Semester wise credits								Total credits of the Programme
I	II	III	IV	V	VI	VII	VIII	
22	22	22	22	22	22	22	22	176

### **ATTENDANCE:**

The attendance rules as per the norms of Hemchandracharya North Gujarat University, Patan.

To be able to appear for the SEE, a student must comply with the following conditions:

1. Should have at least 75% of attendance in all the courses put together.
2. Should have at least 70% of attendance in each course/subject.
3. Should not have any disciplinary proceedings pending against him/her.
4. Should have no pending due.

### **MEDIUM OF INSTRUCTION:**

The Medium of Instruction shall be of **Gujarati medium**. Student is free to write answers either in **Gujarati** and/or **English** language.

### **TEACHING LEARNING PROCESS:**

Teaching and learning in this programme involve classroom lectures as well tutorials. It allows-

- The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention.
- Written assignments and projects submitted by students
- Project-based learning
- Group discussion
- Home assignments
- Quizzes and class tests
- PPT presentations, Seminars, interactive sessions
- Diversity survey
- Co-curricular activity etc.
- Industrial Tour or Field visit

### **LANGUAGE OF QUESTION PAPER:**

Question paper should be drawn in **Gujarati** language and its **English** version should be given.

## **EVALUATION METHODS:**

Academic performance in various courses *i.e.* **MJDSC, MiDSC, AEC, SEC, and RP/OJT** are to be considered as parameters for assessing the achievement of students in the Botany subject. A number of appropriate assessment methods of Botany will be used to determine the extent to which students demonstrate desired learning outcomes.

**Following assessment methodology should be adopted:**

1. A student shall be evaluated through **Continuous and Comprehensive Evaluation (CCE)/ (Internal Evaluation)** and as well as the **Semester End Evaluation (SEE) (External Evaluation)**. The weightage of theory and practical is **25 marks per credit**. CCE shall be **50%**, whereas the weightage of the SEE shall be **50%**.

Sr. No.	Evaluation	4 credits subjects (Marks)	2 credits subjects (Marks)
1	CCE (50%) Classroom & Mid-Term Evaluation	50	25
2	SEE (50%)	50	25
	<b>Total</b>	<b>100</b>	<b>50</b>

2. The grade/marks for **Internship/Apprenticeship/OJT shall be provided by the X Supervisor and faculty guide in the ratio of 60% and 40%** respectively.
3. The concerned SKP can issue a certificate or letter for work completion after successful completion of OJT/Internship/Apprenticeship activities by students.
4. In the **Continuous and Comprehensive Evaluation (CCE)/ (Internal Evaluation)** is spread through the duration of the course and is to be done by the Teacher teaching the course. BoS of the subjects will decide various criteria and their weightage for CCE. The assessment is to be done by various means including:

Written Mode	Oral Mode	Practical Mode	Integrated Mode
1. Semester Exam 2. Class Test 3. Open book exam/test 4. Open note exam/test 5. Self-test/ Online test 6. Essay/Article writing 7. Quizzes/Objective test 8. Class assignment 9. Home assignment 10. Reports Writing 11. Research/Dissertation 12. Case Studies	1. Viva/Oral exam 2. Group Discussion 3. Role Play 4. Authentic Problem Solving 5. Quiz 6. Open Book Reading 7. Interview	1. Lab work 2. Computer simulation/ Virtual labs 3. Craft work 4. Co-curricular work	1. Paper presentation/ Seminar 2. Field Assignment 3. Poster presentation

## **NATURE AND OBJECTIVES OF VARIOUS TYPES OF EVALUATION::**

<b>Written Mode</b>		
<b>Evaluation Type</b>	<b>Nature</b>	<b>Objectives</b>
<b>Semester Exam</b>	Traditionally essay type	For depth and planned preparation
<b>Class test</b>	Traditionally essay type	Fixed date forces students to learn
<b>Open book test</b>	Allowed choice of reference book	Measures what students can do with resources, less stress on memory
<b>Open note test</b>	To get used to the system	Encourage good note taking
<b>Self-test</b>	For subjective and objective items	Mastery learning occurs with proper feedback
<b>Article/essay writing</b>	Individual long written assignment	Individual expression and creativity
<b>Quizzes/Objective test</b>	Short duration structured test	Excellent validity as greater syllabus coverage
<b>Class assignment</b>	With defined time	Student's performance to make decision
<b>Home assignment</b>	With undefined time	Reinforce learning and facilitate mastery of specific skills
<b>Reports Writing</b>	On activities performed or event observed	Develop a key transferable skill
<b>Research/ Dissertation</b>	Detailed research-based report	To judge creativity and research skills
<b>Case Studies</b>	<b>Analyse a given case (real or fictional)</b>	To assess thinking, value, and attitude

<b>Oral Mode</b>		
<b>Evaluation Type</b>	<b>Nature</b>	<b>Objectives</b>
<b>Viva/Oral exam</b>	Individually or in small group	Practical experience towards job interview situation
<b>Group discussion</b>	Small group of 2-5 members work on a joint task	Encourage teamwork
<b>Role Play</b>	Small group of 2-5 members work on a joint task	Develop personality
<b>Authenticate problem solving</b>	Small group of 2-5 members work on a joint task	Communication of ideas
<b>Quiz</b>	Small group of 2-5 members work on a joint task	Assess memory power
<b>Interview</b>	Individually	Judge the personal confidence level

Practical Mode		
Evaluation Type	Nature	Objectives
Lab work	Component of working with one's hand	Keep the students on the task
Computer simulation/virtua	Component of working with one's hand	To understand the practical exposure
Craft work	Component of working with one's hand	Encourage application of concepts learnt
Co-curricular work	Component of working with one's hand	For immediate feedback

Integrated Mode		
Evaluation Type	Nature	Objectives
Paper presentation/ Seminar	Group or individual work	Learn from others presentation
Field Assignment	Field visit with report	Develop observation and recording skills
Poster presentation	Group or individual work	Develop research, creativity, and discussion skills

### **MODELS OF EVALUATION:**

Based on the types of evaluation, various models of evaluation implementation are suggested for theory, practical, self-study and work-based learning. The focus of these models is to encourage the students to improve on skills and performance.

Model for Theory Courses	
CCE- 50% (50)	SEE- 50% (50)
Exam Pattern	Marks
Class Test (Best 2 out of 3)	15
Quiz (Best 3 out of 4)	15
Active Learning	05
Home Assignment	05
Class Assignment	05
Attendance	05
<b>Continuous and Comprehensive Evaluation(CCE)</b>	<b>50</b>
<b>Semester-End Evaluation (SEE)</b>	<b>50</b>

Model for Practical Courses	
CCE- 50% (50)	SEE- 50% (50)
Exam Pattern	Marks
Lab work assessment (Best 4 out of 5)	20
Viva voce/Lab quiz (Best 4 out of 5)	20
Attendance	10
<b>Continuous and Comprehensive Evaluation(CCE)</b>	<b>50</b>
<b>Semester-End Evaluation(SEE)</b>	<b>50</b>

Model for Project/Self Model for Project/Self-study course-study/ Model for work experience course	
CCE- 50% (50)	SEE- 50% (50)
Exam Pattern	Marks
Project Evaluation (Best 3 out of 5)	30
Participation in discussion	10
Attendance	10
<b>Continuous and Comprehensive Evaluation(CCE)</b>	<b>50</b>
<b>Semester-End Evaluation(SEE)</b>	<b>50</b>

13. CCE and SEE shall be of 2 ½ hours for 4 credits course and 2 hours in case of 2 credits courses.

**14. CERTIFIED JOURNAL:**

The End of Semester Examination will be conducted by the University. A *certified journal* of the respective practical course **must be produced** at the time of practical examination by the student.

15. It will be compulsory for a candidate to obtain *passing percentage* in both Internal as well as External Evaluation. The passing marks for each course shall be 36% as decided by concern Board of Studies (BoS) in Botany.
16. Promotion, Re-Admission and Time for Completion of course, Procedure for awarding grades, Provision for appeal, etc. as decided by the *Hemchandracharya North Gujarat University, Patan(Gujarat)*.

**STUDY TOUR:**

Botanical excursion/study tour may be arranged (by the concern faculty with prior permission of **HoD and/or Principal**) within state and/or outside the state to explore/study plant diversity in its natural habitats.

### **COMPUTATION OF SGPA:**

SGPA is computed from the grades as a measure of the student's performance in each semester. It is the ratio of the sum of the product of the number of credits with the grade points and the sum of the number of credits. i.e.

$$\text{SGPA (Si)} = \frac{\sum (C_i \times G_i)}{\sum C_i}$$

Where  $S_i$  is the SGPA for  $i$ th course,  $C_i$  is the number of credits of the  $i$ th course and  $G_i$  is the grade point scored by the student in the  $i$ th course.

### **CUMULATIVE GRADE POINT AVERAGE (CGPA):**

The CGPA is based on the grades in all the courses taken after joining the programme of study. It is the ratio of the sum of the products of total credits scored in a particular semester with the SGPA scored by the student in that semester and the sum of the total number of credits of each semester. i.e.

$$\text{CGPA} = \frac{\sum (C_i \times S_i)}{\sum C_i}$$

Where  $S_i$  is the SGPA of the  $i$ th semester and  $C_i$  is the total number of credits in that semester.

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**B.Sc. Honours Programme with 176 credits CBCS-Semester-Grading Pattern**  
**FRAMED ACCORDING TO NATIONAL EDUCATION POLICY (NEP- 2020)w.e.f. June-2025**  
**General Pattern/Scheme of study components along with credits for Science faculty.**

DEGREE COURSE								
Part/Class	Subject code	Study Components	Instruction Hrs/Week	Examination Marks			Credits	Exam Duration (Hours)
				CCE	SEE	Total		
<b>B.Sc. Semester -V</b>	<b>Semester-V</b>							
	<b>Discipline Specific Core Course(DSC)</b>							
	SC23MJDSBOT501	Major Discipline Specific Core Courses (MJDS)	4	50	50	100	4	02:30
	SC23MJDSBOT501A IKS	IKS-Major Discipline Specific Core Courses (IKSDSC)	4	50	50	100	4	
	SC23MiDSBOT502	Minor Discipline Specific Core Courses (MiDSC)	4	50	50	100	4	
	<b>Practical Course(PDSC)</b>							
	SC23PMJDSBOT501	Major Discipline Specific Core Courses (PMJDSC)	8	50	50	100	4	05:00
	SC23PMiDSBOT502	Minor Discipline Specific Core Courses (MiDSC)	8	50	50	100	4	
	<b>Skill Enhancement Course (SEC)</b>							
	SC23SEBOT506	Skill Enhancement Course (SEC)	2	25	25	50	2	02:00
			<b>30</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	
<b>B.Sc. Semester -VI</b>	<b>Semester-VI</b>							
	<b>Discipline Specific Core Course(DSC)</b>							
	SC23MJDSBOT601	Major Discipline Specific Core Courses (MJDS)	4	50	50	100	4	02:30
	SC23MJDSBOT601A	Major Discipline Specific Core Courses (MJDS)	4	50	50	100	4	
	SC23MiDSBOT602	Minor Discipline Specific Core Courses (MiDSC)	2	25	25	50	2	02:00
	<b>Practical Course(PDSC)</b>							
	SC23PMJDSBOT601& SC23PMJDSBOT601A	Major Discipline Specific Core Courses (PMJDSC)(GROUP A & B)	8 (4+4)	50	50	100	4 (2+2)	05:00
	SC23PMiDSBOT602	Minor Discipline Specific Core Courses (PMiDSC)	4	25	25	50	2	02:30
	<b>Ability Enhancement Course (AEC)</b>							
	SC23AECBOT604	Ability Enhancement Courses (AEC) (Language)	2	25	25	50	2	02:00
<b>Internship</b>								
SC23INTBOT607	Internship	30/Credit	50	50	100	4		
			<b>144</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

**DISCIPLINE SPECIFIC CORE COURSES:**

**SEM-V: SC23MJDSCBOT501: ECOLOGY AND PLANT SYSTEMATICS**

***Programme specific Learning Outcomes:***

On completion of this course, the students will be able to:

- Understand core concepts of biotic and abiotic factors.
- Classify the soils on the basis of physical, chemical and biological components.
- Analysis the phytogeography or phytogeographical division of India.
- Evaluate energy sources of ecological system.
- Assess the adaptation of plants in relation to soil and water.
- Conduct experiments using skills appropriate to subdivisions.
- Classify Plant systematics and recognize the importance of herbarium and Virtual herbarium.
- Evaluate the Important herbaria and botanical gardens.
- Interpret the rules of ICBN in botanical nomenclature.
- Assess terms and concepts related to Phylogenetic Systematics.
- Generalize the characters of the families according to Bentham & Hooker's system of classification.

**INDIAN KNOWLEDGE SYSTEM-MAJOR DISCIPLINE SPECIFIC CORE COURSES(IKS):**

**SEM-V: SC23MJDSCBOT501AIKS: ANCIENT INDIAN BOTANY: A LIVING TRADITION**

***Programme specific Learning Outcomes:***

On completion of this course, the students will be able to:

- To create awareness on significance of historical Indian botanical practices
- To gain knowledge on ancient Indian botanical classification systems
- To understand value of ancient medicinal practices of Charaka, Sushruta and Ayurveda
- To learn traditional agriculture practices of seed saving, crop rotation and rain water harvesting
- To cultivate respect for spiritual plant conservation methods and traditional ecological knowledge
- To integrate ancient Indian practices and modern practices for betterment of society.

**MINOR DISCIPLINE SPECIFIC CORE COURSES:**

**PROGRAMME CODE: SCIUG103**

**SEM-V: SC23MiDSCBOT502: PLANT MORPHOLOGY, INSTRUMENTATION AND  
METHODOLOGY**

**Programme specific Learning Outcomes:**

On completion of the course, the students will be able to:

- Understand Plant Structure: Demonstrate comprehensive knowledge of the external structure of various plant organs including roots, stems, leaves, flowers, fruits, and seeds.
- Differentiate Plant Forms: Identify and differentiate among various plant forms based on their morphological characteristics.
- Recognize Modifications: Analyze the morphological adaptations and modifications in plants that support survival in different environments.
- Correlate Form and Function: Establish relationships between the form and function of different plant parts.
- Use Morphology in Classification: Apply morphological characteristics for the identification and classification of plants.
- Appreciate Plant Diversity: Understand the morphological diversity of angiosperms and other plant groups.
- Apply Field Knowledge: Gain practical skills in plant identification through field studies and herbarium techniques.
- Develop Scientific Approach: Develop observation, analytical, and documentation skills essential for morphological studies.
- Support Ecological Understanding: Use morphological knowledge to understand ecological relationships and plant adaptations.
- Prepare for Advanced Studies: Build a strong foundation for further studies in botany, plant systematics, ecology, and related fields.
- To introduce students to the principles, design, and applications of key laboratory instruments.
- To familiarize students with essential biotechnological techniques and their real-world applications.

- To develop students' skills in conducting fieldwork and maintaining scientific documentation like herbarium and field reports.
- To strengthen students' understanding of basic statistical tools used for analyzing biological data.
- To encourage scientific thinking, precise observation, and data-driven report writing through practical and theoretical exposure.

**SKILL ENHANCEMENT COURSE:**

**PROGRAMME CODE: SCIUG103**

**SEM-V: SC23SECBOT506: NURSERY AND GARDENING**

***Programme specific Learning Outcomes:***

On completion of the course, the students will be able to:

- Understand the process of sowing seeds in nursery.
- List the various resources required for the development of nursery.
- Distinguish among the different forms of sowing and growing plants.
- Analyse the process of Vegetative propagation.
- Appreciate the diversity of plants and selection of gardening
- Examine the cultivation of different vegetables and growth of plants in nursery and gardening.

**DETAILED SYLLABUS OF B.Sc. THIRD YEAR FOR DEGREE COURSE IN BOTANY**

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**(Effective from June 2025-26 UNDER NEP-2020)**

<b>MAJOR DISCIPLINE SPECIFIC CORE COURSE (MJDSC)</b>							
<b>Programme Code: SCIUG103</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>Credits</b>	<b>Lectures</b>	<b>THEORY</b>	
						<b>CCE</b>	<b>SEE</b>
<b>Degree Course</b>	<b>B.Sc. V</b>	<b>SC23MJ DSCBOT 501</b>	<b>ECOLOGY AND PLANT SYSTEMATICS</b>	<b>4</b>	<b>T=60hrs</b>	<b>50%</b>	<b>50%</b>
<b>Course outcomes:</b>	<p><b>Programme specific Learning Outcomes:</b></p> <p>On completion of this course, the students will be able to:</p> <ul style="list-style-type: none"><li>• Demonstrate an understanding of plant ecology and phytogeography of India.</li><li>• Develop critical understanding on angiospermic plants.</li><li>• Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of phytogeography and plant taxonomy.</li></ul> <p><b>Pedagogy:</b> Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</p>						
<b>THEORY UNIT</b>	<b>TOPIC</b>						<b>NO. OF LECTURES (60hrs)</b>
<b>Unit 1</b>	<p><b>Plant Ecology: I</b></p> <ul style="list-style-type: none"><li>• <b>Soil:</b> Structure and type, properties (Physical, Chemical and Biological), profile.</li><li>• <b>Water:</b> States of water in the environment, Precipitation types (rain, fog, snow, hail, dew), Hydrological Cycle.</li><li>• <b>Trophic organisation:</b> Basic source of energy, autotrophy, heterotrophy, Food chains and Food webs; Ecological pyramids.</li><li>• <b>Models and Cycling:</b> Principles of energy flow, Biogeochemical cycles: Carbon, Nitrogen and Phosphorus.</li></ul>						<b>15</b>

<b>Unit 2</b>	<b>Plant Ecology: II</b> <ul style="list-style-type: none"> <li>• <b>Symbiosis</b> (Mutualism, Commensalism), <b>Antagonism</b> (Parasitism, Predation).</li> <li>• <b>Characters of communities:</b> Analytical and Synthetic.</li> <li>• <b>Phytogeography:</b> Regions of India.</li> <li>• <b>Ecological adaptations:</b> Hydrophytes (<i>Hydrilla</i>), Mesophytes (<i>Sunflower</i>) and Xerophytic (<i>Capparis</i>).</li> </ul>	
<b>Unit 3</b>	<b>Plant systematics: I</b> <ul style="list-style-type: none"> <li>• <b>Introduction to systematics:</b> Plant identification and Classification.</li> <li>• <b>Taxonomic evidences:</b> From anatomy and embryology.</li> <li>• <b>Field inventory:</b> Herbarium technique, Important herbaria of the world (any five) and India (any five), Botanical gardens of the India (any five) and Gujarat (Waghai).</li> <li>• <b>Virtual herbarium:</b> E-flora and Documentation.</li> </ul>	<b>15</b>
<b>Unit 4</b>	<b>Plant systematics: II</b> <ul style="list-style-type: none"> <li>• <b>Introduction:</b> Principles, typification and rules of priority, (ICBN).</li> <li>• <b>Classification system:</b> Bentham &amp; Hooker classification.</li> <li>• <b>Study of Dicotyledon Families:</b> <ul style="list-style-type: none"> <li><b>Polypetalae:</b> Malvaceae, Rutaceae, Fabaceae.</li> <li><b>Gamopetalae:</b> Asteraceae (Compositae), Solanaceae, Lamiaceae (Labiatae).</li> <li><b>Monochlamydae:</b> Euphorbiaceae, Amaranthaceae.</li> </ul> </li> <li>• <b>Study of Monocotyledon Families:</b> <ul style="list-style-type: none"> <li>Amaryllidaceae and Poaceae (Gramineae).</li> </ul> </li> </ul>	<b>15</b>

Suggested Readings :

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.
6. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
7. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
8. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
9. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
10. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.

**DETAILED SYLLABUS OF B.Sc. THIRD YEAR FOR DEGREE COURSE IN BOTANY**

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

(Effective from June 2025-26 UNDER NEP-2020)

<b>MAJOR DISCIPLINE SPECIFIC CORE COURSES- INDIAN KNOWLEDGE SYSTEM (IKS)</b>							
<b>Programme Code: SCIUG103</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>Credits</b>	<b>Lectures</b>	<b>THEORY</b>	
						<b>CCE</b>	<b>SEE</b>
<b>Degree Course</b>	<b>B.Sc. V</b>	<b>SC23MJ DSCBOT 501AIKS</b>	<b>ANCIENT INDIAN BOTANY: A LIVING TRADITION</b>	<b>4T</b>	<b>T=60hrs</b>	<b>50%</b>	<b>50%</b>
<b>Course outcomes:</b>	<p>On completion of the course, the students will be able to:</p> <ul style="list-style-type: none"> <li>• Students will understand the significance of Indian Knowledge System in plant science.</li> <li>• The course will create awareness on relevant use of ancient Indian literature of botany.</li> <li>• It will provide understanding on use of Ayurveda, Siddha, and Unani systems to know medicinal properties of plants.</li> <li>• To learn how to classify and identify plants based on their medicinal and therapeutic applications.</li> <li>• To develop skills on conservation of plants using traditional methods such as sacred groves, herbal gardens, and agroforestry</li> <li>• To learn the ecological, cultural and spiritual roles of sacred plants and their associated practices in Indian traditions.</li> <li>• To gain skills in recording and documenting local plant knowledge using ethnobotanical methodologies.</li> <li>• To adapt sustainable agricultural practices such as mixed cropping, crop diversification, and soil fertility management rooted in Indian traditions.</li> </ul> <p><b>Pedagogy:</b> Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</p>						
<b>THEORY UNIT</b>	<b>TOPIC</b>					<b>NO. OF LECTURES (30hrs)</b>	
<b>Unit 1</b>	<ul style="list-style-type: none"> <li>• <b>Scientist and their roles:</b> <ul style="list-style-type: none"> <li>• <b>Charaka and Sushruta:</b> Role in ancient Ayurveda.</li> <li>• <b>Bapalal G. Vaidya and Jay Krushna Indarajit Thakur:</b> Role in herbal medicine.</li> <li>• <b>Sir J. C. Bose:</b> Sensitive instrument and plant response.</li> <li>• <b>Dr. S. K. Jain:</b> Role in Ethnobotany.</li> </ul> </li> </ul>					<b>15</b>	

<b>Unit 2</b>	<ul style="list-style-type: none"> <li>• <b>Ancient medicinal system:</b> <ul style="list-style-type: none"> <li>• <b>Nature:</b> Vata, Pitta and Kapha.</li> <li>• <b>The Pancha Mahabhutas:</b> Prithvi, Jala, Agni, Vayu, Akasha.</li> <li>• <b>Traditional systems:</b> Ayurveda, Siddha and Homeopathy.</li> <li>• <b>Traditional drugs:</b> Decoction, paste, powders, oil and infusions.</li> </ul> </li> </ul>	<b>15</b>
<b>Unit 3</b>	<ul style="list-style-type: none"> <li>• <b>Ancient knowledge:</b> <ul style="list-style-type: none"> <li>• Pest management practices using natural predators, herbal pesticides, and Agnihotra.</li> </ul> </li> <li>• <b>Cultural and Agricultural practices:</b> Soil fertility improvement using green manure, vermiculture, animal dung, crop residues.</li> <li>• <b>Astro theme garden:</b> Nakshatra Vaidic Van (Plants: Local Name, Scientific name, medicinal uses).</li> <li>• <b>Astrological garden:</b> Zodiac Sign Grove (Plants: Local Name, Scientific name, medicinal uses).</li> </ul>	<b>15</b>
<b>Unit 4</b>	<ul style="list-style-type: none"> <li>• <b>Herbal Medicine:</b> <ul style="list-style-type: none"> <li>• <b>Active ingredients:</b> Scientific names and uses of <i>Aloe</i>, <i>Calotropis</i>, <i>Gymnosporia</i> (Mountain Spike Thorn) and Babul.</li> <li>• <b>Complicated relationship:</b> Poisonous and Allergen plants (3 plants of each).</li> <li>• <b>Herbal practice:</b> Local Vaidyas and Bhagats (5 plants).</li> <li>• <b>Ayurveda treatment:</b> Panchakarma, Abhyanga, Basti, Yoga and Meditation.</li> </ul> </li> </ul>	<b>15</b>

**Suggested Readings:**

1. Ethnobotany of India by S. K. Jain
2. Indian Herbal Remedies: The Ultimate Reference to the Medicinal Herbs of India" by C. P. Khare
3. A Dictionary of Indian Folk Medicine and Ethnobotany" by K. C. Joshi
4. The Vedic Flora" by S. M. M. Deshmukh
5. The Book of Indian Herbs" by R. K. Suri
6. Sacred Plants of India" by N. P. Sharma
7. Ayurvedic Plants" by K. S. R. Anjaneyulu
8. Indian Farming: Traditional Techniques and Practices" by R. K. P. Prakash
9. Ayurvedic Medicinal plants by Vasant Lad
10. Traditional Indian Medicine and Herbology" by K. R. Kirtikar and B. D. Basu.
11. "Ayurveda: The Science of Self-Healing" – Dr. Vasant Lad
12. "The Charaka Samhita" – Translated by P.V. Sharma
13. "Siddha Medicine: Fundamentals and Practice" – Dr. K. Sivaraman
14. "Vrikshayurveda: The Science of Plant Life" – Surapala (Translated by Nalini Sadhale)
15. "Pashu Ayurveda: Traditional Indian Veterinary Science" – S.K. Tiwari Ayurvedic Medicinal plants by Vasant Lad

**DETAILED SYLLABUS OF B.Sc. THIRD YEAR FOR DEGREE COURSE IN BOTANY**

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**(Effective from June 2025-26 UNDER NEP-2020)**

<b>MAJOR DISCIPLINE SPECIFIC CORE COURSE -PRACTICAL (PMJDSC)</b>						
<b>Programme Code: SCIUG103</b>						
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>PRACTICAL</b>		
				<b>Credits</b>	<b>CCE</b>	<b>SEE</b>
<b>Degree Course</b>	<b>B.Sc. V</b>	<b>SC23PMJ DSCBOT 501</b>	<b>ECOLOGY AND PLANT SYSTEMATICS</b>	<b>4 (120 hrs)</b>	<b>50%</b>	<b>50%</b>
<b>Course outcomes:</b>	After the completion of the course the students will be able: 1. Understand the instruments, techniques, lab etiquettes and good lab practices for working in Molecular Biology and Genetics. 2. Practical skills in the field and laboratory experiments Molecular Biology and Genetics. 3. Can start own enterprise in molecular biology. <b>Pedagogy:</b> Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.					
<b>PRACTICALS</b>						<b>NO. OF LECTURES (120 hrs)</b>
1. Study of instruments used to measure microclimatic variables: Soil thermometer and rain gauge. 2. Determination of pH of various soil. 3. Analysis for carbonates, nitrates and base deficiency from three soil samples by rapid field tests (0 to 5 scale). 4. Comparison of water holding capacity of three soil samples. 5. Determination of minimum size of quadrat and minimum number of quadrat for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed). 6. Quantitative analysis of herbaceous vegetation (any five) in the college campus for frequency and comparison with Raunkiaer's frequency distribution law. 7. Quantitative analysis of herbaceous vegetation (Any five) for density and abundance in the college campus. 8. Ecological adaptations: Hydrophytes ( <i>Hydrilla</i> stem), Mesophytes (Sunflower stem) Xerophytic ( <i>Capparis</i> stem). 9. Biotic Interactions between living organisms: Mutualism: Root nodules (specimen)						<b>120</b>

<p>Commensalism: Orchid (specimen)  Parasitism: <i>Cuscuta</i> (specimen), <i>Loranthus</i> (specimen)  Predation: <i>Nepenthes</i> (specimen)</p> <p>10. Study of vegetative and floral characters of the following families (Habitat and Botanical Description, V.S. flower, section of ovary, floral diagram/s, floral formula and systematic position according to Bentham &amp; Hooker's system of classification):</p> <ul style="list-style-type: none"> <li>• Malvaceae</li> <li>• Rutaceae,</li> <li>• Fabaceae</li> <li>• Asteraceae (Compositae)</li> <li>• Solanaceae</li> <li>• Lamiaceae (Labiatae)</li> <li>• Euphorbiaceae</li> <li>• Amaranthaceae</li> <li>• Amaryllidaceae</li> <li>• Poaceae (Gramineae)</li> </ul>	
<p><u>Suggested Readings :</u></p> <ol style="list-style-type: none"> <li>1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.</li> <li>2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.</li> <li>3. Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.</li> <li>4. Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.</li> <li>5. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.</li> <li>6. Singh, (2012). Plant Systematics: Theory and Practice Oxford &amp; IBH Pvt. Ltd., New Delhi. 3rd edition.</li> <li>7. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.</li> <li>8. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.</li> <li>9. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.</li> <li>10. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.</li> </ol>	

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**CBCS - Semester - Grading Pattern**  
(Effective from June 2025-26 UNDER NEP-2020)  
**B. SC. :: BOTANY PRACTICAL(MAJOR) :: SEMESTER-V**  
**Programme Code: SCIUG103**  
**ECOLOGY AND PLANT SYSTEMATICS**  
**SC23PMJDSCBOT 501**

**Date:**

**Place:**

**Time: 5 Hrs**

**Total Marks: 50**

**Instructions:** Strictly follow the instructions given by examiner(s).

1. Determine the **minimum size of quadrat/ number of quadrat** by species 08  
area curve  

**or**

Calculate the **Density/Abundance/Frequency** (any five species).
2. Determine the **pH/Carbonate/Nitrate/Base deficiency/Water holding capacity** from **three** soil samples. 07
3. To study and comments upon the **ecological adaptations** from specimen "A". 07
4. Refer to respective **families** with giving reasons from specimens "**B**" and "**C**".  
Including floral formula and floral diagram. 12
5. **Writing exercise on:** 06  
Comment upon spot "D" - (Soil thermometer/rain gauge).  
Comment upon spot "E" - (Biotic Interactions)
6. a. **Certified Journal** 05  
b. **Submission and viva-voce** 05

**DETAILED SYLLABUS OF B.Sc. THIRD YEAR FOR DEGREE COURSE IN BOTANY**

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**(Effective from June 2025-26 UNDER NEP-2020)**

<b>MINOR DISCIPLINE SPECIFIC CORE COURSES (MiDC)</b>							
<b>Programme Code: SCIUG103</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>Credits</b>	<b>Lectures</b>	<b>THEORY</b>	
						<b>CCE</b>	<b>SEE</b>
<b>Degree Course</b>	<b>B.Sc. V</b>	<b>SC23MiDSC BOT502</b>	<b>PLANT MORPHOLOGY, INSTRUMENTATION AND METHODOLOGY</b>	<b>4T</b>	<b>T=60hrs</b>	<b>50%</b>	<b>50%</b>
<b>Course outcomes :</b>	<p>On completion of the course, the students will be able to:</p> <ul style="list-style-type: none"><li>• Identify and describe the external features of various plant organs.</li><li>• Differentiate between types of roots, stems, and leaves based on morphology. Understand the structural adaptations of plants to different environments.</li><li>• Analyze the form and function of reproductive parts in flowering plants. Apply morphological knowledge to classify and identify plant species.</li><li>• Explain the working principles, designs, and applications of major laboratory instruments like autoclave, incubator, and centrifuge.</li><li>• Demonstrate proficiency in performing key biotechniques such as PCR, chromatography, gel electrophoresis, and microtomy.</li><li>• Plan and conduct field studies using simple field equipment and prepare and maintain herbarium specimens effectively.</li><li>• Analyze biological data using statistical measures such as mean, median, mode, standard deviation, chi-square test, and variance.</li><li>• Write concise and structured laboratory and fieldwork reports by applying appropriate scientific methods.</li></ul> <p>• <b>Pedagogy:</b> Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</p>						

<b>THEORY UNIT</b>	<b>TOPIC</b>	<b>NO. OF LECTURES (60hrs)</b>
<b>Unit 1</b>	<ul style="list-style-type: none"> <li>• <b>FLOWER</b></li> <li>• <b>Bracts:</b> Definition and types of Bracts (Foliaceous, Petaloid, Spathe, Involucre and Epicalyx.)</li> <li>• <b>Inflorescence-</b> Definition and its Types. <ul style="list-style-type: none"> <li>• <b>Recemose:</b> Definition and Types - Raceme, Spike, Umbel, Capitulum.</li> <li>• <b>Cymose:</b> Definition and its Types - Solitary, Monochasial (Helicoid &amp; Scorpid), Dichasial and Polychasial Cyme.</li> <li>• <b>Special Inflorescence:</b> Cyathium, Verticillaster and Hypanthodium</li> </ul> </li> <li>• <b>Flower-</b> Definition and parts of Flower.</li> <li>• <b>Kinds of Flower:</b> Actinomorphic &amp; Zygomorphic <ul style="list-style-type: none"> <li>• Tri-, Tetra-, and Pentamorous Flower.</li> <li>• Hypogynous, Perigynous and Epigynous Flower.</li> </ul> </li> <li>• <b>Calyx, Corolla and Perianth</b> – Numbers and Unity.</li> <li>• <b>Aestivation:</b> Definition and Types: Valvate, Twisted. Imbricate, Quinquencial, Vexillary.</li> <li>• <b>Androecium:</b> Cohesion of stamen -Monodelphous, Didelphous, Polydelphous.</li> <li>• <b>Attachment of filament to the anther-</b> Adnate, Dorsifixed, Basifixed, Sagittate and Versatile.</li> <li>• <b>Gynoecium:</b> Free and united, Number.</li> <li>• <b>Placentation:</b> Definition and Types - Marginal, Parietal, Axile, Free central and Basal.</li> </ul>	<b>15</b>
<b>Unit 2</b>	<ul style="list-style-type: none"> <li>• <b>FRUITS</b></li> <li>• Definition, parts of fruits, True and False Fruits.</li> <li>• <b>Simple Fruits:</b> <ul style="list-style-type: none"> <li>• Indehiscent – Caryopsis, Samara</li> <li>• Dehiscent – Capsule-Loculicidal, Septicidal</li> <li>• Schizocarpic- Lomentum, Regma.</li> <li>• Fleshy Fruits – Drupe, Berry.</li> </ul> </li> <li>• <b>Aggregate Fruit-</b> Etaerio of berry.</li> <li>• <b>Composite Fruit-</b> Sorosis.</li> </ul>	<b>15</b>

<b>Unit 3</b>	<ul style="list-style-type: none"> <li>• <b>INSTRUMENTATION</b></li> <li>• Principle, design, procedure and application of following:</li> <li>• Laminar Air Flow</li> <li>• Autoclave</li> <li>• Incubator</li> <li>• Oven</li> </ul>	<b>15</b>
<b>Unit 4</b>	<ul style="list-style-type: none"> <li>• <b>METHODOLOGY</b></li> <li>• PCR</li> <li>• Thin layer chromatography</li> <li>• Gel electrophoresis</li> <li>• Microtomy</li> </ul>	<b>15</b>

***Suggested Readings:***

1. Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
5. Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.
6. Arumugam, N. & Kumaresan, V. (2015). Biotechniques. 1st Edition, Saras Publication, India.
7. Ragland, A. & Kumaresan, V. (2010). Taxonomy of Angiosperms- Systematic Botany, economic Botany and Ethnobotany. Saras Publication, India.
8. Ramakrishnan, P. (2007). Biostatistics. Saras Publication, India.
9. Banerjee, P. K. (2008). Introduction to Biostatistics. S. Chand & Company Ltd., New Delhi, India.

**DETAILED SYLLABUS OF B.Sc. THIRD YEAR FOR DEGREE COURSE IN BOTANY**

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

(Effective from June 2025-26 UNDER NEP-2020)

<b>MINOR DISCIPLINE SPECIFIC CORE COURSES -PRACTICAL (PMiDSC)</b>						
<b>PROGRAMME CODE: SCIUG103</b>						
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>PRACTICAL</b>		
				<b>Credits</b>	<b>CCE</b>	<b>SEE</b>
<b>Degree Course</b>	<b>B.Sc. V</b>	<b>SC23PMiDSC BOT502</b>	<b>PLANT MORPHOLOGY, INSTRUMENTATION AND METHODOLOGY</b>	<b>4 (120hrs)</b>	<b>50%</b>	<b>50%</b>
<b>Course outcomes:</b>	After the completion of the course the students will be able to: On completion of this course, the students will be able to: 1. Demonstrate an understanding of plant ecology and phytogeography of India. 2. Develop critical understanding on angiospermic plants. 3. Demonstrate proficiency in the experimental techniques, methods of appropriate analysis of phytogeography and plant taxonomy. Apply theoretical knowledge in utilization, and report generation of economical and medicinal plants. Create awareness on conservation of medicinal plants and use of natural plant products as alternatives to synthetic products. <b>Pedagogy:</b> Lectures, Tutorials, Assignments, Demonstrations, live specimens, Herbarium specimens, Videos, Team based learning, Field visit and report writing.					
<b>PRACTICALS</b>						<b>NO. OF LECTURES (120 hrs)</b>
<b>Unit 1&amp; 2</b>	<b><u>MORPHOLOGY OF FLOWER</u></b> ❖ <b>Bracts:</b> Foliaceous Bract – <i>Adhatoda vasica</i> Petaloid Bract – <i>Bougainvillea spectabilis</i> Spathe Bract - <i>Rhoeo</i> Involucre Bract – <i>Helianthus anuus</i> Epicalyx Bract – <i>Hibiscus rosa- sinensis</i> ❖ <b>Inflorescence-</b> <b>Racemose:</b> Raceme - <i>Caesalpinia</i> Spike – <i>Achyranthes</i>					<b>60</b>

	<p>Umbel – Simple- onion, compound- <i>coriander</i></p> <p>Capitulum - Sunflower</p> <p><b>Cymose:</b></p> <p>Solitary – Terminal – <i>Datura</i> Axillary – Shoe Flower Monochasial Cyme (Helicoid – <i>Hamelia</i> &amp; Scorpid - <i>Heliotropium</i>) Dichasial Cyme - <i>Clerodendrum</i> Polychasial Cyme- <i>Calotropis</i></p> <p><b>Special Inflorescence:</b></p> <p>Cyathium – <i>Euphorbia</i> Verticillaster - <i>Ocimum</i> Hypanthodium - <i>Ficus</i></p> <p>❖ <b>Kinds of Flower :</b></p> <p>Actinomorphic Flower- Shoe Flower Zygomorphic Flower – Pea / Bean Trimarous Flower - <i>Crinum</i> Tetramarous Flower - Mustard Pentamarous Flower – Shoe Flower Hypogynous Flower - <i>Datura</i> Perigynous Flower - Rose Epigynous Flower.- <i>Coccinia</i></p> <p><b>Calyx :</b></p> <p>Polysepalous – Mustard Gamosepalous - <i>Datura</i></p> <p><b>Corolla :</b></p> <p>Polypetalous – Mustard Gamopetalous - <i>Datura</i></p> <p><b>Perianth – <i>Crinum</i></b></p> <p><b>Aestivation:</b></p> <p>Valvate – Calyx of <i>Datura</i> Twisted – Corolla of <i>Hibiscus</i> Imbricate - Corolla of <i>Caesalpinia</i> Quinquefoliate – Calyx of <i>Thevetia</i> Vexillary- <i>Butea</i></p> <p><b>Androecium :</b></p> <p>Monodelphous Androecium – Shoe Flower Didelphous Androecium – Pea / Bean Polydelphous Androecium – <i>Bombax</i> / <i>Lemon</i></p> <p>Adnate Anther - <i>Anona</i> Dorsifixed Anther - <i>Sesbania</i> Basifixed Anther – <i>Adhatoda</i> Sagittate Anther - <i>Thevetia</i> Versatile Anther – <i>Crinum</i> / Grass</p>	
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	<p><b>Gynoecium :</b>  Apocarpous ovary – Rose  Syncarpous ovary – Shoe Flower</p> <p><b>Placentation :</b>  Marginal – Pea / Bean  Parietal - <i>Argemone</i>  Axile – Shoe Flower  Free central - <i>Portulaca</i>  Basal – Sunflower</p> <p><b><u>FRUITS :</u></b>  <b>Simple Fruits:</b> Indehiscent – Caryopsis- Maize/ Wheat  Samara –<i>Holoptelea</i>  Dehiscent – Capsule  Loculicidal- Cotton  Septicidal-<i>Aristolochia</i>  Schizocarpic- Lomentum – <i>Acacia nilotica</i>  Regma - <i>Ricinus</i>  Fleshy Fruits – Drupe- Mango  Berry- Tomato / Brinjal</p> <p><b>Aggregate Fruit-</b> Etaerio of berry- <i>Anona squamosa</i>  <b>Composite Fruit-</b> Sorosis – Pineapple / <i>Morus</i></p>	
<p><b>Unit</b>  <b>3 &amp; 4</b></p>	<p>• Principle, design, procedure and application of following:</p> <ul style="list-style-type: none"> <li>• Laminar Air Flow</li> <li>• Autoclave</li> <li>• Incubator</li> <li>• Oven</li> <li>• PCR</li> <li>• Thin layer chromatography</li> <li>• Gel electrophoresis</li> <li>• Microtomy</li> </ul>	<p><b>60</b></p>
<p><b><i>Suggested Readings:</i></b></p> <ol style="list-style-type: none"> <li>1. Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.</li> <li>2. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.</li> <li>3. Arumugam, N. &amp; Kumaresan, V. (2015). Biotechniques. 1st Edition, Saras Publication, India.</li> <li>4. Ragland, A. &amp; Kumarsan, V. (2010). Taxonomy of Angiosperms- Systematic Botany, economic Botany and Ethnobotany. Saras Publication, India.</li> <li>5. Ramakrishnan, P. (2007). Biostatistics. Saras Publication, India.</li> <li>6. Banerjee, P. K. (2008). Introduction to Biostatistics. S. Chand &amp; Company Ltd., New Delhi, India</li> </ol>		

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**CBCS - Semester - Grading Pattern**

(Effective from June 2025-26 UNDER NEP-2020)

***B. Sc. :: BOTANY PRACTICAL :: SEMESTER-V***

***(MINOR DISCIPLINE SPECIFIC CORE COURSES)***

***Programme Code: SCIUG103***

***PLANT MORPHOLOGY,***

***INSTRUMENTATION AND METHODOLOGY***

***SC23PMiDSCBOT502***

**Date:**

**Place:**

**Time: 05:00 Hrs**

**Total Marks: 50**

**Instructions:** Strictly follow the instructions given by examiner(s).

- |                                                                                           |    |
|-------------------------------------------------------------------------------------------|----|
| 1. Identify and describe: (each specimen obtain 3 marks)                                  | 18 |
| • specimen <b>A</b> (Types of Bracts)                                                     |    |
| • specimen <b>B</b> (Types of inflorescence)                                              |    |
| • specimen <b>C</b> (Types of flower)                                                     |    |
| • specimen <b>D</b> (Androecium/Gynoecium)                                                |    |
| • specimen <b>E</b> (Placentation)                                                        |    |
| • specimen <b>F</b> (Types of Fruits)                                                     |    |
| 2. Identify and describe with its principle and application (specimen/chart/ photograph): | 24 |
| • specimen <b>G</b>                                                                       |    |
| • specimen <b>H</b>                                                                       |    |
| • specimen <b>I</b>                                                                       |    |
| • specimen <b>J</b>                                                                       |    |
| 3. a. <i>Viva-voce</i>                                                                    | 03 |
| b. Journal                                                                                | 05 |

**DETAILED SYLLABUS OF B.Sc. THIRD YEAR FOR DEGREE COURSE IN BOTANY**

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

(Effective from June 2025-26 UNDER NEP-2020)

<b>SKILL ENHANCEMENT COURSE (SEC)</b>							
<b>Programme Code: SCIUG103</b>							
<b>COURSE</b>	<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>CREDITS</b>	<b>LECTURES</b>	<b>THEORY</b>	
						<b>CCE</b>	<b>SEE</b>
<b>Degree Course</b>	<b>B.Sc. V</b>	<b>SC23SEC BOT506</b>	<b>NURSERY AND GARDENING</b>	<b>2T</b>	<b>T=30hrs</b>	<b>50%</b>	<b>50%</b>
<b>Course outcomes:</b>	<p>On completion of the course, the students will be able to:</p> <ul style="list-style-type: none"> <li>• <b>Career Opportunities:</b> Roles in landscaping, garden maintenance, nursery management, or as a horticulturist.</li> <li>• <b>Entrepreneurship:</b> Start your own plant nursery, landscaping business, or organic gardening venture.</li> <li>• <b>Skill Development:</b> Gain expertise in plant care, soil management, pest control, and sustainable gardening.</li> <li>• <b>Personal Use:</b> Enhance home gardening, kitchen gardens, or terrace farming.</li> <li>• <b>Further Education:</b> Foundation for advanced studies in horticulture, botany, or agricultural sciences.</li> </ul> <p><b>Pedagogy:</b> Lectures/ Use of Multimedia / Assignments/ Hands-on experiments/ Demonstrations/ Field visit.</p>						
<b>THEORY UNIT</b>	<b>TOPIC</b>						<b>NO. OF LECTURES (30hrs)</b>
<b>Unit 1</b>	<p><b>Nursery</b></p> <ul style="list-style-type: none"> <li>• Definition, objectives, scope and nursery management.</li> <li>• Planning and seasonal activities - Planting - direct seeding and transplant.</li> <li>• Seed storage: Seed banks, factors affecting seed viability.</li> <li>• Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.</li> </ul>						<b>15</b>

<b>Unit 2</b>	<b>Gardening</b> <ul style="list-style-type: none"> <li>• Definition, objectives and scope - different types of gardening - landscape and home gardening.</li> <li>• Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.</li> <li>• Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings.</li> <li>• Hardening of plants - green house - mist chamber, shed root, shade house and glass house.</li> </ul>	<b>15</b>
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***Suggested Readings:***

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National \_Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**B.Sc. Programme (CBCS - Semester - Grading Pattern)**  
 (Effective from June 2025-26 UNDER NEP-2020)  
**B. Sc.:: BOTANY :: SEMESTER END EXAMINATION**  
**PROGRAMME CODE: SCIUG103**  
**FORMAT FOR QUESTIONS PAPER FOR 4 CREDITS COURSE IN BOTANY**

(B.Sc. Sem. - V & VI)

The university examination paper consists of four questions.

- First question is of 12 marks and will be from Unit - I.
- Second question is of 13 marks and will be from Unit - II.
- Third question is of 12 marks and will be from Unit - III.
- Fourth question is of 13 marks and will be from Unit - IV.

No. of Printed Pages: \_\_\_

<b>Name of Subject : BOTANY</b>	<b>Paper Code :</b> MJDSCBOT-501, 501A, 601, 601A MiDSCBOT-502	
<b>Name of Paper :</b>		
<b>Total Hours : 02:30 Hrs</b>	<b>Total Marks : 50</b>	
<b>Instructions:</b> (1) This question paper contains four questions. (2) All questions are compulsory. (3) Figures at right side indicate the marks of question. (4) Illustrate your answer with labelled diagram.		
<b>Que.1 (A)</b>	<b>Describe in detail:(any one)</b> (1) (2)	<b>08</b>
<b>(B)</b>	<b>Write a short note on:(any one)</b> (1) (2)	<b>04</b>
<b>Que.2 (A)</b>	<b>Describe in detail:(any one)</b> (1) (2)	<b>09</b>
<b>(B)</b>	<b>Write a short note on:(any one)</b> (1) (2)	<b>04</b>
<b>Que.3 (A)</b>	<b>Describe in detail:(any one)</b> (1) (2)	<b>08</b>
<b>(B)</b>	<b>Write a short note on:(any one)</b> (1) (2)	<b>04</b>
<b>Que.4(A)</b>	<b>Describe in detail:(any one)</b> (1) (2)	<b>09</b>
<b>(B)</b>	<b>Write a short note on:(any one)</b> (1) (2)	<b>04</b>

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**B.Sc. Programme (CBCS - Semester - Grading Pattern)**  
 (Effective from June 2025-26 UNDER NEP-2020)  
**B. Sc.:: BOTANY :: SEMESTER END EXAMINATION**  
**PROGRAMME CODE: SCIUG103**  
**FORMAT FOR QUESTIONS PAPER FOR 2 CREDITS COURSE IN BOTANY**

(B.Sc. Sem. - V & VI)

The university examination paper consists of three questions.

- First question is of **10** marks and will be from **Unit - I**.
- Second question is of **10** marks and will be from **Unit - II**.
- Third question is of **05** marks and will be from **Unit - I & II**.

No. of Printed Pages: \_\_\_\_

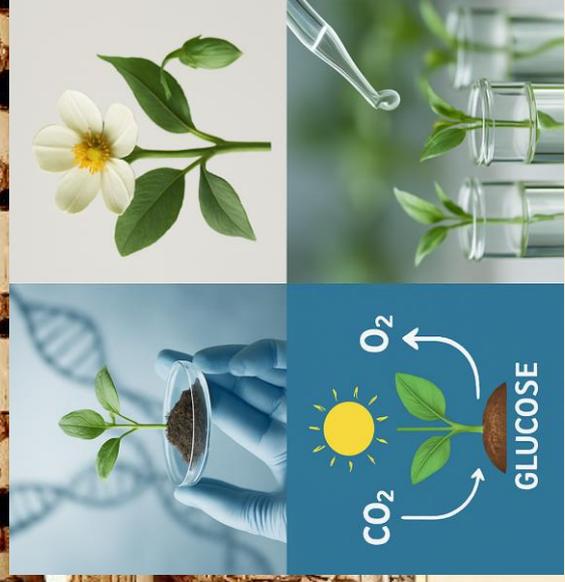
<b>Name of Subject : BOTANY</b>		<b>Paper Code:</b> MiDSCBOT-602 AEC -604 SECBOT- 506
<b>Name of Paper :</b>		
<b>Total Hours : 02:00 Hrs</b>		<b>Total Marks : 25</b>
<b>Instructions:</b> (1) This question paper contains three questions. (2) All questions are compulsory. (3) Figures at right side indicate the marks of question. (4) Illustrate your answer with labelled diagram.		
<b>Que.1(A)</b>	<b>Describe in Detail (any one).</b> (1) (2)	<b>Marks</b> <b>06</b>
<b>(B)</b>	<b>Write a short note on (any one).</b> (1) (2)	<b>04</b>
<b>Que.2(A)</b>	<b>Describe in Detail (any one).</b> (1) (2)	<b>06</b>
<b>(B)</b>	<b>Write a short note on (any one).</b> (1) (2)	<b>04</b>
<b>Que.3</b>	<b>Do as directed ( five out of seven).</b> (1) (2) (3) (4) (5) (6) (7)	<b>05</b>

## **Important Notifications and Guidelines released from UGC & Ministry of Education, Government of India for reference.**

1. NEP-2020-English: From page No. 33-Major problems faced by the higher education system and key changes required in current education system ([https://www.education.gov.in/sites/upload\\_files/mhrd/files/NEP\\_Final\\_English\\_0.pdf](https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf))
2. Gujarati version of NEP-2020 ([https://www.education.gov.in/sites/upload\\_files/mhrd/files/nep/2020/GUJARATI.pdf](https://www.education.gov.in/sites/upload_files/mhrd/files/nep/2020/GUJARATI.pdf))
3. IKS in Higher Education Curricula: Details of course and curriculum of IKS which will be integral part of current education system ([https://www.ugc.gov.in/pdfnews/6436045\\_Guidelines- IKS-in-HE-Curricula.pdf](https://www.ugc.gov.in/pdfnews/6436045_Guidelines- IKS-in-HE-Curricula.pdf))
4. Training of faculty on IKS: Need and process of training of faculties on IKS ([https://www.ugc.gov.in/pdfnews/3746302\\_Guidelines-for-TrainingOrientation-of-Faculty- on-Indian-Knowledge-System-\(IKS\).pdf](https://www.ugc.gov.in/pdfnews/3746302_Guidelines-for-TrainingOrientation-of-Faculty- on-Indian-Knowledge-System-(IKS).pdf))
5. Multiple Entry and Exit Options: The mechanism to adopt flexibility of multiple entry and exit in all HEIs to facilitate the students during academic cycle (<https://www.ugc.gov.in/e-book/GL%20Multiple%20Entry%20Exit.pdf>)
6. Apprenticeship/ship: Objective, process and roles of HEIs and Industries to implement ship/apprenticeship ([https://www.ugc.gov.in/pdfnews/9105852\\_ugc-guidelines Apprenticeshipship.pdf](https://www.ugc.gov.in/pdfnews/9105852_ugc-guidelines_Apprenticeshipship.pdf))
7. Open and Distance Learning (ODL): Guideline, process, and eligible institutes to provide the ODL mode of learning. [https://www.ugc.gov.in/pdfnews/7421799\\_Current-Regulations.pdf](https://www.ugc.gov.in/pdfnews/7421799_Current-Regulations.pdf)
8. Curriculum and Credit Framework: Suggestive points by UGC to design the course curriculum and define the credit structure ([https://www.ugc.gov.in/pdfnews/7193743\\_FYUGP.pdf](https://www.ugc.gov.in/pdfnews/7193743_FYUGP.pdf))
9. Academic Bank of Credits: Objective, function and implementation methodology of Academic Bank of Credits into HEIs [https://www.ugc.gov.in/pdfnews/9327451\\_Academic-Bank-of-Credits-in-Higher-Education.pdf](https://www.ugc.gov.in/pdfnews/9327451_Academic-Bank-of-Credits-in-Higher-Education.pdf))
10. Transforming Higher Education: Objective, approach and readiness of the institution to transform into multidiscipline institutions ([https://www.ugc.gov.in/pdfnews/5599305\\_Guidelines-for-Transforming-Higher-Education- Institutions-into-Multidisciplinary-Institutions.pdf](https://www.ugc.gov.in/pdfnews/5599305_Guidelines-for-Transforming-Higher-Education- Institutions-into-Multidisciplinary-Institutions.pdf))
11. National Credit Framework: Assignment of credits, Implementation, and operationalization of credit framework through ABC [https://www.ugc.gov.in/pdfnews/9028476\\_Report-of-National-Credit-Framework.pdf](https://www.ugc.gov.in/pdfnews/9028476_Report-of-National-Credit-Framework.pdf))
12. National Higher Education Qualification Framework: NHEQF level qualification specification and Course Learning Outcome ([https://www.ugc.gov.in/pdfnews/9028476\\_Report-of-National-Credit-Framework.pdf](https://www.ugc.gov.in/pdfnews/9028476_Report-of-National-Credit-Framework.pdf))
13. Blended mode of Learning: Infrastructure readiness at HEIs, implementation process, assessment and evaluation and suggested framework for blended mode of learning. ([https://www.ugc.gov.in/pdfnews/6100340\\_Concept-Note-Blended-Mode-of-Teaching-and-Learning.pdf](https://www.ugc.gov.in/pdfnews/6100340_Concept-Note-Blended-Mode-of-Teaching-and-Learning.pdf))
14. Practical exam (<https://ngu.ac.in/Admin/CircularPDF/PARIXA-KHANGI-EMAIL-2024.pdf>)
15. Common credit structure (<https://ngu.ac.in/Admin/CircularPDF/Credit%20Framework%20GR%20Gujarati%2011072023.pdf>)

**:- ୧୯୯୯ ହରିଡ଼ିଏ ରାଣିନିଗାଢ଼ :-**

# **BOTANY HONOURS THIRD YEAR FULL SYLLABUS**



HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC A (3.02) State University

PATAN- 384265

**Faculty of Science**

**B. Sc. Zoology**

Syllabus/ scheme

**Semester – 5 to 6**



*With effect from*

*June-2025*

Date: 03/07/2025

Total page: 45

<b>HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN</b>	
<b>B. Sc. (Zoology) Syllabus 2025 (according to NEP-2020)</b>	
<b>Document code</b>	<b>Syllabus ZL- 2025</b>
<b>Name of faculty</b>	<b>Science</b>
<b>Faculty code</b>	<b>SCI</b>
<b>Programme name</b>	<b>B. Sc. ZOOLOGY</b>
<b>Programme code</b>	<b>SCIUG104</b>
<b>Effective from</b>	<b>June-2025</b>

The proposed new structure for B. Sc. course is based on NEP-2020 which is in force June-2025.

### **Course Pattern**

1. This programme is divided into **Eight Semesters** (Four Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 176 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks  $\times$  4). The theory courses with 3 credits shall have 45 hrs of teaching workload (15 weeks  $\times$  3) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks  $\times$  2).

**Attendance:** The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

**Medium of Instruction:** The medium of instruction shall be Gujarati but students are free to write answers in Gujarati or English in examination.

**Language of question paper:** Question paper should be drawn in Gujarati and English translation of the questions must be given in the question paper.

Number of students in each batch for practical examination should be 15.

## Evaluation

### Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skill (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	<b>Total</b>	<b>50</b>

2. For CCE of 25 marks following component should be used.

Sr. No.	Component	Marks
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	<b>Total</b>	<b>25</b>

### Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	Total marks	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each)
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each)
Q. 3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each)
Q. 4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each)
Q. 5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each)
<b>Total</b>	<b>50</b>	

2. For SEE of 25 marks following question paper style should be used.

	<b>Total marks</b>	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each)
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each)
Q. 3	05	08 short questions must be drawn from both units, out of which any 05 must be answered (1 marks each)
<b>Total</b>	<b>25</b>	

## **PROGRAM OBJECTIVE**

1. The primary objective of the program is to impart quality education in the subject of Zoology as a basic science and its applied branches to the students.
2. To provide quality education in a branch of biological sciences i.e., Zoology with different specializations.
3. To facilitate Higher education & research in zoology.
4. To provide quality education offering skill-based programs and motivate the students for self-employment in applied branches of Zoology.
5. To inculcate the spirit of resource conservation and love for nature.
6. To conduct field studies and different projects of local and global interests.
7. To provides opportunities for professional and personal development through curricular and co- curricular activities.
8. Provide consultancy and organize extension activities.

## **PROGRAMME OUTCOMES**

1. To understand the complex phylogeny, physiology, immunology, endocrinology, development biology and evolution of different animals.
2. For instance, if you major in Zoology, you can also still take courses from across the other complementary.
3. Apply the wide range of subject based skills of various fields that provide a base for future career in disciplines such as Health Sciences, Aquaculture, Agriculture, Environmental Management, Biotechnology, Publishing, Teaching and Research.
4. Understand the applications of biological techniques to various fields of biology.
5. When you graduate with a Bachelor of Science (Zoology) you can serve as academician in different institutes.
6. The syllabus has been designed in such a way that it will give good experience to the student to work under pressure.

### B.Sc. Semester V (Zoology)

Course	Coursecode	Papertitle	Teaching hoursper week	CCE	SEE	Total marks	Credit points	Examduration(Hours)
MajorDiscipline Specific corecourse	SC23MJDSC ZOO501	Developmental Biology	4	50	50	100	4	2.30
MajorDiscipline Specific corecourse	SC23MJDSC ZOO501AIKS	Traditional Knowledge in Zoology (IKS-Major)	4	50	50	100	4	2.30
MinorDisciplinary Course	SC23MIDC ZOO502	Wildlife Conservation	4	50	50	100	4	2.30
Major Discipline Specific corecourse Practical Paper	SC23PMJDSC ZOO501	Practical PartA (Developmental Biology)	4	25	25	50(PartA) + 50(PartB) =100	2(PartA) + 2(PartB) =4	Morethan3
	SC23PMJDSC ZOO501AIKS	Practical PartB (Traditional Knowledge in Zoology (IKS-Major))	4	25	25			Morethan3
Minor Discipline Specific core course Practical Paper	SC23PMIDC ZOO502	Wildlife Conservation	8	50	50	100	4	Morethan3
Skill Enhancement Course	SC23SECZOO506	Basics of Biotechnology	2	25	25	50	2	2
<b>Total</b>			<b>30</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

### B.Sc. Semester VI (Zoology)

Course	Course code	Paper title	Teaching hours per week	CCE	SEE	Total marks	Credit points	Exam duration (Hours)
Major Discipline Specific core course	SC23MJDSC ZOO601	Biochemistry	4	50	50	100	4	2.30
Major Discipline Specific core course	SC23MJDSC ZOO601A	Cell Biology, Molecular Biology and Genetics	4	50	50	100	4	2.30
Minor Disciplinary Course	SC23MIDC ZOO602	Biological Chemistry	2	25	25	50	2	2.00
Major Discipline Specific core course Practical Paper	SC23PMJDSC ZOO601	Practical Part A (Biochemistry)	4	25	25	50 (Part A) + 50 (Part B) = 100	2 (Part A) + 2 (Part B) = 4	More than 3
	SC23PMJDSC ZOO601A	Practical Part B (Cell Biology, Molecular Biology and Genetics)	4	25	25			More than 3
Minor Discipline Specific core course Practical Paper	SC23PMID CZOO602	Biological Chemistry	4	25	25	50	2	More than 3
Ability Enhancement Course	SC23AEC ZOO604	English	2	25	25	50	2	2.00
Internship	SC23INTZOO 607	Internship		50	50	100	4	
<b>Total</b>			<b>30</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

# **Semester V**

### B.Sc. Semester V (Zoology)

Course	Coursecode	Papertitle	Teaching hoursper week	CCE	SEE	Total marks	Credit points	Examduration(Hours)
MajorDiscipline Specific corecourse	SC23MJDSC ZOO501	Developmental Biology	4	50	50	100	4	2.30
MajorDiscipline Specific corecourse	SC23MJDSC ZOO501AIKS	Traditional Knowledge in Zoology (IKS-Major)	4	50	50	100	4	2.30
MinorDisciplinary Course	SC23MIDC ZOO502	Wildlife Conservation	4	50	50	100	4	2.30
Major Discipline Specific corecourse Practical Paper	SC23PMJDSC ZOO501	Practical PartA (Developmental Biology)	4	25	25	50(PartA) + 50(PartB) =100	2(PartA) + 2(PartB) =4	Morethan3
	SC23PMJDSC ZOO501AIKS	Practical PartB (Traditional Knowledge in Zoology (IKS-Major))	4	25	25			Morethan3
Minor Discipline Specific core course Practical Paper	SC23PMIDC ZOO502	Wildlife Conservation	8	50	50	100	4	Morethan3
Skill Enhancement Course	SC23SECZOO506	Basics of Biotechnology	2	25	25	50	2	2
<b>Total</b>			<b>30</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**COURSE NAME B. SC. ZOOLOGY SEMESTER V**

**PROGRAM CODE: SCIUG104**

**MAJOR DISCIPLINE SPECIFIC COURSE CODE: SC23MJDS CZOO501**

**DEVELOPMENTAL BIOLOGY**

**EFFECTIVE FROM JUNE 2025-26 UNDER NEP**

<b>Total Credits- 04</b> <b>(04 Period/Week)</b>	<b>Theory</b>	<b>External-50 Marks</b>
		<b>Internal- 50 Marks</b>

**Program Outcome:**

After thorough understanding of the content student will be able to explain:

1. Various processes involved in gametogenesis.
2. Early developmental processes occurring in vertebrates.
3. Later developmental processes occurring in vertebrates

**Course Outcome:**

After thorough understanding of the content student will be able to explain:

1. To develop knowledge of developmental biology.
2. To develop knowledge about early developmental stages in animals.
3. To develop knowledge about later developmental stages in animals.
4. To develop knowledge about advance techniques in developmental biology

<b>Sr. No</b>			<b>Credit</b>	<b>Hr</b>
<b>1</b>	<b>Unit-1</b>	<ul style="list-style-type: none"><li>• History and concepts of developmental biology.</li><li>• Gametogenesis, Spermatogenesis, Oogenesis.</li><li>• Male gamete: structure and types of sperms.</li><li>• Female gamete: structure, types of eggs, Egg membranes.</li></ul>	<b>1</b>	<b>15</b>
<b>2</b>	<b>Unit-2</b>	<ul style="list-style-type: none"><li>• Process of fertilization, blocks to polyspermy, physiological changes during fertilization.</li><li>• Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques).</li><li>• Early development of frog and chick up to gastrulation; Embryonic induction and organizers.</li><li>• Organogenesis in frog: formation of neural tube and heart.</li><li>• Development of chick embryo.</li></ul>	<b>1</b>	<b>15</b>

3	<b>Unit-3</b>	<ul style="list-style-type: none"> <li>• Fate of Germ Layers; Extra-embryonic membranes in birds; Placenta (Structure, types, and functions of placenta).</li> <li>• Metamorphosis: Changes, hormonal regulations in amphibians and insects.</li> <li>• Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each).</li> <li>• Stem Cells &amp; Their Applications – Types (embryonic, adult, induced pluripotent stem cells), regenerative medicine.</li> </ul>	<b>1</b>	<b>15</b>
4	<b>Unit-4</b>	<ul style="list-style-type: none"> <li>• Mammalian female reproductive cycles estrous cycle and menstruation.</li> <li>• Aging: the biology of senescence.</li> <li>• Teratogenesis: Teratogenic agents and their effects on embryonic development.</li> <li>• Assisted Reproductive Technologies (ART): sperm banks, frozen embryos, ovarian tissue freezing, in vitro fertilization (IVF).</li> </ul>	<b>1</b>	<b>15</b>

**Reference:**

**Further Reading:**

1. Gilbert, S. F. (2010). *Developmental Biology*, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
2. Balinsky B. I. and Fabian B. C. (1981). *An Introduction to Embryology*, V Edition, International Thompson Computer Press
3. Carlson, R. F. *Patten's Foundations of Embryology*
4. Gardner, D.K., Weissman, A., Howles, C.M., & Shoham, Z. (Eds.). (2023). *Textbook of Assisted Reproductive Techniques: Volume 1: Laboratory Perspectives* (6th ed.). CRC Press.

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**COURSE NAME B. SC. ZOOLOGY SEMESTER V**

**PROGRAM CODE: SCIUG104**

**MAJOR DISCIPLINE SPECIFIC COURSE CODE:SC23MJDSCZOO501AIKS**

**TRADITIONAL KNOWLEDGE IN ZOOLOGY (IKS-MAJOR)**

**EFFECTIVE FROM JUNE 2025-26 UNDER NEP**

<b>Total Credits- 04 (04 Period/Week)</b>	<b>Theory</b>	<b>External-50 Marks</b>
		<b>Internal- 50 Marks</b>

**Program Outcome:**

1. The programme shall help students to understand importance and role of animals in an ecosystem.
2. Understand the applications of techniques to various fields of biology.
3. The programme shall provide subject based skills of various fields that provide a base for future career in disciplines such as Health Sciences, Aquaculture, Agriculture, Environmental Management, Biotechnology, Publishing, Teaching and Research.

**Course Outcome:**

After thorough understanding of the content student will be able to explain:

1. Scope and importance of IKS and Zoology
2. Importance of Yoga, Ayurveda, and its health benefits
3. Tradition of animal conservation

<b>Sr. No</b>		<b>Credit</b>	<b>Hr</b>
<b>1</b>	<p><b>Unit-1</b></p> <ul style="list-style-type: none"> <li>• Introduction to Indian Knowledge System: Sankhya, Vaisheshik, Yoga, Ayurveda, Nyaya, Vedanta Etc.</li> <li>• Ancient Indian texts describing animals. Description of cow and other animals in Vedas.</li> <li>• Traditional uses of animals in agricultural practices and milk production: Cow, Buffalo, Goat, Sheep etc.</li> <li>• Other traditional uses of animals like transportation and wars: Horse, Camel, and Elephants.</li> <li>• Cultural significance of animals highlighted by traditional festivals and Rituals.</li> </ul>	<b>1</b>	<b>15</b>
<b>2</b>	<p><b>Unit-2</b></p> <ul style="list-style-type: none"> <li>• Yoga: Introduction to Ashtang Yoga with special emphasis on Asanas and Pranayama.</li> <li>• Effect of the yoga on the Physiology: Role of Bhramari in brain health.</li> <li>• Effect of Kapalbhathi on digestive health and other systems.</li> <li>• Role of Omkar on mental health, Ujjayi, and throat health.</li> </ul>	<b>1</b>	<b>15</b>

		<ul style="list-style-type: none"> <li>• Anulom Vilom and its health benefits.</li> <li>• Bhastrika Pranayama: Effect on the lungs and brain physiology.</li> </ul>		
<b>3</b>	<b>Unit-3</b>	<ul style="list-style-type: none"> <li>• Ayurveda and human health: Introduction to Ayurvedic texts; Charak Samhita, Sushrut Samhita, Ashtang Hriday etc.</li> <li>• Use of animals in Ayurveda: Jaloka Avcharan (Leech therapy) mentioned in Ayurveda: process and its benefits. Cowpathy: Use of cow urine in various illness as mentioned in the Ayurvedic texts.</li> <li>• Use of Panchagavya for health benefits.</li> <li>• Use of cow dung and cow ghee in Dhooan Chikitsa, Properties and uses of milk and urine of different animals as described in Ayurvedic texts.</li> <li>• Viruddh Ahar as per Ayurveda and illness caused by it.</li> <li>• Introduction to Panchakarma: The cleansing processes for different organ systems, procedure, their benefits to restore the health. Different Panchkarma practices for various diseases.</li> </ul>	<b>1</b>	<b>15</b>
<b>4</b>	<b>Unit-4</b>	<ul style="list-style-type: none"> <li>• Traditional ecological knowledge and its relevance to biodiversity conservation, Sacred animals of India as per our ancient texts.</li> <li>• Conservation of ecosystem by our ancestors: sacred grooves of Rajasthan, Madhya Pradesh, Western Ghats and Meghalaya: their religious and ecological Importance.</li> <li>• Sacred grooves as hotspot of biodiversity.</li> <li>• Temple based conservation and hospitals for animals. Ashrams as Abhyaranya for animals.</li> <li>• Different animals associated with God and Goddess, reinforcing their protection.</li> <li>• Symbolism of animals in Indian literature.</li> </ul>	<b>1</b>	<b>15</b>
<p><b>Reference:</b></p> <p><b>Further Reading:</b></p> <ol style="list-style-type: none"> <li>1. Charak Sutrathan Adhyay 1: Dirghjivantiya</li> <li>2. Charak Sutrasthan: Adhyay 26, Atreya Bhadra kapyā</li> <li>3. Abhigyan Shakuntala by Mahakavi kalidas</li> <li>4. Jalauka Avacharaniya Adhyay, Sushrut Samhita</li> <li>5. Patanjali Yogasutra</li> <li>6. Yoga Vashishta</li> </ol>				

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**COURSE NAME B. SC. ZOOLOGY SEMESTER V**

**PROGRAM CODE: SCIUG104**

**PRACTICAL MAJOR DISCIPLINE SPECIFIC COURSE CODE:**

**SC23PMJDSCZOO501 & SC23PMJDSCZOO501AIKS**

**DEVELOPMENTAL BIOLOGY PRACTICAL PART A**

**TRADITIONAL KNOWLEDGE IN ZOOLOGY (IKS-MAJOR) PART B**

**EFFECTIVE FROM JUNE 2024-25 UNDER NEP**

<b>Total Credits- 04</b>	<b>Part A: 2 credits</b>	<b>(04 Period/Week)</b>	<b>Internal- 25 Marks</b>	<b>External-25 Marks</b>	<b>Total marks: 100</b>
	<b>Part B: 2 credits</b>	<b>(04 Period/Week)</b>	<b>Internal- 25 Marks</b>	<b>External-25 Marks</b>	

**SC23PMJDSCZOO501 DEVELOPMENTAL BIOLOGY PRACTICAL PART A**

**List of Practicals**

1. To study the process of spermatogenesis through permanent slides.
2. To study the different types of sperm through permanent slides.
3. To prepare temporary mount of sperm from collected sample.
4. To study the process of oogenesis through permanent slides.
5. To study the different types of eggs through permanent slides or specimen.
6. To study the different types of cleavage through permanent slides.
7. To study the different patterns of cleavage through permanent slides.
8. To study blastula and gastrula stages in frog and chick through permanent slides.
9. To study structure of egg of hen using fresh or boiled egg.
10. To study development of chick embryo with respect to hour of incubation through permanent slides.
11. To study permanent mount of chick embryo from fertilized eggs.
12. To study torsion and flexion in chick through permanent slides or charts.
13. To study formation of various organs in frog through permanent slides of T. S. and L.S. of various organs.
14. To study metamorphosis in frog through modes, permanent slides or live specimens.
15. To study estrous cycle using chart.
16. To study menstrual cycle hormonal changes using chart.
17. Study of teratogenesis – teratogenic agents and their effects on embryonic development.

**SC23PMJDSCZOO501AIKS: TRADITIONAL KNOWLEDGE IN ZOOLOGY (IKS-MAJOR) PART B**  
**List of Practicals**

1. To study six schools of Indian philosophy in brief.
2. Description of ancient books describing animals.
3. To study traditional uses of animals for agricultural practices and milk production by chart/ models.
4. To study traditional uses of animals for transportation and other purposes by chart/ models.
5. To understand the Ashtang yoga by charts/ visuals.
6. To study and practice Omkar, Bhramari and Bhastrika write their benefits.
7. To study and practice Kapalbhata, Anulom Vilom and Ujjayi and write their benefits.
8. To understand the effect of Pranayama on human physiology.
9. To study Jaloka Avcharan; process and benefits by charts/models.
10. To study cowpathy and role of Panchagavya for human health by charts/ models
11. To study the Panchakarma process and role in different diseases by charts/models.
12. To study the sacred animals of India by charts/models.
13. To study about sacred grooves of India by charts/ models.
14. To understand the symbolism of animals in Indian literature.
15. To visit a culturally important place like Gaushala, Yoga Shala, Ayurveda college or a place traditionally conserving the animals to understand the Indian knowledge system in context with biological science and make report of it.

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**COURSE NAME B. SC. ZOOLOGY SEMESTER V**  
**PROGRAM CODE: SCIUG104**  
**MINORDISCIPLINARY SPECIFIC COURSE CODE: SC23MIDCZOO502**

**WILDLIFE CONSERVATION**

**EFFECTIVE FROM JUNE 2024-25 UNDER NEP**

<b>Total Credits - 04</b>	<b>(04 Period/Week)</b>	<b>Internal- 50 Marks</b>	<b>External-50 Marks</b>	<b>Total marks: 100</b>
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**Program Outcome:**

1. The programme shall help students to understand importance and role of animals in an ecosystem.
2. Understand the applications of techniques to various fields of biology.
3. The programme shall provide subject based skills of various fields that provide a base for future career in disciplines such as Health Sciences, Aquaculture, Agriculture, Environmental Management, Biotechnology, Publishing, Teaching and Research.

**Course Outcome:**

After thorough understanding of the content student will be able to explain:

1. Students will learn to identify and classify major wildlife species in India and understand their ecological roles in biodiversity conservation.
2. Students will learn about India's Wildlife Protection Act, 1972, conservation policies, and different approaches such as in-situ and ex-situ conservation.
3. Students will learn about key conservation initiatives like Project Tiger, Project Elephant, and Project Snow Leopard, along with their impact and challenges.
4. Students will learn essential wildlife research techniques, including population estimation, biodiversity assessment, and human-wildlife conflict management.

Sr. No		Credit	Hr
<b>1</b>	<b>Unit-1</b> <ul style="list-style-type: none"> <li>● Definition and scope of wildlife biology.</li> <li>● Biodiversity of India: Major ecosystems (forests, wetlands, grasslands, deserts, and marine ecosystems).</li> <li>● Ecological roles of wildlife and their importance in ecosystem functioning.</li> <li>● Classification of Indian wildlife: Mammals, birds, reptiles, amphibians, and aquatic species.</li> <li>● Threats to wildlife: Habitat destruction, poaching, pollution, invasive species, and climate change.</li> </ul>	<b>1</b>	<b>15</b>

2	<b>Unit-2</b>	<ul style="list-style-type: none"> <li>● Wildlife conservation approaches: In-situ (National Parks, Wildlife Sanctuaries, Biosphere Reserves) and Ex-situ (Zoos, Rescue Centers, Seed Banks).</li> <li>● Mapping of major National Parks, Wildlife Sanctuaries, and Biosphere Reserves in India.</li> <li>● Overview of India's Wildlife Protection Act, 1972 and amendments.</li> <li>● Role of national and international organizations: Wildlife Institute of India (WII), National Biodiversity Authority (NBA), IUCN, WWF, CITES, and UNEP.</li> </ul>	1	15
3	<b>Unit-3</b>	<ul style="list-style-type: none"> <li>● Project Tiger: History, objectives, success, and challenges</li> <li>● Project Elephant: Conservation of elephants and mitigation of human-elephant conflicts.</li> <li>● Conservation efforts for other endangered species: One-horned Rhinoceros, Indian Bustard, and Gangetic Dolphin.</li> <li>● Human-wildlife conflict mitigation: Case studies and sustainable solutions.</li> </ul>	1	15
4	<b>Unit-4</b>	<ul style="list-style-type: none"> <li>● Methods of population estimation: Line transect, camera trapping, and radio telemetry.</li> <li>● Introduction to GIS and remote sensing in wildlife conservation.</li> <li>● Role of genetics in wildlife conservation: DNA fingerprinting and species identification.</li> <li>● Biodiversity assessment and preparation of biodiversity reports.</li> <li>● Sustainable wildlife management: Wildlife corridors, protected area management, and role of legal frameworks.</li> </ul>	1	15

**Reference:**

1. T A Bookhout 1996. Research and Management Techniques for Wildlife and Habitats. The Wildlife Society, ML
2. D E Wilson 2002. Measuring and Monitoring Biological Diversity: Standard Methods. The Smithsonian Institution, USA
3. J P Sands et al. 2012. Wildlife Science: Connecting Research with Management. CRC Press, Taylor and Francis Group.

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**COURSE NAME B. SC. ZOOLOGY SEMESTER V**  
**PROGRAM CODE: SCIUG104**  
**PRACTICAL MINORDISCIPLINARY SPECIFIC COURSE CODE:**  
**SC23PMIDCZOO502**

**WILDLIFE CONSERVATION**

**EFFECTIVE FROM JUNE 2024-25 UNDER NEP**

<b>Total Credits- 04      (08 Period/Week)</b>	<b>External-50 Marks</b>
	<b>Internal- 50 Marks</b>

**List of Practicals**

1. Identification and classification of common wildlife species in India, including mammals, birds, reptiles, and amphibians using field guides and photographs.
2. Study of different types of protected areas in India (National Parks, Wildlife Sanctuaries, Biosphere Reserves) and their significance in conservation.
3. Mapping of national parks of India using simple map-marking techniques.
4. Mapping of wildlife sanctuaries of India using simple map-marking techniques.
5. Mapping of biosphere reserves of India using simple map-marking techniques.
6. Observation of wildlife behavior through direct field visits or recorded videos to understand feeding, movement, and interaction patterns.
7. Introduction to population estimation techniques such as direct counting and camera trapping to understand how wildlife populations are studied using power point presentation.
8. Study of major wildlife conservation projects in India, including Project Tiger, Project Elephant, and Project Snow Leopard, and their impact on species protection.
9. To study role of national and international organizations.
10. Identification of wildlife signs such as pugmarks, scat, nests, and feeding remains to track animal presence in an area.
11. Role of local communities in wildlife conservation by studying traditional conservation practices and community-led initiatives.
12. Study of human-wildlife conflict issues in India and discussion of possible solutions through case studies.
13. Water quality assessment of a nearby wetland or river by analyzing basic physical parameters (Temperature, Turbidity, Colour, Taste, Odor, Total solids) and chemical parameters (pH, Free CO<sub>2</sub>, Dissolved Oxygen).
14. Preparation of a biodiversity report by documenting plant and animal species in a local ecosystem of given area.
15. Visit to a nearby wildlife sanctuary, zoo, or national park to observe conservation practices and wildlife management strategies.

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**COURSE NAME B. SC. ZOOLOGY SEMESTER V**  
**PROGRAM CODE: SCIUG104**  
**SKILL ENHANCEMENT COURSE CODE: SC23SECZOO506**

**BASICS OF BIOTECHNOLOGY**

**EFFECTIVE FROM JUNE 2024-25 UNDER NEP**

<b>Total Credits- 02 (02 Period/Week)</b>	<b>Theory</b>	<b>External- 25 Marks</b> <b>Internal- 25 Marks</b>
-------------------------------------------	---------------	--------------------------------------------------------

**Program Outcome:**

1. The programme shall help students to understand importance and role of animals in an ecosystem.
2. Understand the applications of techniques to various fields of biology.
3. The programme shall provide subject based skills of various fields that provide a base for future career in disciplines such as Health Sciences, Aquaculture, Agriculture, Environmental Management, Biotechnology, Publishing, Teaching and Research.

**Course Outcome:**

After thorough understanding of the content student will be able to explain:

1. The DNA based biotechnological aspects.
2. The use of biotechnology and agriculture and medical field

Sr. No		Credit	Hr
1	<b>Unit-1</b> <ul style="list-style-type: none"> <li>● Recombinant DNA technology, tools of r-DNA technology; restriction enzymes, DNA ligase.</li> <li>● Vectors for cloning: plasmids, vectors based on bacteriophage, animal and plant viral vectors, host cells.</li> <li>● processes of recombinant DNA technology: isolation of genetic material, polymerase chain reaction (PCR), introduction of r- DNA into host cells. identification of recombinants, obtaining products, downstream processing.</li> </ul>	1	15
2	<b>Unit-2</b> <ul style="list-style-type: none"> <li>● Applications of biotechnology: Application of biotechnology in agriculture; BT cotton.</li> <li>● Application of biotechnology in medical field: genetically engineered insulin, gene therapy, molecular diagnosis.</li> <li>● Transgenic animals and their Uses.</li> <li>● Ethical issues and biosafety measures.</li> </ul>	1	15

**Reference:**

1. Verma, P.S., & Agrawal, V.K. (2010). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.
2. Lodish, H., et al. (2007). Molecular Cell Biology. W.H. Freeman and Company, New York, USA.
3. Sambamurty, A.V.S.S. (2008). Molecular Biology. Narosa Publishing House, New Delhi.

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**COURSE NAME B. SC. ZOOLOGY SEMESTER V**

**PROGRAM CODE: SCIUG104**

**PRACTICAL MAJOR DISCIPLINE SPECIFIC COURSE CODE:**

**SC23PMJDSCZOO501 & SC23PMJDSCZOO501AIKS**

**DEVELOPMENTAL BIOLOGY PRACTICAL PART A**

**TRADITIONAL KNOWLEDGE IN ZOOLOGY (IKS-MAJOR) PRACTICAL PART B**

**EFFECTIVE FROM JUNE 2024-25 UNDER NEP**

**PRACTICAL SKELETON**

**Time: more than 3 Hours**

**Total Marks: 50**

**DEVELOPMENTAL BIOLOGY PRACTICAL PART A**

<b>Q 1</b>		Experiment related to embryonic Development of vertebrate.	<b>06</b>
<b>Q 2</b>		Practical related to gametogenesis.	<b>06</b>
<b>Q 3</b>		Do as directed. 1. Identify and describe the developmental stage of chick embryo. 2. Identify and describe the stage of frog metamorphosis 3. Spotting related to developmental cycle/effect of teratogens on development.	<b>06</b>
<b>Q 4</b>	<b>a</b>	Viva-voce	<b>03</b>
	<b>b</b>	Journal	<b>04</b>

**TRADITIONAL KNOWLEDGE IN ZOOLOGY (IKS-MAJOR) PRACTICAL PART B**

<b>Q 1</b>		Perform _____ Pranayama with Accuracy and write its benefits in detail.	<b>05</b>
<b>Q 2</b>		Write the Process of _____ and describe its uses. (Jalauka Avcharan/ Panchakarma).	<b>04</b>
<b>Q3</b>		Do as directed: 1. Identify and write uses. (Animals for agricultural practices/ Milk Production/ Transportation). 2. Identify and write Cultural Significance. (Sacred Animals/ Sacred Grooves). 3. Describe _____ in brief. (Six Schools of Indian Philosophy/ Anyone).	<b>06</b>
<b>Q 4</b>		Submission of Report based on visit to a place/ work done related to Indian knowledge system.	<b>04</b>
<b>Q 5</b>	<b>a</b>	Viva-voce	<b>03</b>
	<b>b</b>	Journal	<b>03</b>

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**COURSE NAME B. SC. ZOOLOGY SEMESTER V**  
**PROGRAM CODE: SCIUG104**  
**PRACTICAL MINORDISCIPLINARY SPECIFIC COURSE CODE:**  
**SC23MIDCZOO502**

**WILDLIFE CONSERVATION**

**EFFECTIVE FROM JUNE 2024-25 UNDER NEP**

**PRACTICAL SKELETON**

**Time: more than 3 Hours**

**Total Marks: 50**

<b>Q 1</b>	Practical related to water quality assessment of a nearby wetland or river.	<b>08</b>
<b>Q 2</b>	Study different type of protected area of India.	<b>04</b>
<b>Q 3</b>	Do as directed. 1. Identify and classify common wildlife species (mammals, birds, reptiles, and amphibians). 2. Identify and classify common wildlife species (mammals, birds, reptiles, and amphibians). 3. Observe the animal behaviour with photo/video and describe it. 4. Mapping given protected area using map-marking techniques. 5. Identify and describe the population counting techniques. 6. Identify and describe. (Wildlife signs). 7. Identify and describe. (Wildlife Projects). 8. Identify and describe. (National/International Organizations).	<b>16</b>
<b>Q 4</b>	Submission of local biodiversity report.	<b>06</b>
<b>Q5</b>	Submission of visit report (Sanctuary, National Park, Zoo).	<b>06</b>
<b>Q6</b>	Viva-voce	<b>05</b>
<b>Q7</b>	Journal	<b>05</b>

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY

NAAC A (3.02) State University

PATAN- 384265

**Faculty of Science**

**B. Sc. Microbiology**

Syllabus/ scheme

**Semester – 5 to 6**



*With effect from*

*June-2025*

Date: 03/07/2025

Total page: 24

<b>HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY PATAN</b>	
<b>B. Sc. (Microbiology) Syllabus 2025 (according to NEP-2020)</b>	
<b>Document code</b>	<b>Syllabus MIC- 2025</b>
<b>Name of faculty</b>	<b>Science</b>
<b>Faculty code</b>	<b>SCI</b>
<b>Programme name</b>	<b>B. Sc. MICROBIOLOGY</b>
<b>Programme code</b>	<b>SCIUG105</b>
<b>Effective from</b>	<b>June-2025</b>

The proposed new structure for B. Sc. course is based on NEP-2020 which is in force June-2025.

### **Course Pattern**

1. This programme is divided into **Eight Semesters** (Four Years). The duration of an academic year consists of two semesters, each of 15 weeks for teaching. The academic session in each semester will provide 90 teaching days. Each semester has 22 credits, and the programme is comprised of total 176 credits.
2. The theory courses with 4 credits shall have 60 hrs of direct classroom teaching workload (15 weeks  $\times$  4). The theory courses with 3 credits shall have 45 hrs of teaching workload (15 weeks  $\times$  3) and the theory courses with 2 credits shall have 30 hrs of teaching workload (15 weeks  $\times$  2).

**Attendance:** The attendance rules will be as per the rules and regulation of Hemchandracharya North Gujarat University, Patan.

**Medium of Instruction:** The medium of instruction shall be Gujarati but students are free to write answers in Gujarati or English in examination.

**Language of question paper:** Question paper should be drawn in Gujarati and English translation of the questions must be given in the question paper.

Number of students in each batch for practical examination should be 15.

## Evaluation

### Continuation and Comprehensive Evaluation (CCE)

1. For CCE of 50 marks following component should be used.

<b>Sr. No.</b>	<b>Component</b>	<b>Marks</b>
1	Daily/Weekly/Monthly unit test/ Internal exam	25
2	Assignment/ Quiz test	10
3	Development of soft skill (Seminar/ Group discussion)	05
4	Solving exercise/ Work base training/ Reading analysis	05
5	Attendance	05
	<b>Total</b>	<b>50</b>

2. For CCE of 25 marks following component should be used.

<b>Sr. No.</b>	<b>Component</b>	<b>Marks</b>
1	Daily/Weekly/Monthly unit test/ Internal exam	15
2	Assignment/ Quiz test	05
4	Attendance	05
	<b>Total</b>	<b>25</b>

### Semester End Evaluation (SEE)

1. For SEE of 50 marks following question paper style should be used.

	<b>Total marks</b>	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each)
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each)
Q. 3	10	Must be drawn from Unit 3 and will have three long questions out of which any two must be answered (5 marks each)
Q. 4	10	Must be drawn from Unit 4 and will have three long questions out of which any two must be answered (5 marks each)
Q. 5	10	08 short questions must be drawn from all units, out of which any 05 must be answered (2 marks each)
<b>Total</b>	<b>50</b>	

2. For SEE of 25 marks following question paper style should be used.

	<b>Total marks</b>	
Q. 1	10	Must be drawn from Unit 1 and will have three long questions out of which any two must be answered (5 marks each)
Q. 2	10	Must be drawn from Unit 2 and will have three long questions out of which any two must be answered (5 marks each)
Q. 3	05	08 short questions must be drawn from both units, out of which any 05 must be answered (1 marks each)
<b>Total</b>	<b>25</b>	

## **PROGRAM OBJECTIVE**

1. The primary objective of the program is to impart quality education in the subject of Microbiology as a basic science and its applied branches to the students.
2. To provide quality education in a branch of biological sciences i.e., Microbiology with different specializations.
3. To facilitate Higher education & research in Microbiology.
4. To provide quality education offering skill-based programs and motivate the students for self-employment in applied branches of Microbiology.
5. To inculcate the spirit of microbial resource conservation, utilization and also love for nature.
6. To provides opportunities for professional and personal development through curricular and co- curricular activities.
7. Provide consultancy and organize extension activities.

## **PROGRAMME OUTCOMES**

1. To understand the complex organization of microbial world, physiology, immunology, bioprospecting and importance of microbes in various biogeochemical
2. cycles and for overall development.
3. For instance, if you major in Microbiology, you can also still take courses from across the other complementary.
4. Apply the wide range of subject based skills of various fields that provide a base for future career in disciplines such as Fermentation technology, Food microbiology, Environmental microbiology, Microbial biotechnology, Agriculture, Publishing, Teaching and Research.
5. Understand the applications of biological techniques to various fields of biology.
6. When you graduate with a Bachelor of Science (Microbiology) you can serve as academician in different institutes.
7. The syllabus has been designed in such a way that it will give good experience to the student to work under pressure.

### B.Sc. Semester V (Microbiology)

Course	Course code	Paper title	Teaching hours per week	CCE	SEE	Total marks	Credit points	Exam duration (Hours)
Major Discipline Specific core course	SC23MJDSC MIC501	MEDICAL MICROBIOLOGY	4	50	50	100	4	2.30
Major Discipline Specific core course	SC23MJDSC MIC501AIKS	MICROBIOLOGY: VEDIC TO MODERN TIMES	4	50	50	100	4	2.30
Minor Disciplinary Course	SC23MIDC MIC502	CLINICAL AND DIAGNOSTIC MICROBIOLOGY	4	50	50	100	4	2.30
Major Discipline Specific core course Practical Paper	SC23PMJDSC MIC501	MEDICAL MICROBIOLOGY	4	25	25	50 (Part A) + 50 (Part B) = 100	2 (Part A) + 2 (Part B) = 4	More than 3
	SC23PMJDSC MIC501AIKS	MICROBIOLOGY: VEDIC TO MODERN SCIENCE	4	25	25			More than 3
Minor Discipline Specific core course Practical Paper	SC23PMIDC MIC502	CLINICAL AND DIAGNOSTIC MICROBIOLOGY	8	50	50	100	4	More than 3
Skill Enhancement Course	SC23SEC MIC506	MUSHROOM AND SPIRULINA CULTIVATION	2	25	25	50	2	2
<b>Total</b>			<b>30</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

### B.Sc. Semester VI (Microbiology)

Course	Course code	Paper title	Teaching hours per week	CCE	SEE	Total marks	Credit points	Exam duration (Hours)
Major Discipline Specific core course	SC23MJDSC MIC601	ENVIRONMENTAL MICROBIOLOGY	4	50	50	100	4	2.30
Major Discipline Specific core course	SC23MJDSC MIC601A	WATER AND WASTE WATER MICROBIOLOGY	4	50	50	100	4	2.30
Minor Disciplinary Course	SC23MIDC MIC602	MICROBES AND ENVIRONEMNT	2	25	25	50	2	2.00
Major Discipline Specific core course Practical Paper	SC23PMJDSC MIC601	ENVIRONMENTAL MICROBIOLOGY	4	25	25	50 (Part A) + 50 (Part B) = 100	2 (Part A) + 2 (Part B) = 4	More than 3
	SC23PMJDSC MIC601A	WATER AND WASTE WATER MICROBIOLOGY	4	25	25			More than 3
Minor Discipline Specific core course Practical Paper	SC23PMIC MIC602	MICROBES AND ENVIRONEMNT	4	25	25	50	2	More than 3
Ability Enhancement Course	SC23AEC MIC604	ENGLISH	2	25	25	50	2	2.00
Internship	SC23INT MIC607	INTERNSHIP		50	50	100	4	
<b>Total</b>			<b>30</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

# **Semester V**

### B.Sc. Semester V (Microbiology)

Course	Course code	Paper title	Teaching hours per week	CCE	SEE	Total marks	Credit points	Exam duration (Hours)
Major Discipline Specific core course	SC23MJDSC MIC501	MEDICAL MICROBIOLOGY	4	50	50	100	4	2.30
Major Discipline Specific core course	SC23MJDSC MIC501AIKS	MICROBIOLOGY: VEDIC TO MODERN TIMES	4	50	50	100	4	2.30
Minor Disciplinary Course	SC23MIDC MIC502	CLINICAL AND DIAGNOSTIC MICROBIOLOGY	4	50	50	100	4	2.30
Major Discipline Specific core course Practical Paper	SC23PMJDSC MIC501	MEDICAL MICROBIOLOGY	4	25	25	50 (Part A) + 50 (Part B) = 100	2 (Part A) + 2 (Part B) = 4	More than 3
	SC23PMJDSC MIC501AIKS	MICROBIOLOGY: VEDIC TO MODERN SCIENCE	4	25	25			More than 3
Minor Discipline Specific core course Practical Paper	SC23PMIDC MIC502	CLINICAL AND DIAGNOSTIC MICROBIOLOGY	8	50	50	100	4	More than 3
Skill Enhancement Course	SC23SEC MIC506	MUSHROOM AND SPIRULINA CULTIVATION	2	25	25	50	2	2
<b>Total</b>			<b>30</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**COURSE NAME B. SC. MICROBIOLOGY SEMESTER V**

**MAJOR DISCIPLINE SPECIFIC COURSE CODE: SC23MJDSMIC501**

<b>Total Credits- 04 (04 Period/Week)</b>	<b>Theory</b>	<b>External-50 Marks</b>
		<b>Internal- 50 Marks</b>

**MEDICAL MICROBIOLOGY**

**Unit 1: Normal microflora of the human body and host pathogen interaction**

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS

**Unit 2: Bacterial and fungal diseases**

**Bacterial diseases:** List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control.

Respiratory Diseases: *Streptococcus pyogenes*, *Haemophilus influenzae*, *Mycobacterium tuberculosis*

Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Helicobacter pylori*

Others: *Staphylococcus aureus*, *Bacillus anthracis*, *Clostridium tetani*, *Treponema pallidum*, *Clostridium difficile*

**Fungal diseases:** Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention

Cutaneous mycoses: Tinea pedis (Athlete's foot)

Systemic mycoses: Histoplasmosis

Opportunistic mycoses: Candidiasis

**Unit 3: Viral diseases and Protozoan diseases**

**Viral diseases:** List of diseases of various organ systems and their causative agents. The

following diseases in detail with Symptoms, mode of transmission, prophylaxis and control.

Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

**Protozoan diseases:** List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control

Malaria, Kala-azar

#### **Unit 4: Sample collection, transport and diagnosis and Antimicrobial agents**

Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immuno fluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).

##### **Antimicrobial agents**

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism

Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin

Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine

Antibiotic resistance, MDR, XDR, MRSA, NDM-1

##### **Outcomes:**

- ✓ Students will know about fundamental aspects medical microbiology
- ✓ Students will learn the causes and prevention of various diseases
- ✓ Students will gain knowledge on antimicrobial agents used to treat various diseases.

##### **References**

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4<sup>th</sup> edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education  
Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**COURSE NAME B. SC. MICROBIOLOGY SEMESTER V**

**MAJOR DISCIPLINE SPECIFIC COURSE CODE: SC23MJDSCMIC501A**  
**(IKS)**

<b>Total credits 04 (04 periods/week)</b>	<b>Theory</b>	<b>External (50 marks)</b>
		<b>Internal (50 marks)</b>

**MICROBIOLOGY: VEDIC TO MODERN TIMES**

**OBJECTIVE:**

To understand the vedic culture related to description of different techniques of microorganisms and landmark discoveries of microbiology

**UNIT-1: Vedic Microbiology**

- Vedic Microbiology: Introduction to Vedas- Types and great saying of Vedas; Aryans- definition, indigenous or invaders; Rishi Kanva- the Father of Vedic Microbiology.
- Cosmogony: Vedic concept of origin of Life Vedic period; Vedic classification of Krimis- classification by Charak; shape and colour of germs (Krimis); occurrence of germs (Krimis) in the environment - on animals, body surface of human, water, whey, milk, food grains; knowledge of invisible germs through logie and Devine Eyes.
- Classification of germs (Krimis)- major groups of Krimis- Drishta, Adrishta; Vanous names of the krimis Vedas and in Charaka Samhita; colours of Krimis as in Vedic texts: different terms used for microbes- Amiva, Durnāma, Sunāma. Yādudhān. pisaca, etc.

**UNIT II: Pathogenic Germs and Diseases**

- Health and healthy life; prevalence of utensil and food grains; kshudrarog in humans- Pandu Roga (jaundice), Galaganda/Gandmala (mumps) and Masurika (smallpox); prophylaxis- changes in eating habit, clothing habit and bathing.
- Destruction of germs- destruction of germs and their progenies, destruction of germs in active (sakriya) and dormant (susupta) phases, destruction by sun rays, viricidal property in sun rays, eradication of microbes by sun rays.

### **UNIT-III Vedic Technology**

- Occurrence of diseases- Yakshma on different parts of body, Kushth, etc.; eradication of Krimis by using medicinal herbs- Apāmārga (*Achyranthususpera*), Ajashringi (*Pergulariadaemia*), Vach (*Acoruscalamus*) and Prishniparni (*Urariapicta*):
- eradication of Yakshma by Guggul (*Commiphora wightii*) and by Vach (*Acoruscalamus*); eradication of leprosy by Kushtha (*Costusspeciosus*) and by Prsniparni (*Urariapicta*)
- Agnihotro (Hawan, Homa)- material used in daily Yajña, effect of Agnihotra on environment, plants and human health.

### **UNIT –IV Emergence of Modern Microbiology: Spontaneous vs Biogenesis**

- Golden era of microbiology, contributions of scientist and Researchers during golden age of Microbiology, Carl Woese classification, Whittaker five Kingdom classification, Eight Kingdom classification, ribosomal RNA in microbial taxonomy, concept of microbial species, Bergey's Manual of Determinative Bacteriology;
- Microscopy- light, dark field, phase-contrast, fluorescence, and electron microscope: staining techniques- flagella, endospore, capsule, Gram staining, Acid fast staining, Negative staining, VAM staining.

#### **Outcomes:**

At the end of course student will be able of Vedic microbiology and scope of microbiology

- To know the different milestone in the history of microbiology, importance
- To understand and know out application of techniques used in the field of Microbiology.

#### **Suggested Reading**

1. Dubey R. C. 2021, Vedic Microbiology- A Scientific /Approach, Motilal Banarasidas International, Delhi 110007.
2. Dubey R. C. and Muheshwari, D.K. A Textbook of Microbtology. 3rd ed.. S. Chand S Ram Nagar, New Delhi, p.1034.
3. Cappachino. Microbiology- 4 laboratory Manual, Pearson Education India ISBN: 978-9332535190

4. Powar and Dagainawala, General Microbiology Voll and Vol2, Himalaya Publishing House, ISBN-13: 978-9350240892
5. Dubey R. C. And Maheshwari D K. Practical Microbiology, 2<sup>nd</sup> edition. S Chand & Co. P Ltd, New Delhi, p.413. ISBN: 81:219-2559-2

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**COURSE NAME B. SC. MICROBIOLOGY SEMESTER V**

**MAJOR DISCIPLINE SPECIFIC COURSE CODE: SC23PMJDSCMIC501**

<b>Total Credits- 04</b>	<b>Part A: 2 credits</b>	<b>(04 Period/Week)</b>	<b>Internal- 25 Marks</b>	<b>External-25 Marks</b>	<b>Total marks: 100</b>
	<b>Part B: 2 credits</b>	<b>(04 Period/Week)</b>	<b>Internal- 25 Marks</b>	<b>External-25 Marks</b>	

**PART – A & B**

1. Identify pathogenic bacteria (any three of *E. coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*, *Bacillus*) on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2. Study of composition and use of important differential media for identification of pathogenic bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3. Study of bacterial flora of skin by swab method
4. Perform antibacterial sensitivity by Kirby-Bauer method
5. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)
6. Study of various stages of Malaria parasite in RBCs using permanent mounts.
7. Eradication of Krimis by using medicinal herbs
8. Detection of microorganisms from body surface of human, waste water, whey, milk and food grains etc.
9. Effect of Agnohotra on microorganism
10. Effect of antibacterial and antifungal drugs on growth of bacteria and fungi

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**COURSE NAME B. SC. MICROBIOLOGY SEMESTER V**

**MINOR DISCIPLINE SPECIFIC COURSE CODE: SC23MIDSCMIC502**

<b>Total credits 04 (04 periods/week)</b>	<b>Theory</b>	<b>External (50 marks)</b>
		<b>Internal (50 marks)</b>

**CLINICAL AND DIAGNOSTIC MICROBIOLOGY  
(Minor)**

**Course Objectives:**

This course will help understand the current trends and a concept related to Clinical Microbiology and also gives an insight into various types diseases. This course also focused on diagnosis of various microbial diseases.

**UNIT – 1 : Diseases and their transmission**

Diseases- sources and types of diseases. Epidemiology of Infectious diseases, Diseases in population- Epidemic, Pandemic, Endemic diseases, Sporadic, outbreaks, Portals of Entry and Exit, Herd Immunity, Control of Disease transmission. Methods of transmission and role of biological vectors- (1) House fly (2) Mosquitoes (3) sand fly in disease transmission.

**UNIT – II : Types of Infections**

Types of Infections –Description of pathogenesis, etiology and laboratory diagnosis of bacteraemia, blood stream infections, Respiratory tract infections (Pneumonia, Flu) Central Nervous System infections (meningitis, encephalitis) Urinary tract infections and Gastrointestinal tract infections (E. coli and Klebsiella). Sexually transmitted diseases: Treponema, Neisseria.

**UNIT – III : Identification of pathogens**

Identification of organisms - microscopic examination of specimen for Bacterial pathogens – simple, differential staining, Giemsa, Leishman, Wright stains and motility. Biochemical reaction – Sugar fermentation test, antibiotic Susceptibility testing – MIC, Kirby Bauer, dilution methods. Cultural tests- IMVIC tests. Isolation and identification of viruses.

## **UNIT – IV: Sample collection and serology**

Clinical lab technology- Methods of collection of urine, blood, sputum, stool etc. The techniques of preservation of samples. Separation of blood plasma and serum. Blood smear preparations, E.S.R, P.C.V, Blood indices - Platelet count: BT, CT. Examination of urine: Sample collection, microscopic examination- crystals, casts, sediments, pregnancy tests. Examination of Stool - Indication, Collection, Microscopic examination and its significance.

Serology – Antigen - antibody reactions – Agglutinations (blood grouping, WIDAL) Hemagglutination, Precipitation (VDRL), Complement fixation test, Immunodiffusion, Immuno-electrophoretic (rocket, counter current). ELISA, RIA. Quantitative study of Antigen - Antibody precipitin reactions, Western blot analysis for HIV

### **Learning outcomes**

- Deep understanding of the disease cycles and their outbreaks
- Gaining theoretical knowledge of most common disease-causing organisms
- Enumerating the methods and vehicles of disease transmission
- Understanding the basics of Clinical laboratory protocols
- Systematic knowledge on the pathogenesis and laboratory diagnosis of diseases
- Developing insights into clinical practices and serological techniques

### **REFERENCE BOOKS**

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Virology, Sawant, K.C., 2005, First edition, Dominant Publishers and distributors, Delhi.
4. Subash O. Panija Textbook of Medical Parasitology, 1996. First edition. All India Publishers and Distributors Regd. 920 Poonamallee High Road, Chennai.
5. Rajesh Karyakarte and Ajith Damle (2005) Medical Parasitology, books and Allied (P)Ltd. Kolkata.
6. Jaya Ram Paniker, Textbook of Medical Parasitology, Published by 'Jaypee Brothers', 4th Edition.

7. Coloratlas, Textbook of Diagnostic Microbiology (5th Edition), edited by Eimer.W. Koneman, published by Lippinett.
8. Mosby, Diagnostic Microbiology by Bailey and Swotts, 10th Edition, published.
9. David Greenwood, Richard C.B.Slack, John.F.Peutherer, Medical Microbiology, 16th Edition.
10. SharmaJ.B., Medical Microbiology – A Clinical perspective, paras publishing.
11. Patrick R.Murray, Ken.S.Rosenthal, George.S.Kobayashi, Michael A. Ptaller, Medical Microbiology, 3rd Edition.
12. Jawetz, Melnick and Adelberg's, Medical Microbiology (2004) 23rd Edition, Mc Graw Hill.

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**COURSE NAME B. SC. MICROBIOLOGY SEMESTER V**

**MINOR DISCIPLINE SPECIFIC COURSE CODE: SC23PMIDSCMIC502**

<b>Total credits 04 (08 periods/week)</b>	<b>PRACTICAL</b>	<b>External (50 marks)</b>
		<b>Internal (50marks)</b>

**CLINICAL AND DIAGNOSTIC MICROBIOLOGY (Minor)  
(PRACTICAL)**

1. Identify pathogenic bacteria (any three of *E. coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*, *Bacillus*) on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2. Study of bacterial flora of skin by swab method
3. Perform antibacterial sensitivity by Kirby-Bauer method
4. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)
5. Study of various stages of Malaria parasite in RBCs using permanent mounts.
6. Gram staining of bacteria
7. Preparation of thin blood film for malaria and observation under microscope
8. Latex agglutination test
9. Determination of resistance/sensitivity of bacteria using disc diffusion method
10. Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method
11. Demonstrations of PCR and ELISA: Principle, working and applications
12. Laboratory diagnosis of common helminthes infections (permanent slide observations of Helminths' Round worm, Hook worm and Pin worm)
13. Medical Parasitology – *E. histolytica*, *G. lamblia*, *Trypanosomas*, *Leishmania* and *Plasmodium* (Permanent Slide Observation)
14. Collection of throat swabs – culturing the specimen. And laboratory examination for *streptococcus pyogenes*

HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

COURSE NAME B. SC. MICROBIOLOGY SEMESTER V

SKILL ENHANCEMENT COURSE CODE: SC23SECMIC506

Total credits 02 (02 periods/week)	Theory	External (25 marks)
		Internal (25 marks)

MUSHROOM AND SPIRULINA CULTIVATION

**Course Objectives:** The course imparts entrepreneurial skills with objectives (i) to learn about the types of edible mushrooms and their uses to human kind (ii) to gain knowledge on cultivation methods for mushroom and the diseases that commonly affect them (iii) to appreciate the importance of *Spirulina* to human kind, understanding their cultivation methods and processing techniques.

**Unit - I Mushrooms – Cultivation and economics**

- Edible and non-edible mushroom –historical account, most commonly cultivated mushrooms in the world, distribution and production in various countries.
- Cultivation of button, oyster and paddy straw mushroom –raising a pure culture – spawn preparation and mass cultivation – harvest pests and diseases in mushroom
- Economics of mushroom cultivation – precautions in mushroom cultivation – precaution to be taken while selecting the area, spawn preparation, spawn run, during cropping harvesting etc. Mushroom recipes (western and Indian recipes, pickles, powders, jams etc.

**Unit – II *Spirulina* and its cultivation**

- Introduction to SCP production –historical use and rediscovery of *Spirulina* importance– morphology, taxonomy and habitat of *Spirulina*– biochemical composition including proximate composition – amino acids – unsaturated fatty acids – minerals and vitamins. Human health benefits of *Spirulina*.
- Natural production –laboratory cultivation – small scale commercial production – commercial and mass cultivation (tank construction, culture medium, strain selection, scaling up of the process) – importance of light and pH in *Spirulina* cultivation – harvesting, drying and packing.

## Reference books

1. Changs T. and Hayanes W.A. (Ed.) (1978) *Biology and Cultivation of Edible Mushrooms*. Academic Press. N.Y.
2. Habib M.A.B., Parvin M., Huntington T.C. and Hasan M.R. (2008) A review on culture, production and use of Spirulina as food for humans and feeds for domestic animals and fish. *FAO Fishers and Aquaculture Circular No. 1034*, FAO, Rome, Italy.
3. Biswas S., Datta M. and Ngachan S.V. (2012) *Mushrooms: A Manual for Cultivation*, PHI.
4. Selvendran D. (2015) Large Scale Algal Biomass (Spirulina) Production in India. In: D. Das (Ed.) *Algal Biorefinery: An Integrated Approach*, Springer.
5. Zadrazil F. and Grabbe K. (1983) *Edible Mushroom*, Biotechnology Vol. 3, Weinheim: Verlag Chemie, Berlin.

**Course Outcome:** Upon successful completion of the course the candidate will

- gain understanding on the edible mushrooms, its distribution and production in various countries.
- gain insight on the cultivation of various mushrooms.
- gain knowledge on economics of mushroom cultivation and preparation of various mushroom recipes.
- understand the importance of Spirulina and their cultivation methods

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**COURSE NAME B. SC. MICROBIOLOGY SEMESTER V**

**PRACTICAL MAJOR DISCIPLINE SPECIFIC COURSE CODE:**

**SC23PMJDSCMIC501 & SC23PMJDSCMIC501A (IKS)**

**PRACTICAL SKELETON**

**Time: more than 3 Hours**

**Total Marks: 50**

**PART A**

<b>Q 1</b>		Experiment to perform	<b>06</b>
<b>Q 2</b>		Practical	<b>06</b>
<b>Q 3</b>		Do as directed. 1. A 2. B 3. C	<b>06</b>
<b>Q 4</b>	<b>a</b>	Viva-voce	<b>03</b>
	<b>b</b>	Journal	<b>04</b>

**PART B**

<b>Q 1</b>		Perform	<b>05</b>
<b>Q 2</b>		Write	<b>04</b>
<b>Q 3</b>		Do as directed: 1. A 2. B 3. C	<b>06</b>
<b>Q 4</b>		Spotting (part A and B)	<b>04</b>
<b>Q 5</b>	<b>a</b>	Viva-voce	<b>03</b>
	<b>b</b>	Journal	<b>03</b>

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**  
**COURSE NAME B. SC. MICROBIOLOGY SEMESTER V**

**PRACTICAL MINORDISCIPLINARY SPECIFIC COURSE**  
**CODE: SC23MIDCMIC502**

**PRACTICAL SKELETON**

**Time: more than 3 Hours**

**Total Marks: 50**

<b>Q 1</b>	Practical	<b>08</b>
<b>Q 2</b>	Practical	<b>04</b>
<b>Q 3</b>	Do as directed. A B C D E F G H	<b>16</b>
<b>Q 4</b>	Submission / report	<b>06</b>
<b>Q5</b>	spoting	<b>06</b>
<b>Q6</b>	Viva-voce	<b>05</b>
<b>Q7</b>	Journal	<b>05</b>

**HEMCHANDRACHARYA NORTH GUJARAT  
UNIVERSITY PATAN**

**B.Sc. Biotechnology Syllabus (New Education  
Policy-NEP)**

<b>Document code</b>	<b>Syllabus Biotechnology NEP-2023</b>
<b>Name of faculty</b>	<b>Science</b>
<b>Faculty code</b>	<b>SCI</b>
<b>Programme name</b>	<b>Undergraduate(B.Sc.)</b>
<b>Subject</b>	<b>Biotechnology</b>
<b>Programme code</b>	<b>SCIUG106</b>
<b>Effective from</b>	<b>June-2025</b>

**Hemchandracharya North Gujarat University, Patan**

**B. Sc. Biotechnology  
Syllabus**

**w.e.f.**

**from June 25-26**

**under NEP**

## **Introduction:**

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process, examination and evaluation systems, besides governance and other matters.

The UGC has formulated various regulations and guidelines from time to time to improve the higher education system and maintain minimum standards and quality across the Higher Educational Institutions (HEIs) in India. The academic reforms recommended by the UGC in the recent past have led to overall improvement in the higher education system. However, due to lot of diversity in the system of higher education, there are multiple approaches followed by universities towards examination, evaluation and grading system. While the HEIs must have the flexibility and freedom in designing the examination and evaluation methods that best fits the curriculum, syllabi and teaching – learning methods, there is a need to devise a sensible system for awarding the grades based on the performance of students.

*The National Education Policy (NEP) 2020* (here after referred to as NEP or Policy) recognizes that higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution-a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all. It notes that “given the 21st-century requirements, quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals”. In accordance with the NEP-2020, the UGC has formulated a new student-centric “Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)” incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options. This will facilitate students to pursue their career path by choosing the subject / field of the interest. The grading system is considered to be better than the conventional marks system and hence it has been followed in the top institutions in India and abroad. So it is desirable to introduce uniform grading system. This will facilitate student mobility across institutions within and across countries and also enable potential employers to assess the performance of students. To bring in the desired uniformity, in grading system and method for computing the cumulative grade point average (CGPA) based on the performance of students in the examinations, the UGC has formulated these guidelines.

## **NEP–2020:**

NEP, 2020 aim sat a new and forward-looking Vision for India’s Higher Education System. This curriculum framework for the bachelor-level program in BIOTECHNOLOGY is developed keeping in view of the student centric learning pedagogy, which is entirely multidisciplinary outcome-oriented and curiosity-driven. To avoid rote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum framework focuses on pragmatist approach where by practical application of theoretical concepts is taught with substantial coverage of practical and field works.

The platform aim sat equipping the graduates with necessary skills for BIOTECHNOLOGY-related careers, careers with general graduate –level aptitude and for higher education in BIOTECHNOLOGY. Augmented in this framework are graduate attributes including critical thinking, basic psychology, scientific reasoning, moral ethical reasoning and soon.

Learning outcomes for the two programmes these frameworks have been developed, learning outcomes for individual courses, pedagogical methods and assessment methods. Looking at all these new concepts and progress, the detailed syllabus of B.Sc. (Honours) – BIOTECHNOLOGY has been designed and decided to be implemented from the academic session from June 2023-24.

## **PROGRAMME SPECIFIC OUTCOMES TO BE ATTAINED AT THE END OF THE PROGRAMME**

According to Guideline of NEP 2020, the Board of Studies in Biotechnology recognizes that curriculum, course content and assessment of scholastic achievements play important roles in shaping education. The committee is of the view that assessment should support and encourage the broad instructional goals such as basic knowledge of the discipline of Biotechnology including phenomenology, theories and techniques, concepts and general principles. This should also support the ability to ask subjective

questions and to obtain its solutions by use of qualitative and quantitative reasoning and by experimental investigation. With this in mind, we aim to provide a firm foundation in every aspect of Biotechnology ranging from a broad spectrum of modern trends in Biotechnology to experimental, computational and mathematical skills of students. Hence, the UG (B.Sc.) syllabi has been framed in such a way that it bridges the gap between the plus two and PG (M.Sc.) levels of Biotechnology by providing a more comprehensive and logical framework in almost all areas of basic Biotechnology.

### **Aims of the Programme:**

- To make students eligible for Higher Studies and professional courses.
- To develop the skills required together in formation from resources and use them.
- To develop the abilities to read, understand and interpret physical in formation–verbal, mathematical and graphical.
- To provide an intellectually stimulating environment to develop skills and enthusiasms of students to the best of their potential.
- To give need-based education in Biotechnology of the highest quality at the undergraduate level.
- To offer courses to the choice of the students.
- To enable students to perform experiments and interpret the results of observation, including an assessment of experimental uncertainties.
- To make students eligible for government job.

### **Objectives of Programme:**

By the end of the Third year (6<sup>th</sup> semester), the students should have attained a common level in basic of Biotechnology to complement the core for their future courses and developed their experimental and data analysis skills through experiments at laboratories.

### **OUTLINE OF CHOICE BASED CREDIT SYSTEM**

1. **Major Course (MJDC):** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a *Major Discipline specific course*.
2. **Minor discipline (MIDSC)** helps a student to gain a broader understanding beyond them as or discipline.
3. **Multidisciplinary Course (MDC):** 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.
4. **Inter disciplinary Course (IDC) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University / Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline /subject of study).
5. **Ability Enhancement Courses (AEC):** Environmental Science, English Communication/MIL Communication are mandatory for all disciplines.
6. **Skill Enhancement Courses (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and /or skill-based instruction.
7. **Value Added Courses (VAC):** These courses may be chosen from a pool of courses designed to provide value –based education course instruction.
8. **Indian knowledge System (IKS):**  
The Proposed new courses in Biotechnology or undergraduate classes are re assigned

in accordance to semester / CBCS /Grading system with new education policy. The new course is based on model curriculum of the university grants commission.

### **COURSES/ACTIVITIES UNDER THE PROGRAM:**

- 1. Lecture courses:** Courses involving lectures relating to a field or discipline by an expert or qualified personnel in a field of learning, work/ vocation, or professional practice.
- 2. Tutorial courses:** Courses involving problem-solving and discussions relating to a field or discipline under the guidance of qualified personnel in a field of learning, work / vocational or professional practice.
- 3. Practical or Laboratory work:** A course requiring students to participate in a project or practical or lab activity that applies previously learned/studied principles/theory related to the chosen field of learning, work/vocation, or professional practice under the supervision of an expert or qualified individual in the field of learning, work/vocation or professional practice
- 4. Seminar:** A course requiring students to participate in structured discussion/conversation or debate focused on assigned tasks/readings, current or historical events, or shared experiences guided or led by an expert or qualified personnel in a field of learning, work/vocation, or professional practice.
- 5. Internship:** A course requiring students to participate in a professional activity or work experience, or cooperative education activity with an entity external to the education institution, normally under the supervision of an expert of the given external entity. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning.
- 6. Studio activities:** Studio activities involve the engagement of students in creative or artistic activities. Every student is engaged in performing a creative activity to obtain a specific outcome. Studio-based activities involve visual- or aesthetic focused experiential work.
- 7. Field practice/projects:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity.
- 8. Community engagement and service:** Courses requiring students to participate in field-based learning/projects generally under the supervision of an expert of the given external entity. The curricular component of ‘community engagement and service’ will involve activities that would expose students to the socio-economic issues in society so that the theoretical learning’s can be supplemented by actual life experiences to generate solutions to real-life problems.

### **SALIENT FEATURES:**

- B.Sc. (Honours) Biotechnology in UG Programme - Semester V and VI shall be offered from the Academic year, June 2025.
- Biotechnology subject like Major, Minor, Skill enhancement (In Sem 5) and Major, Minor and Internship (In Sem 6) in the Universities / Affiliated Colleges shall offer undergraduate programme in Faculty of Science from the Academic year 2025-26.
- A student will have to get enrolled a Discipline Specific Core Course (DSC) depending upon his/her requirement of a degree in the said discipline of study. A student will have a choice of

selecting an Ability Enhancement Course (AEC), Skill Enhancement Course (SEC) as well as Value Added Course (VAC) or Indian knowledge System (IKS) from a pool of courses.

- Each course shall be assigned a specific number of Credits.
- Discipline Specific Core Course (DSC) is the course which should compulsorily be studied by a candidate as a Major and Minor requirement so as to get degree in a said discipline of study.
- There shall be One Major (MDSC) and Minor (MiDSC) Compulsory course (Theory) each with 4 credit in each semester and their practical's each with 4 credit which is grouped in A and B.
- In addition to the Major/Minor, a student will have to choose AEC, SEC as well as VAC/IKS from a pool of courses in both semester V and VI.
- AEC, SEC and IKS (Sem 5), INTERNSHIP (Sem 6) courses shall have to be offered. The credit weight-age for AEC, SEC courses shall be of 2 credit and for internship shall be of 4 credit.
- Each course shall have a unique Course code. The Discipline Specific Core Course, Ability Enhancement Course, Value Added Course, Indian knowledge System (IKS) and Skill Enhancement Course shall be abbreviated respectively as **DSC (Major/Minor), IDC/MDC, AEC, VAC/ IKS and SEC.**
  1. Discipline Specific Core Course **DSC (Major/Minor)**, Practical Discipline Specific Core Course **PDSC**
  2. Inter/Multi-Disciplinary Course **IDC/MDC**
  3. Ability Enhancement Course (Languages) **AEC**
  4. Value Added Course **VAC or** Indian knowledge System **IKS**
  5. Skill Enhancement Course **SEC**
- Each Academic year shall consist of **two** semesters, each of **15 weeks** of teaching equivalent to **90 working days**. The Odd semester period shall be from **July to November** and the Even semester periods shall be from **December to April**.
- The theory course with **4 credit** shall be of **60 Hours** (15 weeks x 4 credits) duration,
- The theory course with **2 credit** shall be of **30 Hours** (15 weeks x 2 credits) duration.
- **Practical with 2 Credit** shall be of **60 Hours** (15 weeks x 4 hours) duration.
- **Practical with 4 Credit** shall be of **120 Hours** (15 weeks x 8 hours) duration.
- **Internship with 4 Credit shall be of 120 Hours ( 30 hrs per credit)**

#### **ATTENDANCE:**

The attendance rules as per the norms of Hemchandracharya North Gujarat University, Patan.

#### **MEDIUM OF INSTRUCTION:**

The Medium of Instruction shall be of **Gujarati medium**. Student is free to write answers either in **Gujarati** and/ or **English** language.

#### **TEACHING LEARNING PROCESS:**

Teaching and learning in this programme involve **classroom lectures as well tutorials**.

It allows-

- ❖ The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention.
- ❖ Written assignments and projects submitted by students
- ❖ Project - based learning
- ❖ Group discussion

- ❖ Home assignments
- ❖ Quizzes and Class Tests
- ❖ PPT presentations, Seminars, inter active sessions
- ❖ Diversity survey
- ❖ Co-curricular activity etc.
- ❖ Industrial Tour or Field visit

**LANGUAGE OF QUESTION PAPER:**

Question paper should be drawn in **Gujarati** language and its **English** version should be given.

**EVALUATION METHOD :**

Academic performance in various courses i.e. MJDSC, MiDSC, AEC, VAC/IKS, SEC and INTERNSHIP are to be considered as parameters for assessing the achievement of students in the BIOTECHNOLOGY subject. A number of appropriate assessment methods of BIOTECHNOLOGY will be used to determine the extent to which students demonstrate desired learning outcomes.

**Following assessment methodology should be adopted:**

- Theoral and written examinations (Scheduled and surprise tests),
- Closed-book and open-book tests,
- Problem-solving exercises,
- Practical assignments and laboratory reports,
- Observation of practical skills,
- Individual and group project reports,
- Efficient delivery using seminar presentations,
- Viva-voce interviews are majorly adopted assessment methods for this curriculum.
- The computerized adaptive testing, literature surveys and evaluations, peer sand self-assessment, out puts formindividual and collaborative work are also other important approaches for assessment purposes.
- A student shall be evaluated through **Comprehensive Continuous Examination (CCE)- (Internal Evaluation)** as well as the **Semester End Examination (SEE External Evaluation)**.
- The weight- age of CCE shall be 50%, where as the weight-age of the Semester End Examination (SEE) shall be 50%.
- In **Comprehensive Continuous Examination (CCE)/ (Internal Evaluation)** assessment is spread through the duration of the course and is to be done by the Teacher teaching the course. BoS of the subjects will decide various criteria and their weight–age for CCA. The assessment is to be done by various means including:
  - Written Tests, MCQs based Tests / Quiz
  - Presentations / Seminars
  - Group discussions / Group activities
  - Assignments etc., Project work/ Field work

No	Assessment	4 Credit Course Marks	2 Credit Course Marks	4 Credit Course Marks
		theory & Practical	theory & Practical	ernship (In SEM 6)
	E Comprehensive Continuous Examination (50%) ❖ Classroom and Internal Evaluation	50	25	50
	E Semester End Exam (50%)	50	25	50

Total	100	50	100
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- The distribution of **Internal Evaluation CCE** is given as per criteria given below.

Components	MAJOR 4 Credit Theory	MI/AEC/SEC 2 Credit Theory
Written Test /Weekly Test (2 Test Best out of 3)	20 Marks	10 Marks
Quiz (2 Test Best out of 3)	10 Marks	---
Active Learning During whole Term	10 Marks	05 Marks
Home Assignments	05 Marks	05 Marks
Attendance–Regularity in Learning, Written Test and Activity	05 Marks	05 Marks
Total of CCE	50 Marks	25 Marks

- SCHEME OF ASSESMENT in CCE and SEE (Uni. Examination) for Each PRACTICAL**

No.	Name of the head	Marks for Major		Marks MI/MD C
		Group A	Group B	
1.	Understanding and approach to the experiment, use of apparatus	05 Marks	05 Marks	05 Marks
2.	Tabulation with correct observation table noted by the student and verified by examiner.	05 Marks	05 Marks	05 Marks
3.	Oral questions Regarding the experiment (Viva)	07 Marks	07 Marks	07 Marks
4.	Lab manners and practical skills as observed by the examiner.	05 Marks	05 Marks	05 Marks
5.	Accuracy of the results judged by comparing the students results With those supplied by expert assistant who has set the experiment.	01 Marks	01 Marks	01 Marks
6.	Marks for Journal. (Must be produced)	02 Marks	02 Marks	02 Marks
Total		25 Marks	25 Marks	25 Marks

- ❖ There will be two Group of Practicals in Major and Minor subject having total credit 4. Each group of Practical will be of 2 credit.
- ❖ In Major and Minor subject, total Marks of both Group will be 100. (i) 50 Marks is of CCE and (ii) 50 Marks is of SEE. Students must attend both group of practical in practical examination.
- ❖ In Minor subject, total marks will be 50 in Sem 6.
- ❖ For Internship, total marks will be 100, (i) 50 Marks is of CCE and (ii) 50 Marks is of SEE.

- Batch Size of Practical:**

According to Uniform model statutes for the Gujarat Public Universities Act-2023, EDUCATION DEPARTMENT – GOVERNMENT OF GUJARAT guideline, The batch size shall not be less than ten and not more than twenty. In B Sc Biotechnology Sem 5 and 6, the batch size in practical must be of 15.

- The **Semester End Examination** (SEE *External Evaluation*) shall have an assessment based upon following perspective with respect to all the courses:
  - Evaluation with respect to Knowledge,
  - Evaluation with respect to Understanding,
  - Evaluation with respect to Skill,
  - Evaluation with respect to Application and
  - Higher Order Thinking Skills.

- With respect to all the above components, there shall be following types of Questions from each unit of the course.
  - ❖ MCQs/Fill in the blanks / Match the pairs, etc
  - ❖ Short answer questions
  - ❖ Medium answer questions
  - ❖ Long answer questions, Examples /Problems, Short notes etc.

Third Year B Sc Sem V & VI Credit in Theory –Practical Distribution						
Semester	Discipline Specific Core Courses		Ability Enhancement Course (Languages) (2)	VAC/ IKS/ Course (2)	Skill Enhancement / Internship Course (2)	Total Credit
	Major (12)	Minor (8) OR (4)				
	Theory+ Practical Credit	Theory+ Practical Credit	Credit	Credit	Credit	
V	8 T + 4 P = <b>12</b> [In Practical 2 Credit of Group A and 2 Credit of Group B]	4 T + 4 P = <b>8</b> [In Practical 2 Credit of Group A and 2 Credit of Group B]	NA	NA	<b>2 T (SEC)</b>	<b>22</b>
VI	8 T + 4 P = <b>12</b> [In Practical 2 Credit of Group A and 2 Credit of Group B]	2 T + 2 P = <b>4</b> [In Practical 2 Credit of Only One Group]	<b>2 T</b>	NA	<b>4 T (INTERNSHIP)</b>	<b>22</b>
<b>T = Theory      P = Practical</b>						

**Exam pattern of Theory and Practical Examination in SEM 5, 6 for MAJOR, MINOR subject**

<b>For Major Course</b>		
<b>Course</b>	<b>Theory</b>	<b>Practical</b>
Credit	4 + 4 = 8 Credit (Two Theory Papers)	4 Credit (Group A -2 credit and Group B-2 credit)
Teaching Hours /	4 + 4 = 8 Hours	8 Hours (Group A -4 Hours and Group B-4)
Examination Marks CCE - Internal SEE - External	100 + 100 Marks (For CCE 50+50) (For SEE 50+50)	<b>100 Marks</b> • 50 Marks for <b>Group A Experiment</b> (25 Marks -CCE & 25 marks - SEE) • 50 Marks for <b>Group B Experiment</b> (25 Marks -CCE & 25 marks - SEE)
Examination Hours	2.5 Hours (CEE & SEE)	5 Hours (2.5 Hours for each Group)
<b>For MINOR, AEC</b>		
<b>Course</b>	<b>Theory</b> MINOR, AEC, SEC	<b>Practical</b> MINOR
Credit	2 Credit	2 Credit
Teaching Hours /	2 Hours	4 Hours
Examination Marks CCE - Internal SEE - External	50 Marks (For CCE 25 Marks) (For SEE 25 Marks)	<b>50 Marks</b> 25 Marks -CCE & 25 Marks - SEE
Examination Hours	2.5 Hours (CEE & SEE)	2.5 Hours SEE and CCE

• **CERTIFIED JOURNAL:**

The Semester End Examination will be conducted by the University. A *certified journal* of the respective practical course **MUST BE PRODUCED** at the time of practical examination by the student.

- It will be compulsory for a candidate to obtain *passing percentage* in both Internal as well as External Evaluation. The passing marks for each course shall be **36%** as decided by concern Board of Studies HNGU in Biotechnology.
- Promotion, Re-Admission and Time for Completion of Course, Procedure for Awarding Grades, Provision for Appeal, etc. as decided by the Hemchandracharya North Gujarat University, Patan.

**Awarding Certificates, Diplomas and Degrees:**

**Certificate in Science:**

Students who opt to exit after completion of the first year and have secured 48 credits will be awarded the Certificate in Science with the three disciplines chosen by student in the first year. Thus, for example, if a student of B.Sc. program with Biotechnology as the Major discipline and Microbiology as the minor disciplines and Zoology as inter disciplines opts to exit after successful completion of the first year, the student will be awarded “Certificate in Science with Biotechnology, Microbiology and Zoology”.

**Diploma of Science:**

Students who opt to exit after completion of the second year and have secured 92 credits will be awarded the Diploma of Science in the principal discipline. Thus, for example, if a student of B.Sc. program with Biotechnology as the Major discipline opts to exit after successful completion of two years, the student will be awarded “Diploma of Science in Biotechnology”.

**Bachelor of Science:**

Students who opt to exit after completion of the third year and have secured 132 credits will be awarded the Bachelor of Science in the Major (principal) discipline.

**Bachelor of Science (Honors):**

Students of 4-year B.Sc. program who successfully complete 4 years, without arigorous research project/ dissertation will be awarded the Bachelor of Science (Honors) in the Major discipline (principal discipline).

**Bachelor of Science (Honors with Research):**

Students of 4-year B.Sc. program who successfully complete 4 years, with a rigorous research project/dissertation will be awarded the Bachelor of Science (Honors with research) in the Major discipline (principal discipline).

- **Note:** During the preparation of this curriculum, ample care is taken for consideration of the followings:
  - (a) NEP-2020
  - (b) Model curriculum of U.G.C.
  - (c) National Credit Framework Report of UGC, 2023
  - (d) Concept of continuous evaluation
  - (e) CGPA (Cumulative Grade Point Average Credit)
  - (f) CBCS (Choice Based Credit System)
  - (g) Semester approach
  - (h) Revised rules and regulation of Hemchandracharya North Gujarat University, Patan.

There shall be coverage of maximum 30% syllabus through online mode of teaching as per directives of UGC.

Arrangement of credit Distribution Framework for three/four years Honours/Honours with Research Degree Programme with Multiple Entry and Exits options for all the institutions:

<b>OPTION I BACHELOR'S DEGREE WITH HONOURS (WITH RESEARCH)</b>										
NCrF Credit Level	Semester	Major (Core) (68/88)	Minor (Electives) (32)	Multi/Inter-disciplinary (12)	AEC (10)	SEC/ Internship (12)	VAC/ IKS (8)	RP/ OJT	Total Credit/ Sem. (144/176)	Qualification / Certificate
4.5 1 <sup>st</sup> Year	I	8	4	4	2	2 (SEC)	2 (IKS)	-	22	<b>UG Certificate</b>
	II	8	4	4	2	2 (SEC)	2	-	22	
First Year Total Credits		<b>16</b>	<b>8</b>	<b>8</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>-</b>	<b>44</b>	
<b>Exit1: Award of UG certificate in Major course with 44 credits with additional 4credits of Summer Internship in core specific NSQF defined course OR continue with Major and Minor course for next NCrFcredit level</b>										
5.0 2 <sup>nd</sup> Year	III	12	-	4	2	2 (SEC)	2 (IKS)	-	22	<b>UG Diploma</b>
	IV	12	4	-	2	2 (SEC)	2 (VAC)	-	22	
Second Year Total Credits		<b>40</b>	<b>12</b>	<b>12</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>-</b>	<b>88</b>	
<b>Exit 2 : Award of UG Diploma in Major course with 88 credits with additional 4 credits of Summer Internship in core specific NSQF defined course OR continue with Major and Minor course for next NCrF credit level</b>										
5.5 3 <sup>rd</sup> Year	V	12	8	-	-	2 (SEC)	-	-	22	<b>UG Degree</b>
	VI	12	4	-	2	4(Internship)	-	-	22	
Third Year Total Credits		<b>64</b>	<b>24</b>	<b>12</b>	<b>10</b>	<b>14</b>	<b>8</b>	<b>-</b>	<b>132</b>	
<b>Award of UG Degree in Major course with 132 credits and Internship in core discipline OR continue with Major and Minor course for next NCrF credit level</b>										
6.0 4 <sup>th</sup> Year	VII	12	4	-	-	-	-	6 (OJT)	22	<b>UG Honours Degree</b>
	VIII	12	4	-	-	-	-	6 (OJT)	22	
Fourth Year Total Credits		<b>88</b>	<b>32</b>	<b>12</b>	<b>10</b>	<b>14</b>	<b>8</b>	<b>12</b>	<b>176</b>	

Award of UG Honours Degree in Major (without Research)course with total 176 credits										
OPTION II BACHELOR'S DEGREE WITH HONOURS (WITH RESEARCH)										
6.0 4 <sup>th</sup> Year	VII	12	4	-	-	-	-	6 (RP)	22	UG Honours with Research Degree
	VIII	12	4	-	-	-	-	6 (RP)	22	
Fourth Year Total Credits		<b>88</b>	<b>32</b>	<b>12</b>	<b>10</b>	<b>14</b>	<b>8</b>	<b>12</b>	<b>176</b>	
Award of UG Honours with Research Degree in Major course with total 176 credits										

**Abbreviation:** AEC -Ability Enhancement Course, IKS-Indian Knowledge System,  
 NCrF-National Credit Framework OJT-On-the-Job Training,  
 VAC-Value Added Course, SEC-Skills Enhancement Course, RP- Research Project

**General Credit-Subject Structure and Examination Pattern /Marking Scheme of study components along with 22 credits in B.Sc.  
BIOTECHNOLOGY SEM – 5 and 6 are as below.**

Sr. No.	Course Code	Study Components	InstructionHr s/week	Examination			Credit	Exam Duration (Hours)
				Internal	Uni.Ex am	Total		
<b>SEMESTER– V PROGRAM CODE:SCIUG106</b>								
<b>Theory Course (DSC)</b>								
1	SC23MJDCBIO501	Major-1:Discipline Specific Core Course (MJDCS)	04	50	50	100	4	02:30
2	SC23MJDCBIO501A	Major-2: IKS: Discipline Specific Core Course (IKSMJDCS)	04	50	50	100	4	02:30
3	SC23MIDCBIO502	Minor:Discipline Specific Core Course (MiDSC)	04	50	50	100	4	02:30
<b>Practical Course (PDSC)</b>								
5	SC23PMJDSCBIO501	Major:Discipline Specific Core Course (Group A) (PMJDSC Total 4 Credit, 8 hrs/week)	04	25	25	50	2	2:30
		Major:Discipline Specific Core Course (GroupB)	04	25	25	50	2	2:30
6	SC23PMIDSCBIO502	Minor: Discipline Specific Core Course (PMiDSC Total 4 Credit, 8 hrs/week)	04	25	25	50	2	2:30
			04	25	25	50	2	2:30
<b>Skill Enhancement Course</b>								
7	SC23SECBIO506	Skill Enhancement Course (SEC)	02	25	25	50	2	1:30
Total			30	275	275	550	22	

**SEMESTER-VI PROGRAMME CODE : SCIUG106**

Sr. No.	Course Code	Study Components	Instruction Hrs/	Examination			Credit	Exam Duration
				Internal	Uni.Exam	Total		
<b>SEMESTER- VI PROGRAM CODE:SCIUG106</b>								
<b>Theory Course (DSC)</b>								
1	SC23MJDCBIO601	Major-1:Discipline Specific Core Course (MJDCS)	04	50	50	100	4	02:30
2	SC23MJDCBIO601A	Major-2:Discipline Specific Core Course (MJDCS)	04	50	50	100	4	02:30
3	SC23MIDCBIO602	Minor:Discipline Specific Core Course (MiDSC)	02	25	25	50	2	02:00
<b>Practical Course (PDSC)</b>								
4	SC23PMJDSCBIO601	Major:Discipline Specific Core Course (Group A) <b>(PMJDSC Total 4 Credit, 8 hrs/week)</b>	04	25	25	50	2	2:30
		Major:Discipline Specific Core Course (GroupB)	04	25	25	50	2	2:30
5	SC23PMIDSCBIO602	Minor: Discipline Specific Core Course <b>(PMiDSC Total 2 Credit, 4 hrs/week)</b>	04	25	25	50	2	2:30
<b>ABILITY ENHANCEMENT COURSE (AEC) - Language</b>								
6	SC23AEC604	<b>Ability Enhancement Course (AEC)</b>	02	25	25	50	2	1:30
<b>INTERNSHIP</b>								
7	SC23INTBIO607	<b>Internship (30Hrs per Credit, Total 4 credit)</b>	120	50	50	100	4	
Total			144	275	275	550	22	

<b>Semester V</b>					
Sr No	Course Type	Course Name	Course Code	Credit	Lect Hours
1	Major-1 (T)	Immunology	SC23MJDSCBIO501	4	4
2	Major-2 (T)(IKS)	Traditional Biotechnology in Indian Knowledge Systems (IKS)	SC23MJDSCBIO501A	4	4
3	Major Practical	Laboratory Experiment ( <b>Group A &amp; Group B</b> )	SC23PMJDSCBIO501	4	8
4	Minor - 1 (T)	Clinical Immunology	SC23MIDCBIO502	4	4
5	Minor Practical	Laboratory Experiment	SC23PMIDSCBIO502	4	8
6	SEC (T)	Bioentrepreneurship	SC23SECBIO506	2	2
<b>Semester VI</b>					
1	Major-1 (T)	Fundamentals of r-DNA technology	SC23MJDSCBIO601	4	4
2	Major-2 (T)	Environment biotechnology	SC23MJDSCBIO601A	4	4
3	Major Practical	Laboratory Experiment ( <b>Group A &amp; Group B</b> )	SC23PMJDSCBIO601	4	8
4	Minor (T)	Animal Biotechnology	SC23MIDCBIO602	2	2
5	Minor Practical	Laboratory Experiment	SC23PMIDSCBIO602	2	4
6	AEC (Language)	Ability Enhancement Course (AEC)	SC23AEC604	2	2
7	INTERNSHIP	Internship Related Major Course (30 Hrs per Credit, Total 4 credit)	SC23INTBIO607	4	120

**Syllabus B.Sc. (Biotechnology) Sem-V and VI**

Sr. No.	Course code	Study components	Instructions Hrs./week	Examination			Credit	Exam Hours
				Continuous & Comprehensive Evaluation (CCE)	Semester End Evaluation (SEE)	Total		
<b>Semester V</b>								
<b>Theory Course (DSC)</b>								
1	SC23MJDSCBIO501	<b>Immunology</b>	04	50	50	100	4	2:30
2	SC23MJDSCBIO501A	<b>Traditional Biotechnology in Indian Knowledge Systems (IKS)</b>	04	50	50	100	4	2:30
3	SC23MIDSCBIO502	<b>Clinical Immunology</b>	04	50	50	100	4	2:30
<b>Practical Course (PDSC)</b>								
4	SC23PMJDSCBIO501 (Group A) & SC23PMJDSCBIO501A (GroupB)	<b>Immunology &amp; Traditional Biotechnology in Indian Knowledge Systems (IKS)</b>	4(GroupA +GroupB)	50	25GroupA 25GroupB	25GroupA 25GroupB	4	5:00
5	SC23PMIDSCBIO502	<b>Clinical Immunology</b>	04	50	50	100	4	5:00
<b>Ability Enhancement Course</b>								
6	SC23AECBIO504	English	02	---	50	50	2	2:00
<b>Skill Enhancement Course (SEC)</b>								
8	SC23SECBIO506		02	---	50	100	2	2:00

<b>Semester VI</b>								
<b>Theory Course (DSC)</b>								
1	SC23MJDSCBIO601	<b>Environment biotechnology</b>	04	50	50	100	4	2:30
2	SC23MJDSCBIO601A	<b>Fundamentals of r- DNA technology</b>	04	50	50	100	4	2:30
3	SC23MIDSCBIO602	<b>Animal Biotechnology</b>	02	25	25	50	2	2:00
<b>Practical Course (PDSC)</b>								
4	SC23PMJDSCBIO601 (Group A) & SC23PMJDSCBIO601A (GroupB)	<b>Environment biotechnology &amp; Fundamentals of r- DNA technology</b>	4(GroupA +GroupB)	50	25GroupA 25GroupB	25GroupA 25GroupB	4	5:00
5	SC23PMIDSCBIO602	<b>Animal Biotechnology</b>	02	25	25	50	2	2:30
<b>Ability Enhancement Course</b>								
6	SC23AECBIO604	English	02	---	50	50	2	2:00
<b>Value Added Course</b>								
7	---		02	---	50	50	2	2:00
<b>Skill Enhancement Course (SEC)</b>								
8	SC23SECBIO607		02	---	50	100	2	2:00

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**SCIUG106**

**BT (Biotechnology)**

**SEMESTER -V**

**Immunology**

**SC23MJDSBIO501**

**EFFECTIVE FROM JUNE 2025-26 UNDER NEP**

<b>TotalCredits-04(04Periods/Week)</b>		<b>Theory</b>	<b>External50marks</b>
			<b>Internal50marks</b>
<b>Program Outcome</b>			
<ol style="list-style-type: none"> <li>Students will be able to demonstrate their knowledge of biotechnology concepts.</li> <li>Students will possess technical knowledge and hands-on laboratory skills needed to support biotechnology research activity.</li> <li>Students will show understanding of their knowledge of industrial regulations and the regulatory environment in the biotechnology industry.</li> <li>Students will be able to demonstrate the ability to apply research strategies to solve biotechnology problems.</li> <li>Students will be able to demonstrate the ability to communicate effectively with appropriate audiences with regard to the field of biotechnology.</li> <li>Students will show understanding of management tools and concepts.</li> <li>Students will be able to demonstrate the applications of computational skills in biotechnology.</li> <li>Students will be able to demonstrate the ability to work effectively in teams</li> </ol>			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>Identify the cellular and molecular basis of immune responsiveness; and understand the roles of the immune system in both maintaining health and contributing to disease.</li> <li>Comprehend, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity and their coordination in fighting invading pathogens.</li> <li>Outline key events and cellular players in antigen presentation and immunological events as seen in transplantation and allergic reactions.</li> <li>Explain the mechanisms involved in immune system alterations and comprehend the function of vaccines and immunotherapy</li> </ol>			
<b>Sr. No.</b>			<b>Credit Hrs.</b>
1	UNIT-1	Innate and Adaptive Immunity, Cells and Organs of the Immune System (Lymphocytes, Macrophages, Dendritic Cells), Primary and Secondary Lymphoid Organs	1 15
2	UNIT-2	Antigen, Characteristics of antigen. Epitope and hapten, T dependent and T independent antigen, adjuvant. HLA locus, structure and functions of MHC class I and MHC class II molecules.	1 15
3	UNIT-3	Structure and functions of immunoglobulin., isotopes of antibody, Antigenic determinants on antibody, VDJ rearrangement, Overview of complement system. Activation Pathways (Classical, Alternative, Lectin) Biological Functions of the Complement System	1 15
4	UNIT-4	Primary and secondary immune response. Generation of B and T cell immune response. Immunological techniques: precipitation reactions, agglutination reactions, immunoelectrophoresis, immunoblotting, immunofluorescence, RIA, ELISA.	1 15

## **References:**

1. **Kuby Immunology**-Authors: Judith A. Owen, Jenni Punt, Sharon A. Stranford
2. **Janeway's Immunobiology**- Authors: Kenneth Murphy, Casey Weaver
3. **Roitt's Essential Immunology**-Authors: Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt
4. **Fundamental Immunology**-Editor: William E. Paul
5. **Cellular and Molecular Immunology**- Authors: Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai
6. **Immunology: A Short Course**-Authors: Richard Coico, Geoffrey Sunshine

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**SCIUG106**

**BT (Biotechnology)**

**SEMESTER -V**

**Traditional Biotechnology in Indian Knowledge Systems (IKS)**

**SC23MJDSCBIO501A**

**EFFECTIVE FROM JUNE 2025-26 UNDER NEP**

TotalCredits-04(04Periods/Week)		Theory	External50marks		
			Internal50marks		
<b>Program Outcome</b>					
<ol style="list-style-type: none"> <li>1. Students will be able to demonstrate their knowledge of biotechnology concepts.</li> <li>2. Students will possess technical knowledge and hands-on laboratory skills needed to support biotechnology research activity.</li> <li>3. Students will show understanding of their knowledge of industrial regulations and the regulatory environment in the biotechnology industry.</li> <li>4. Students will be able to demonstrate the ability to apply research strategies to solve biotechnology problems.</li> <li>5. Students will be able to demonstrate the ability to communicate effectively with appropriate audiences with regard to the field of biotechnology.</li> <li>6. Students will show understanding of management tools and concepts.</li> <li>7. Students will be able to demonstrate the applications of computational skills in biotechnology.</li> <li>8. Students will be able to demonstrate the ability to work effectively in teams</li> </ol>					
<b>Course Outcome</b>					
By the end of this course, students will be able to:					
<ol style="list-style-type: none"> <li>1. Recognize the historical roots and foundational practices of biotechnology in Indian traditions.</li> <li>2. Understand the biological and scientific rationale behind traditional methods.</li> <li>3. Correlate ancient biotechnological practices with modern concepts like fermentation, IVF, cloning, etc.</li> <li>4. Critically evaluate ethical and ecological aspects of traditional and modern biotechnology.</li> </ol>					
Sr. No.				Credit	Hrs.
1	UNIT-1	Introduction to Indian Knowledge Systems (IKS) Indigenous knowledge in agriculture, medicine, and health Principles of <i>Ayurveda</i> , <i>Siddha</i> , and <i>Vrikshayurveda</i> Classical texts: <i>Charaka Samhita</i> , <i>Sushruta Samhita</i> , <i>Vrikshayurveda</i> Traditional tools and techniques used in biotechnology <b><i>Ancient Examples:</i></b> Use of turmeric, neem, and cow dung as antiseptics and soil enhancers Soil testing and treatment described in <i>Vrikshayurveda</i>		1	15
2	UNIT-2	Basics of IVF and cloning in modern biotechnology Historical references to embryology and reproduction in ancient texts Mass embryogenesis, in vitro fertilization concepts in epics Ethics of reproductive technologies in IKS and modern science <b><i>Ancient Examples:</i></b> <i>Mahabharata</i> : Kauravas' birth from divided embryo (cloning analogy) <i>Dronacharya/Agastya</i> : Born from pot — early IVF idea <i>Charaka Samhita</i> : Descriptions of embryonic development		1	15

3	UNIT-3	Seed treatment and preservation using natural substances Grafting and vegetative propagation techniques Natural pest control methods using plant derivatives Microbial inoculants in traditional composting Biocontrol and organic farming through Panchagavya <b>Ancient Examples:</b> <i>Vrikshayurveda</i> : Techniques of grafting and disease management Use of cow urine, ash, neem for pest and seed treatments Banana propagation documented in early texts	1	15
4	UNIT-4	Plant-based pharmaceuticals and Rasa Shastra Ancient surgery techniques and tools Bioethics: Dharma, sustainability, and life protection Traditional veterinary biotechnology and wound healing <b>Ancient Examples:</b> Sushruta Samhita: Over 300 surgical procedures including rhinoplasty Use of honey and ghee for wound healing Plant-based drugs like neem, tulsi, and ashwagandha in disease management Contribution of Indian scientists in modern biotechnology.	1	15

**References:**

1. *Sushruta Samhita* – Translated excerpts
2. *Charaka Samhita* – Chapters on biology and embryology
3. *Vrikshayurveda* by Surapala
4. R.S. Agarwal – *Ancient Indian Science and Biotechnology*
5. AYUSH publications and journals
6. S.B. Primrose & Richard Twyman – *Principles of Biotechnology* (for modern context)

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**SCIUG106**

**BT (Biotechnology)**

**SEMESTER -V**

**MAJOR PRACTICAL COURSE (LABORATORY EXPERIMENTS) SC23PMJDSCBIO501**

**EFFECTIVE FROM JUNE 2025-26 UNDER NEP**

<b>Total Credits-04</b> (2 (Group A) and 2 (Group B))		<b>Practical</b>	<b>External 25 marks</b>	
			<b>Internal 25 marks</b>	
<b>Program Outcome</b>				
<ol style="list-style-type: none"> <li>Students will be able to demonstrate their knowledge of biotechnology concepts.</li> <li>Students will possess technical knowledge and hands-on laboratory skills needed to support biotechnology research activity.</li> <li>Students will show understanding of their knowledge of industrial regulations and the regulatory environment in the biotechnology industry.</li> <li>Students will be able to demonstrate the ability to apply research strategies to solve biotechnology problems.</li> <li>Students will be able to demonstrate the ability to communicate effectively with appropriate audiences with regard to the field of biotechnology.</li> <li>Students will show understanding of management tools and concepts.</li> <li>Students will be able to demonstrate the applications of computational skills in biotechnology.</li> <li>Students will be able to demonstrate the ability to work effectively in teams</li> </ol>				
<b>Course Outcome</b>				
<ol style="list-style-type: none"> <li>Understand components of immune system, their morphology and counts.</li> <li>Estimation of hemoglobin.</li> <li>Understanding antigen-antibody reaction.</li> <li>Understanding blood group and its importance.</li> <li>Understand modern biotechnology advancements in health, reproductive techniques and their ancient analog system, agriculture and antimicrobial ayurved medicines.</li> </ol>				
<b>Sr. No.</b>			<b>Credit</b>	<b>Hrs.</b>
1	Group A	<b>SC23PMJDSCBIO501(Group A) Practicals</b> <ol style="list-style-type: none"> <li>Total count of White Blood Cells (WBCs).</li> <li>Total count of Red Blood Cells (RBCs).</li> <li>Differential Count of White Blood Cells (WBCs).</li> <li>Estimation Hemoglobin by Sahli's Method.</li> <li>Blood grouping</li> <li>WIDAL test (Slide Test)</li> </ol>	1	8
2	Group B	<b>SC23PMJDSCBIO501(Group B) Practicals</b> <ol style="list-style-type: none"> <li>Comparative analysis of ancient and modern IVF</li> <li>Documentation of local traditional farming methods</li> <li>Preparation of Panchagavya and study of microbial growth</li> <li>Herbal extract testing for antimicrobial properties</li> </ol>	1	8

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**SCIUG106**

**BT (Biotechnology)**

**SEMESTER-V**

**Clinical Immunology**

**SC23MIDSCBIO502**

**EFFECTIVE FROM JUNE 2025-26 UNDER NEP**

<b>TotalCredits-04(04Periods/Week)</b>		<b>Theory</b>	<b>External 50 marks</b>	
			<b>Internal 50 marks</b>	
<b>Program Outcome</b>				
<ol style="list-style-type: none"> <li>1. Students will be able to demonstrate their knowledge of biotechnology concepts.</li> <li>2. Students will possess technical knowledge and hands-on laboratory skills needed to support biotechnology research activity.</li> <li>3. Students will show understanding of their knowledge of industrial regulations and the regulatory environment in the biotechnology industry.</li> <li>4. Students will be able to demonstrate the ability to apply research strategies to solve biotechnology problems.</li> <li>5. Students will be able to demonstrate the ability to communicate effectively with appropriate audiences with regard to the field of biotechnology.</li> <li>6. Students will show understanding of management tools and concepts.</li> <li>7. Students will be able to demonstrate the applications of computational skills in biotechnology.</li> <li>8. Students will be able to demonstrate the ability to work effectively in teams</li> </ol>				
<b>Course Outcome</b>				
<ol style="list-style-type: none"> <li>1. Explain the components and mechanisms of the innate and adaptive immune systems.</li> <li>2. Describe how immune responses are regulated under normal and pathological conditions.</li> <li>3. Classify hypersensitivity reactions, autoimmune diseases, and immunodeficiency disorders.</li> <li>4. Analyze the pathophysiological mechanisms underlying various immune system disorders.</li> </ol>				
<b>No.</b>			<b>Credit</b>	<b>Hrs.</b>
1	UNIT-1	<b>Introduction to Clinical Immunology</b> -Overview and Scope, Components of the Immune System: Innate and Adaptive Immunity, Cells and Molecules Involved in Immune Responses (Lymphocytes, Antibodies, Cytokines), Classification of Immune Disorders (Autoimmune, Immunodeficiency, Hypersensitivity)	1	15
2	UNIT-2	<b>Hypersensitivity Reactions</b> - Type I: Immediate (Anaphylactic) Reactions, Type II: Cytotoxic Reactions, Type III: Immune Complex Reactions Type IV: Delayed-Type Hypersensitivity Primary Immunodeficiencies (SCID, DiGeorge Syndrome) Secondary Immunodeficiencies (HIV/AIDS, Malnutrition, Chemotherapy) Reactions	1	15
3	Unit-3	Basic concepts of tumor immunology, Transplantation immunology. Explains basics of donor-recipient matching.		
4	Unit-4	Diagnostic methods for the detection of immunodeficiency, allergic diseases, autoimmune and proliferative diseases of the immune system		

## References:

1. Janeway's Immunobiology"Authors: Kenneth Murphy, Casey Weaver
2. Clinical Immunology: Principles and Practice"Authors: Robert R. Rich, Thomas A. Fleisher, William T. Shearer, et al.
3. Roitt's Essential Immunology"Authors: Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt
4. Kuby Immunology"Authors: Jenni Punt, Sharon Stranford, Patricia Jones, Judith A. Owen
5. Abbas and Lichtman's Basic Immunology: Functions and Disorders of the Immune System"Authors: Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai
6. The Immune System"Authors: Peter Parham
7. Immunology: A Short Course"Authors: Richard Coico, Geoffrey Sunshine
8. Clinical Immunology and Serology: A Laboratory Perspective"Author: Linda E. Miller
9. Immunotherapy: Principles and Practice"Editors: Lisa H. Butterfield, Howard L. Kaufman, Francesco M. Marincola
10. Diagnostic Immunology"Author: Catherine Sheehan

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**SCIUG106**

**BT (Biotechnology)**

**SEMESTER -V**

**MINOR PRACTICAL COURSE (LABORATORY EXPERIMENTS)**

**SC23PMIDSCBIO502**

**EFFECTIVE FROM JUNE 2025-26 UNDER NEP**

<b>Total Credits-04</b>		<b>Practical</b>	<b>External 50 marks</b>
			<b>Internal 50 marks</b>
<b>Program Outcome</b>			
<ol style="list-style-type: none"> <li>Students will be able to demonstrate their knowledge of biotechnology concepts.</li> <li>Students will possess technical knowledge and hands-on laboratory skills needed to support biotechnology research activity.</li> <li>Students will show understanding of their knowledge of industrial regulations and the regulatory environment in the biotechnology industry.</li> <li>Students will be able to demonstrate the ability to apply research strategies to solve biotechnology problems.</li> <li>Students will be able to demonstrate the ability to communicate effectively with appropriate audiences with regard to the field of biotechnology.</li> <li>Students will show understanding of management tools and concepts.</li> <li>Students will be able to demonstrate the applications of computational skills in biotechnology.</li> <li>Students will be able to demonstrate the ability to work effectively in teams</li> </ol>			
<b>Course Outcome</b>			
<ol style="list-style-type: none"> <li>Hands on Immunological assays and blood components.</li> <li>Storage and handling of clinical specimens.</li> <li>Blood grouping methods.</li> <li>Understanding agglutination process.</li> <li>Blood counts and hemoglobin estimation.</li> <li>Understanding ELISA.</li> <li>Plant media and initial preparation.</li> <li>Importance of sterilization.</li> <li>Media and plant preparation.</li> <li>Culture and subculture of various plant parts.</li> </ol>			
<b>Sr. No.</b>			<b>Credit Hrs.</b>
1	Group A	<p align="center"><b>SC23PMIDSCBIO502 Practical</b></p> <ol style="list-style-type: none"> <li>Collection and preparation of blood, serum, and plasma samples for immunological assays.</li> <li>Proper handling and storage of clinical specimens.</li> <li>ABO and Rh blood grouping using slide and tube methods.</li> <li>Interpretation of agglutination patterns and clinical significance.</li> <li>Estimation of total leukocyte count (TLC) using hemocytometer.</li> <li>Differential leukocyte count (DLC) using stained blood smears.</li> <li>Estimation of hemoglobin using cyanmethemoglobin method.</li> <li>Interpretation of results in clinical diagnostics.</li> <li>Performing ELISA for detecting antibodies or antigens in patient samples.</li> <li>Quantification and analysis of ELISA results.</li> </ol>	1 8

**HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN**

**SCIUG106**

**BT (Biotechnology)**

**SEMESTER -V**

**Bioentrepreneurship**

**SC23SEC BIO506**

**EFFECTIVE FROM JUNE 2025-26 UNDER NEP**

Total Credits-02(02Periods/Week)		Theory	External 25 marks	
			Internal 25 marks	
<b>Program Outcome</b>				
<ol style="list-style-type: none"> <li>Students will be able to demonstrate their knowledge of biotechnology concepts.</li> <li>Students will possess technical knowledge and hands-on laboratory skills needed to support biotechnology research activity.</li> <li>Students will show understanding of their knowledge of industrial regulations and the regulatory environment in the biotechnology industry.</li> <li>Students will be able to demonstrate the ability to apply research strategies to solve biotechnology problems.</li> <li>Students will be able to demonstrate the ability to communicate effectively with appropriate audiences with regard to the field of biotechnology.</li> <li>Students will show understanding of management tools and concepts.</li> <li>Students will be able to demonstrate the applications of computational skills in biotechnology.</li> <li>Students will be able to demonstrate the ability to work effectively in teams</li> </ol>				
<b>Course Outcome</b>				
<ol style="list-style-type: none"> <li>Understanding the Bio-Entrepreneurial Landscape.</li> <li>Developing Entrepreneurial Skills.</li> <li>Navigating Legal and Ethical Issues.</li> <li>Understanding Financial Management.</li> <li>Strategic Thinking and Decision Making.</li> <li>Building a Network.</li> <li>Innovation and Commercialization.</li> </ol>				
Sr. No.			Credit	Hrs.
1	Unit-I Accounting and Finance	Taking decision on starting a venture; Assessment of feasibility of a given venture/new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/Plan for seeking loans from financial institution and Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management	1	15
2	Unit-II	Developing distribution channels; Pricing/Policies/Competition; Promotion/ Advertising; Services Marketing Negotiations/Strategy With financiers, bankers etc.; With government/law enforcement authorities; With companies/Institutions for technology transfer; Dispute resolution skills; External environment/changes; Crisis/Avoiding/Managing; Broader vision–Global thinking Information Technology How to use IT for business administration; Use of IT in improving business performance; Available software for better financial management; E-business setup, management. Human	1	15

		Resource Development (HRD) Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up		
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**References**

Swati Agarwal (Editor), Sonu Kumari (Editor), Suphiya Khan (Editor). Bioentrepreneurship and Transferring Technology into Product Development. Business Science Reference  
Thomas Brenner, Holger Patzelt. Handbook of Bioentrepreneurship. Springer New York, NY

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HEMCHANDRACHARYA NORTH GUJARAT UNIVERSITY, PATAN

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# **B.Sc. (Mathematics)**

**Detailed Syllabus as per NEP with Effect from July 2025**



**FACULTY:** SCIENCE  
**SUBJECT:** MATHEMATICS  
**PROGRAMME NAME:** BACHELOR OF SCIENCE  
**PROGRAMME CODE:** SCIUG107  
**SEMESTER:** V to VI (3<sup>rd</sup> Year)  
**TOTAL PAGE:** 01 TO 43 (with First Cover Page)  
**DATE:** 13-February-2025

Term	Type of Course	Mathematics Course Code	Total Units /Practical	Credit	Hrs. Per Term	External Marks (SEE)	Internal Marks (CCE)	Total Marks	External Examination Duration	Page No	
<b>Semester V</b>	<b>MJDSC</b>	<b>MAT501</b>	<b>4</b>	<b>4</b>	<b>60</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>2.5 Hrs</b>	<b>03/43</b>	
		<b>Practical MAT501</b>	<b>10</b>	<b>2</b>	<b>60</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>Min 3 Hrs</b>	<b>07/43</b>	
		<b>MAT501A</b>	<b>4</b>	<b>4</b>	<b>60</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>2.5Hrs</b>	<b>05/43</b>	
		<b>Practical MAT501A</b>	<b>10</b>	<b>2</b>	<b>60</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>Min 3 Hrs</b>	<b>09/43</b>	
	<b>MIDSC</b>	<b>MAT502 (A or B)</b>	<b>4</b>	<b>4</b>	<b>60</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>2.5 Hrs</b>	<b>13/43</b> <b>15/43</b>	
		<b>Practical MAT502</b>	<b>10</b>	<b>2</b>	<b>60</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>Min 3 Hrs</b>	<b>17/43</b>	
		<b>Practical MAT502A</b>	<b>10</b>	<b>2</b>	<b>60</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>Min 3 Hrs</b>	<b>19/43</b>	
	<b>SEC</b>	<b>MAT506</b>	<b>2</b>	<b>2</b>	<b>30</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>2.0Hrs</b>	<b>23/43</b>	
	<b>Semester VI</b>	<b>MJDSC</b>	<b>MAT601</b>	<b>4</b>	<b>4</b>	<b>60</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>2.5 Hrs</b>	<b>25/43</b>
			<b>Practical MAT601</b>	<b>10</b>	<b>2</b>	<b>60</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>Min 3 Hrs</b>	<b>29/43</b>
<b>MAT601A</b>			<b>4</b>	<b>4</b>	<b>60</b>	<b>50</b>	<b>50</b>	<b>100</b>	<b>2.5Hrs</b>	<b>27/43</b>	
<b>Practical MAT601A</b>			<b>10</b>	<b>2</b>	<b>60</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>Min 3 Hrs</b>	<b>31/43</b>	
<b>MIDSC</b>		<b>MAT602 (A or B)</b>	<b>2</b>	<b>2</b>	<b>30</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>2Hrs</b>	<b>36/43</b> <b>38/43</b>	
		<b>Practical MAT602</b>	<b>10</b>	<b>2</b>	<b>60</b>	<b>25</b>	<b>25</b>	<b>50</b>	<b>Min 3 Hrs</b>	<b>40/43</b>	
<b>INTERSHIP</b>		<b>MAT607</b>		<b>4</b>							
<b>Sem 5 &amp; Sem 6</b>			<b>Evaluation System for CCE and SEE</b>							<b>42/43</b>	

## B.Sc. (Mathematics) SEMESTER-5 Syllabus

### Hemchandracharya North Gujarat University, Patan

As per NEP-2020

<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>B.Sc.</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Major Discipline Theory Course</b>
<b>COURSE CODE:</b>	<b>SC23MJDSCMAT501</b>
<b>PAPER NAME</b>	<b>Group Theory</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Theory Credits:</b>	<b>04 (04 Period /Week)</b>
<b>Exam Pattern:</b>	<b>50 Marks (CCE) + 50 Marks (SEE) = 100 Marks</b>

#### Program Outcome :

<b>1</b>	<b>LEARNING OUTCOMES :</b> The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:
<b>2</b>	<b>Knowledge and Understanding:</b> When one has completed this degree he/she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.
<b>3</b>	<b>Cognitive Skills:</b> When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.
<b>4</b>	<b>Practical Skills:</b> When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.

#### Course Outcomes:

<b>1</b>	To understand basic principles of algebraic structure of group and its properties.
<b>2</b>	Able to understand the concept of subgroup and normal subgroup.
<b>3</b>	To understand the concept of permutation and homomorphism
<b>4</b>	Extend the concepts of homomorphism to isomorphism and cyclic group.

SR. NO.	UNIT	DETAILS	CREDIT	Total Hrs.
1	1	<b>Group and Its Applications.</b> Definition of a Group, Its properties and Examples, Elementary properties of a Group, Equivalent definitions of Group, Generalized form of Associative Law, Finite, abelian, Dihedral, cyclic Groups: Definitions and Examples.	1	15
2	2	<b>Subgroup and Normal Subgroup</b> Definition of a Subgroup and Its Properties and Examples, Lagrange's theorem and its applications. Definition of a Normal subgroup and its Properties and Examples, Quotient groups.	1	15
3	3	<b>Permutation and Homomorphism</b> Definition of a Permutation and Its applications, Transpositions and cycle, Definition of homomorphism of group and its applications, Kernel of Homomorphism. Fundamental theorem of Group homomorphism.	1	15
4	4	<b>Isomorphism and Cyclic groups</b> Isomorphism between groups, Groups of order four and six, Properties of cyclic groups, Generators of a cyclic group, Isomorphism of cyclic groups, Subgroup of a cyclic group, Cayley's Theorem.	1	15
<b>References:</b>				
1	<b>Textbook:</b> The course is covered by the Book : I H Sheth, <b>Abstract Algebra</b> , Prentice Hall of India (PHI) Publication. Chapter 6(6.1 to 6.7), Chapter 7(7.1 to 7.3), Chapter 8(8.1 to 8.3), Chapter 9(9.1 to 9.3), Chapter 10(10.1 to 10.2), Chapter 11(11.1 to 11.5), Chapter 12(12.1 to 12.6)			
2	I N Herstein, Topics in Algebra, Wiley Eastern Ltd.			
3	N. Jacobson, Basic Algebra Vol I & II, Hindustan Publishing company			
4	Shanti Narayan, A text book of Modern Algebra, S. Chand & Co.			
<b>Further Reading:</b>				
1	P. B. Bhattacharya, S. K. Jain, S R Nagpal, Basics Abstract Algebra, (second Edition), Cambridge University Press.			
2	Contemporary Abstract Algebra by Joseph A. Gallian.			

<b>Hemchandracharya North Gujarat University, Patan</b>	
<b>As per NEP-2020</b>	
<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>B.Sc.</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Major Discipline Theory Course</b>
<b>COURSE CODE:</b>	<b>SC23MJDSCMAT 501 A</b>
<b>PAPER NAME</b>	<b>IKS:Vedic Mathematics</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Theory Credits:</b>	<b>04 (04 Period /Week)</b>
<b>Exam Pattern:</b>	<b>50 Marks (CCE) + 50 Marks (SEE) = 100 Marks</b>
<b>Program Outcome :</b>	
<b>1</b>	<b>LEARNING OUTCOMES:</b> The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:
<b>2</b>	<b>Knowledge and understanding:</b> When one has completed this degree he / she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.
<b>3</b>	<b>Cognitive skills:</b> When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.
<b>4</b>	<b>Practical skills:</b> When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.
<b>Course Outcomes:</b>	
<b>1</b>	Analyze historical Indian approach arithmetic, algebra, geometry and trigonometry.
<b>2</b>	Compare traditional Indian methods with modern mathematical tools.
<b>3</b>	Apply traditional algorithms and theories in contemporary contexts.
<b>4</b>	Foster interdisciplinary thinking by linking IKS with science, astronomy, architecture, and philosophy.

SR. NO.	UNIT	DETAILS	CREDIT	Total Hrs.
1	1	<p><b>LEFTTORIGHTCALCULATIONS:</b> Addition, Multiplication, Writing left to right sums, Subtractions, Digits sums, Checking Devices, All from 9 and the last from 10</p> <p><b>SPECIALMETHODS:</b> Multiplication near a base, Mental Calculations, Special numbers, Division by 9 etc.</p>	1	15
2	2	<p><b>RECURRINGDECIMALS:</b> Denominators ending 9, A short cut, Proportionately, Longer numbers, Denominators ending in 1,2,3,4,6,7,8</p> <p><b>TRIPLES:</b> Definitions, Triples for <math>45^\circ</math>, <math>30^\circ</math> and <math>60^\circ</math>, Triple additions, double angles, Variations of 3,4,5, Quadrant angles, Rotations.</p>	1	15
3	3	<p><b>GENERALMULTIPLICATION:</b> Two-figure numbers, Moving multiplier, Algebraic products, Three-figure numbers, Four-figure numbers, Writing left to right sums, From right to left, Using bar numbers</p> <p><b>SOLUTIONOFEQUATIONS:</b> Transpose and apply, Simultaneous equations, Quadratic equations, One in ratio the other one zero, Mergers, When the samuccaya is the same it is zero, The ultimate and twice the penultimate, Only the last terms, Summation of series, Factorisation.</p>	1	15
4	4	<p><b>SQUARES AND SQUAREROOTS:</b> Squaring 2-figure numbers, Algebraic squaring, Squaring longer numbers, Written calculations, Square roots of perfect squares.</p> <p><b>APPLICATIONOFTRIPLES:</b> Triple subtraction, Triple geometry, Angle between two lines, Half angle, Coordinate geometry, Complex numbers.</p>	1	15

References:	
1	<b>'VedicMathematics' Advanced Level, Kenneth R. Williams Motilal Banarsidass Publishers Pvt. Limited, Delhi.</b>
2	VEDICMATHEMATICS By Jagadguru swami sri bharatikrisnatirthji maharaja, puri. <i>General Editor</i> Dr. V.S.AGRAWALA, Motilal Banarasidass, Delhi
Further Reading:	
1	Mathematics in India, Author: Kim Plofker Publisher: Princeton University Press, 2009, ISBN: 978-0-691-12067-6

<b>Hemchandracharya North Gujarat University, Patan</b>	
<b>As per NEP-2020</b>	
<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>B.Sc.</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Major Discipline Practical Course (Using MATLAB or Python SOFTWARE )</b>
<b>COURSE CODE:</b>	<b>SC23PMJDSCMAT501</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Practical Credits:</b>	<b>02 (04 Period /Week)(Batch of 15 Students)</b>
<b>Marks:</b>	<b>External :25 + Internal : 25 = Total :50</b>
<b>The basic requirement for the smooth and better conduction of the practical program:</b>	
<b>1</b>	Must require a Computer operator for better conduction of the practical and maintenance of computer systems.
<b>2</b>	Must have a computer lab fully equipped with Microsoft Office tools and internet facility.
<b>Program Outcome :</b>	
<b>1</b>	<b>LEARNING OUTCOMES:</b> The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:
<b>2</b>	<b>Knowledge and understanding:</b> When one has completed this degree he/she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.
<b>3</b>	<b>Cognitive skills:</b> When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.
<b>4</b>	<b>Practical skills:</b> When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.
<b>Course Outcome :</b>	
<b>1</b>	Able to use the MATLAB programming environment.
<b>2</b>	Understand the capabilities of MATLAB for solving complex mathematical problems.
<b>3</b>	Understand the tools that are essential in solving real-world problems applying appropriate Mathematical concept.

<b>PRACTICALDETAILS</b>	
<b>Unit-1</b>	<p style="text-align: center;"><b><u>Introduction to MATLAB</u></b></p> <p>Starting and ending MATLAB session, MATLAB environment, MATLAB help, types of files, search path, some useful MATLAB commands, data types, constant and variables, operators, built-in functions, assignment statement, illustrative programs.</p> <p><b>Vectors and Matrices</b> Scalars and vectors, entering data in matrices, line continuation, matrices subscripts/indices, multi-dimensional matrices and arrays, matrix manipulations, generation of special matrices, useful commands, matrix and array operations, function with array inputs.</p>
<b>Unit-2</b>	<p style="text-align: center;"><b><u>Polynomials</u></b></p> <p>Entering a polynomial, polynomial evaluation, roots of a polynomial, polynomial operations - addition and subtraction, multiplication, division, formulation of polynomial equation, characteristic polynomial of a matrix, polynomial differentiation, integration, and curve fitting, evaluation of polynomial with matrix arguments.</p>
<b>References:</b>	
<b>1</b>	<p><b>Text Book: “MATLAB and its Applications in Engineering”</b> Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, Pearson.</p> <p><b>Unit-1</b> Chapter 1: 1.8, Chapter 2: 2.9 Chapter 3: 3.11</p> <p><b>Unit-2</b> Chapter 4: 4.13</p>
<b>2</b>	“MATLAB: An Introduction with Applications” by Amos Gilat, Wiley; Fourth edition, 2012
<b>3</b>	“A Guide to MATLAB: For Beginners and Experienced Users” by Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, 2001.
<b>4</b>	Introduction to Computation and Programming Using Python, John V Guttag, Prentice Hall of India.
<b>5</b>	Core Python Programming, R. Nageswara Rao, Dreamtech Press, Wiley India.
<b>6</b>	Core Python Programming, Wesley J. Chun, Prentice Hall.
<b>7</b>	Fundamentals of Python – First Programs, Kenneth A. Lambert, CENGAGE Publication.
<b>Further Reading:</b>	
<b>1</b>	“MATLAB for Engineers” by Holly Moore, Pearson, 2018
<b>2</b>	“Introduction to MATLAB for Engineers” by William J. Palm, III, McGraw-Hill Education, 2010.

<b>Hemchandracharya North Gujarat University, Patan</b>	
<b>As per NEP-2020</b>	
<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>B.Sc.</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Major Discipline Practical Course (Using MATLAB or Python SOFTWARE )</b>
<b>COURSE CODE:</b>	<b>SC23PMJDSCMAT501 A</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Practical Credits:</b>	<b>02 (04 Period /Week)(Batch of 15 Students)</b>
<b>Marks:</b>	<b>External :25 + Internal : 25 = Total :50</b>
<b>The basic requirement for the smooth and better conduction of the practical program:</b>	
<b>1</b>	Must require a Computer operator for better conduction of the practical and maintenance of computer systems.
<b>2</b>	Must have a computer lab fully equipped with Microsoft Office tools and internet facility.
<b>Program Outcome :</b>	
<b>1</b>	<b>LEARNING OUTCOMES:</b> The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:
<b>2</b>	<b>Knowledge and understanding:</b> When one has completed this degree he/she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.
<b>3</b>	<b>Cognitive skills:</b> When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.
<b>4</b>	<b>Practical skills:</b> When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.
<b>Course Outcome :</b>	
<b>1</b>	Able to use the MATLAB programming environment.
<b>2</b>	Understand the capabilities of MATLAB for solving complex mathematical problems.
<b>3</b>	Understand the tools that are essential in solving real-world problems applying appropriate Mathematical concept.

<b>PRACTICALDETAILS</b>	
<b>Unit-1</b>	<b><u>MATLAB Graphics</u></b> Two-dimensional plots, multiple plots, style options, legend command, subplots, specialized two-dimensional plots, three-dimensional plots.
<b>Unit-2</b>	<b><u>Symbolic Processing With MATLAB</u></b> Symbolic Expressions and Algebra, Algebraic and Transcendental Equations, Calculus, Symbolic Linear Algebra, ordinary and partial differential equation, Symbolic Tutors.
<b>References:</b>	
<b>1</b>	<b>Text Book: “MATLAB and its Applications in Engineering”</b> Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, Pearson. <b>Unit-1</b> Chapter 6: 6.8 <b>Unit-2</b> Chapter 9: 9.3 only. Additional commands for symbolic toolbox are to be covered from the list given below.
<b>2</b>	“MATLAB: An Introduction with Applications” by Amos Gilat, Wiley; Fourth edition, 2012
<b>3</b>	“A Guide to MATLAB: For Beginners and Experienced Users” by Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, 2001.
<b>4</b>	Introduction to Computation and Programming Using Python, John V Guttag, Prentice Hall of India.
<b>5</b>	Core Python Programming, R. Nageswara Rao, Dreamtech Press, Wiley India.
<b>6</b>	Core Python Programming, Wesley J. Chun, Prentice Hall.
<b>7</b>	Fundamentals of Python – First Programs, Kenneth A. Lambert, CENGAGE Publication.
<b>Further Reading:</b>	
<b>1</b>	“MATLAB for Engineers” by Holly Moore, Pearson, 2018
<b>2</b>	“Introduction to MATLAB for Engineers” by William J. Palm, III, McGraw-Hill Education, 2010.

### **Symbolic Math Toolbox**

<b>Functions for Creating and Evaluating Symbolic Expressions</b>	
Class	Returns the class of an expression.
Digits	Sets the number of decimal digits used to do variable precision arithmetic.
Double	Converts an expression to numeric form.
Ezplot	Generates a plot of a symbolic expression.
ezplot3	3-D parametric plot
Ezplot	plot a 2-D curve in polar coordinates
Findsym	Finds the symbolic variables in a symbolic expression.
Numden	Returns the numerator and denominator of an expression.
Sym	Creates a symbolic variable.
Syms	Creates one or more symbolic variables.
Vpa	Sets the number of digits used to evaluate expressions.

### Functions for Manipulating Symbolic Expressions

Collect	Collects coefficients of like powers in an expression.
Expand	Expands an expression by carrying out powers.
Factor	Factors an expression.
poly2sym	Converts a polynomial coefficient vector to a symbolic polynomial.
Pretty	Displays an expression in a form that resembles typeset mathematics.
Simple	Searches for the shortest form of an expression.
Simplify	Simplifies an expression using Maple's simplification rules.
Subs	Substitutes variables or expressions.
sym2poly	Converts an expression to a polynomial coefficient vector.
<b>Symbolic Calculus Functions</b>	
Diff	Returns the derivative of an expression.
Jacobian	Compute the Jacobian matrix.
Dirac	Dirac delta function (unit impulse).
Heaviside	Heaviside function (unit step).
Int	Returns the integral of an expression.
Limit	Returns the limit of an expression.
Symsum	Returns the symbolic summation of an expression.
Taylor	Returns the Taylor series of a function.
<b>Symbolic Linear Algebra Functions</b>	
Det	Returns the determinant of a matrix.
Eig	Returns the eigenvalues (characteristic roots) of a matrix.
Inv	Returns the inverse of a matrix.
Poly	Returns the characteristic polynomial of a matrix.
<b>Symbolic Tutors</b>	
Arclen	Find the arclength of the curve.

composefun	compose two functions
Dirdifftool	plot or animate directional derivatives
Eigtool	interactive matrix eigenvalues
Gradtool	plot or animate gradient(s)
Linsys	plot a system of 2-D or 3-D linear equations
Ratfun	demonstrate the graphing of rational functions
Rsums	Riemann sum approximate integration tutor
Taylortool	taylor approximation tutor

**Assignment:** The student should submit the electronic copy of diary file showing the execution/output of Matlab session(s).

**N.B.:** As the *NEP-2020 has a high probability to be operationalized efficiently and effectively for the elevating learners*, the **Essential Requirements** for all Mathematical Practical including MATLAB or Python Practicals of Mathematical subjects are as under:

1. Mathematical Laboratory inbuilt with sufficient number of Computers (as per the students enrollments and the number of practical batches) and MATLAB or Python SOFTWARE with basic requirements for the MATLAB or Python Practicals.
2. Mathematical Laboratory inbuilt with Graphs, Charts, Printer, Physical Models (two dimensional as well as three dimensional) & Virtual Models (Higher Dimensional – Computerized) and basic requirements for the same.
3. Use also “PYTHON” Software instead of MATLAB Software.
4. *Essential Requirement for Mathematical Computer Laboratory:*
  - (i) At least One full time **Computer Operator** having mathematical ability to run Matlab Software and related Computerized Mathematical Practical.
  - (ii) One Peon for computer laboratory.

<b>Hemchandracharya North Gujarat University, Patan</b>	
<b>As per NEP-2020</b>	
<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>B.Sc.</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Minor Discipline Theory Course</b>
<b>COURSE CODE:</b>	<b>SC23MIDSCMAT 502 (A)</b>
<b>PAPER NAME</b>	<b>Optimization Techniques</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Theory Credits:</b>	<b>04 (04 Period /Week)</b>
<b>Exam Pattern:</b>	<b>50 Marks (CCE) + 50 Marks (SEE) = 100 Marks</b>
<b>Program Outcome :</b>	
<b>1</b>	<b>LEARNING OUTCOMES:</b> The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:
<b>2</b>	<b>Knowledge and understanding:</b> When one has completed this degree he/she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.
<b>3</b>	<b>Cognitive skills:</b> When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.
<b>4</b>	<b>Practical skills:</b> When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.
<b>Course Outcomes:</b>	
<b>1</b>	To analyze the concept of Operations Research, Linear programming
<b>2</b>	To understand the concept of artificial variable, two phase method, Big-M method etc...
<b>3</b>	Able to understand the concept of Duality Theory and Integer Programming
<b>4</b>	Understand the Network Models- Concept of Networks and Assignment Problem

SR. NO.	UNIT	DETAILS	CREDIT	Total Hrs.
1	1	[Only Example oriented] Introduction: Nature and scope of Operations Research, Linear programming: (a) Formulation of LPP, LPP Model and method of solution- Graphical method, Slack-Surplus and unrestricted variables	1	15
2	2	[Only Example oriented] Simplex Algorithm, Simplex Method, Artificial Slack variables, Two phase method, Big-M / Penalty method, Variation in simplex method solution- unbounded.	1	15
3	3	[Only Example oriented] <b>Duality Theory:</b> The essence of duality theory, primal-dual relationships, Duality theorems, Dual simplex method. <b>Transportation Problem-</b> Introduction, general method of a T.P., unbounded T.P. NWCM, Least cost method, VAM methods to find the initial solution	1	15
4	4	[Only Example oriented] Dual of a Transportation Problem and MODI method for Transportation Problem <b>Assignment Problem-</b> General model of A.P.(A.P. as a special case of a T.P.) Hungarian Method of solving a A.P., variations in a A.P.- maximization, prohibited assignments.	1	15
<b>References:</b>				
1	<b>Textbook:</b> Operations Research , by. J.K.Sharma. Macmillan Publishers India Ltd.			
2	Operations Research by Nita Shah, Ravi Gor and Hardik Soni, Prentice Hall of India.			
3	Operations Research( Principles and Practice) by Pradeep Prabhakar Pai, Oxford University Press.			
<b>Further Reading:</b>				
1	Operations Research by Prof. N.P. agarwal, Ramesh Book Depot, Jaipur.			
2	Optimization Methods in Operations Research and Systems Analysis-K V Mittal			
3	Operations Research by Kanti swarup P.K.Gupta and Manmohan.			

<b>Hemchandracharya North Gujarat University, Patan</b>	
<b>As per NEP-2020</b>	
<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>B.Sc.</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Minor Discipline Theory Course [Optional/Basket]</b>
<b>COURSE CODE:</b>	<b>SC23MIDSCMAT 502 (B)</b>
<b>PAPER NAME</b>	<b>Number Theory</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Theory Credits:</b>	<b>04 (04 Period /Week)</b>
<b>Exam Pattern:</b>	<b>50 Marks (CCE) + 50 Marks (SEE) = 100 Marks</b>
<b>Program Outcome :</b>	
<b>1</b>	<b>LEARNING OUTCOMES:</b> The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:
<b>2</b>	<b>Knowledge and understanding:</b> When one has completed this degree he/she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.
<b>3</b>	<b>Cognitive skills:</b> When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.
<b>4</b>	<b>Practical skills:</b> When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.
<b>Course Outcomes:</b>	
<b>1</b>	Understand and apply fundamental principles of number theory, including mathematical induction, the binomial theorem, and the division algorithm, to solve basic numerical problems.
<b>2</b>	Analyze and solve linear Diophantine equations, utilize the Fundamental Theorem of Arithmetic, and apply classical number theory techniques such as the Sieve of Eratosthenes and the Goldbach Conjecture.
<b>3</b>	Demonstrate proficiency in modular arithmetic by exploring properties of congruencies, number representations, linear congruencies, and the Chinese Remainder Theorem.
<b>4</b>	Explore advanced number theory concepts, including Fermat's Theorem, Wilson's Theorem, Euler's Phi function, and Euler's theorem, and apply them to solve related mathematical problems.

SR. NO.	UNIT	DETAILS	CREDIT	Total Hrs.
1	1	Preliminaries – Well ordering Principles, Mathematical Induction, The Binomial Theorem, Early Number Theory, Division Algorithm, GCD, Euclidean Algorithm.[Without Proof] (Chapter 1: Sections 1.1, 1.2 and Chapter 2: Sections 2.1, 2.3)	1	15
2	2	Diophantine Equations – The equation $ax+by=c$ and its solutions, The Fundamental Theorem of Arithmetic [Without Proof], The Sieve of Eratosthenes, The Goldbach Conjecture. (Chapter 2: Section 2.5 and Chapter 3: Sections 3.1 to 3.3)	1	15
3	3	Congruences and Number Representations – Basic Properties of Congruences, Binary and Decimal Representation of Integers, Linear Congruences, The Chinese Remainder Theorem.[Without Proof] (Chapter 4: Sections 4.2 to 4.4)	1	15
4	4	Advanced Theorems – Fermat’s Theorem, Wilson’s Theorem, Euler’s Phi function, Euler’s theorem [Without Proof] and Problems on Euler’s Theorem(Chapter 5: Sections 5.1 to 5.3 and Chapter 7: Sections 7.2 to 7.4)	1	15
<b>References:</b>				
1	<b>Textbook:</b> David M. Burton, Elementary Number Theory, McGraw Hill Education (India) Pvt. Ltd., New Delhi			
2	Neville Robinns, Beginning Number Theory, 2 <sup>nd</sup> Ed., Narosa Publishing House Pvt. Limited, Delhi.			
<b>Further Reading:</b>				
1	Richard E. Klima, Neil Sigmon, Ernest Stitzinger, Applications of Abstract Algebra with Maple, CRC Press, Boca Raton.			
2	S. Kumaravelu and Susheela Kumaravelu, Elements of Number Theory, Raja Sankar Offset Printers.			

<b>Hemchandracharya North Gujarat University, Patan</b>	
<b>As per NEP-2020</b>	
<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>B.Sc.</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Minor Discipline Practical Course (Using MATLAB or Python SOFTWARE )</b>
<b>COURSE CODE:</b>	<b>SC23PMIDSCMAT502</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Practical Credits:</b>	<b>02 (04 Period /Week)(Batch of 15 Students)</b>
<b>Marks:</b>	<b>External :25 + Internal : 25 = Total :50</b>
<b>The basic requirement for the smooth and better conduction of the practical program:</b>	
<b>1</b>	Must require a Computer operator for better conduction of the practical and maintenance of computer systems.
<b>2</b>	Must have a computer lab fully equipped with Microsoft Office tools and internet facility.
<b>Program Outcome :</b>	
<b>1</b>	<b>LEARNING OUTCOMES:</b> The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:
<b>2</b>	<b>Knowledge and understanding:</b> When one has completed this degree he/she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.
<b>3</b>	<b>Cognitive skills:</b> When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.
<b>4</b>	<b>Practical skills:</b> When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.
<b>Course Outcome :</b>	
<b>1</b>	Ensure the student can competently use the MATLAB programming environment.
<b>2</b>	Understand the capabilities of MATLAB for solving complex mathematical problems.
<b>3</b>	Understand the tools that are essential in solving real-world problems applying appropriate Mathematical concept.

<b>PRACTICALDETAILS</b>	
<b>Unit-1</b>	<p style="text-align: center;"><b><u>Introduction to MATLAB</u></b></p> <p>Starting and ending MATLAB session, MATLAB environment, MATLAB help, types of files, search path, some useful MATLAB commands, data types, constant and variables, operators, built-in functions, assignment statement, illustrative programs.</p> <p><b>Vectors and Matrices</b> Scalars and vectors, entering data in matrices, line continuation, matrices subscripts/indices, multi-dimensional matrices and arrays, matrix manipulations, generation of special matrices, useful commands, matrix and array operations, function with array inputs.</p>
<b>Unit-2</b>	<p style="text-align: center;"><b><u>Polynomials</u></b></p> <p>Entering a polynomial, polynomial evaluation, roots of a polynomial, polynomial operations - addition and subtraction, multiplication, division, formulation of polynomial equation, characteristic polynomial of a matrix, polynomial differentiation, integration, and curve fitting, evaluation of polynomial with matrix arguments.</p>
<b>References:</b>	
<b>1</b>	<p><b>Text Book: “MATLAB and its Applications in Engineering”</b> Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, Pearson.</p> <p><b>Unit-1</b> Chapter 1: 1.8, Chapter 2: 2.9 Chapter 3: 3.11</p> <p><b>Unit-2</b> Chapter 4: 4.13</p>
<b>2</b>	“MATLAB: An Introduction with Applications” by Amos Gilat, Wiley; Fourth edition, 2012
<b>3</b>	“A Guide to MATLAB: For Beginners and Experienced Users” by Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, 2001.
<b>4</b>	Introduction to Computation and Programming Using Python, John V Guttag, Prentice Hall of India.
<b>5</b>	Core Python Programming, R. Nageswara Rao, Dreamtech Press, Wiley India.
<b>6</b>	Core Python Programming, Wesley J. Chun, Prentice Hall.
<b>7</b>	Fundamentals of Python – First Programs, Kenneth A. Lambert, CENGAGE Publication.
<b>Further Reading:</b>	
<b>1</b>	“MATLAB for Engineers” by Holly Moore, Pearson, 2018
<b>2</b>	“Introduction to MATLAB for Engineers” by William J. Palm, III, McGraw-Hill Education, 2010.

<b>Hemchandracharya North Gujarat University, Patan</b>	
<b>As per NEP-2020</b>	
<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>B.Sc.</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Minor Discipline Practical Course (Using MATLAB or Python SOFTWARE )</b>
<b>COURSE CODE:</b>	<b>SC23PMIDSCMAT502A</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Practical Credits:</b>	<b>02 (04 Period /Week)(Batch of 15 Students)</b>
<b>Marks:</b>	<b>External :25 + Internal : 25 = Total :50</b>
<b>The basic requirement for the smooth and better conduction of the practical program:</b>	
<b>1</b>	Must require a Computer operator for better conduction of the practical and maintenance of computer systems.
<b>2</b>	Must have a computer lab fully equipped with Microsoft Office tools and internet facility.
<b>Program Outcome :</b>	
<b>1</b>	<b>LEARNING OUTCOMES:</b> The programme leading to this degree provides the opportunities to develop and demonstrate knowledge and understanding in the following areas:
<b>2</b>	<b>Knowledge and understanding:</b> When one has completed this degree he/she will have knowledge and understanding of the fundamental concepts, principles and techniques from a range of topic areas.
<b>3</b>	<b>Cognitive skills:</b> When one has completed this degree he/she will be able to understand how to solve some problems using the methods taught and develop abstract mathematical thinking.
<b>4</b>	<b>Practical skills:</b> When one has completed this degree, he/she will be able to demonstrate the Communicate clearly knowledge, ideas and conclusions about mathematics and improve his/her own learning and performance.
<b>Course Outcome :</b>	
<b>1</b>	Ensure the student can competently use the MATLAB programming environment.
<b>2</b>	Understand the capabilities of MATLAB for solving complex mathematical problems.
<b>3</b>	Understand the tools that are essential in solving real-world problems applying appropriate Mathematical concept.

<b>PRACTICALDETAILS</b>	
<b>Unit-1</b>	<b><u>MATLAB Graphics</u></b> Two-dimensional plots, multiple plots, style options, legend command, subplots, specialized two-dimensional plots, three-dimensional plots.
<b>Unit-2</b>	<b><u>Symbolic Processing With MATLAB</u></b> Symbolic Expressions and Algebra, Algebraic and Transcendental Equations, Calculus, Symbolic Linear Algebra, ordinary and partial differential equation, Symbolic Tutors.
<b>References:</b>	
<b>1</b>	<b>Text Book: “MATLAB and its Applications in Engineering”</b> Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, Pearson. <b>Unit-1</b> Chapter 6: 6.8 <b>Unit-2</b> Chapter 9: 9.3 only. Additional commands for symbolic toolbox are to be covered from the list given below.
<b>2</b>	“MATLAB: An Introduction with Applications” by Amos Gilat, Wiley; Fourth edition, 2012
<b>3</b>	“A Guide to MATLAB: For Beginners and Experienced Users” by Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, 2001.
<b>4</b>	Introduction to Computation and Programming Using Python, John V Guttag, Prentice Hall of India.
<b>5</b>	Core Python Programming, R. Nageswara Rao, Dreamtech Press, Wiley India.
<b>6</b>	Core Python Programming, Wesley J. Chun, Prentice Hall.
<b>7</b>	Fundamentals of Python – First Programs, Kenneth A. Lambert, CENGAGE Publication.
<b>Further Reading:</b>	
<b>1</b>	“MATLAB for Engineers” by Holly Moore, Pearson, 2018
<b>2</b>	“Introduction to MATLAB for Engineers” by William J. Palm, III, McGraw-Hill Education, 2010.

### Symbolic Math Toolbox

<b>Functions for Creating and Evaluating Symbolic Expressions</b>	
Class	Returns the class of an expression.
Digits	Sets the number of decimal digits used to do variable precision arithmetic.
Double	Converts an expression to numeric form.
Ezplot	Generates a plot of a symbolic expression.
ezplot3	3-D parametric plot
Ezpolar	plot a 2-D curve in polar coordinates
Findsym	Finds the symbolic variables in a symbolic expression.
Chairman	

numden	Returns the numerator and denominator of an expression.
Sym	Creates a symbolic variable.
Syms	Creates one or more symbolic variables.
Vpa	Sets the number of digits used to evaluate expressions.

### Functions for Manipulating Symbolic Expressions

Collect	Collects coefficients of like powers in an expression.
Expand	Expands an expression by carrying out powers.
Factor	Factors an expression.
poly2sym	Converts a polynomial coefficient vector to a symbolic polynomial.
Pretty	Displays an expression in a form that resembles typeset mathematics.
Simple	Searches for the shortest form of an expression.
Simplify	Simplifies an expression using Maple's simplification rules.
Subs	Substitutes variables or expressions.
sym2poly	Converts an expression to a polynomial coefficient vector.

### Symbolic Calculus Functions

Diff	Returns the derivative of an expression.
jacobian	Compute the Jacobian matrix.
Dirac	Dirac delta function (unit impulse).
Heaviside	Heaviside function (unit step).
Int	Returns the integral of an expression.
Limit	Returns the limit of an expression.
symsum	Returns the symbolic summation of an expression.
Taylor	Returns the Taylor series of a function.

### Symbolic Linear Algebra Functions

Det	Returns the determinant of a matrix.
Eig	Returns the eigenvalues (characteristic roots) of a matrix.
Inv	Returns the inverse of a matrix.

Poly	Returns the characteristic polynomial of a matrix.
<b>Symbolic Tutors</b>	
Arclen	Find the arclength of the curve.
composefun	compose two functions
dirdifftool	plot or animate directional derivatives
Eigtool	interactive matrix eigenvalues
gradtool	plot or animate gradient(s)
Linsys	plot a system of 2-D or 3-D linear equations
Ratfun	demonstrate the graphing of rational functions
Rsums	Riemann sum approximate integration tutor
taylortool	taylor approximation tutor

**Assignment:** The student should submit the electronic copy of diary file showing the execution/output of Matlab session(s).

**N.B.:** As the *NEP-2020 has a high probability to be operationalized efficiently and effectively for the elevating learners*, the Essential Requirements for all Mathematical Practical including MATLAB or Python Practicals of Mathematical subjects are as under:

1. Mathematical Laboratory inbuilt with sufficient number of Computers (as per the students enrollments and the number of practical batches) and MATLAB or Python SOFTWARE with basic requirements for the MATLAB or Python Practicals.
2. Mathematical Laboratory inbuilt with Graphs, Charts, Printer, Physical Models (two dimensional as well as three dimensional) & Virtual Models (Higher Dimensional – Computerized) and basic requirements for the same.
3. Use also “PYTHON” Software instead of MATLAB Software.

**4. Essential Requirement for Mathematical Computer Laboratory:**

- (i) At least One full time Computer Operator having mathematical ability to run Matlab or Python Software and related Computerized Mathematical Practical.
- (ii) One Peon for computer laboratory.

<b>Hemchandracharya North Gujarat University, Patan</b>	
<b>As per NEP-2020</b>	
<b>SUBJECT :</b>	<b>MATHEMATICS</b>
<b>PROGRAM CODE:</b>	<b>(B.Sc.) SCIUG107</b>
<b>SEMESTER:</b>	<b>V</b>
<b>COURSE NAME:</b>	<b>Skill Enhancement Theory Course-5</b>
<b>COURSE CODE:</b>	<b>SC23SECMAT506</b>
<b>PAPER NAME:</b>	<b>Mathematics for Competitive Exams-5</b>
<b>With Effect From :</b>	<b>JULY 2025</b>
<b>Total Theory Credits:</b>	<b>02 (02 Period /Week)</b>
<b>Exam Pattern:</b>	<b>25 Marks(CCE)+25 Marks(SEE)= 50 Marks</b>
<b>Program Outcome :</b>	
1	The B.Sc. Mathematics program aims to equip students with a strong foundation in mathematical concepts, techniques, and problem-solving skills.
2	Upon completion of the program, students should be able to apply mathematical principles to analyze and solve complex problems in various fields such as engineering, computer science, and physics.
3	The program also focuses on developing students' critical thinking and logical reasoning abilities, enabling them to effectively communicate mathematical ideas and concepts.
4	Graduates of the B.Sc. Mathematics program will possess a solid understanding of advanced Mathematical topics, including calculus, algebra, preparing them for further academic pursuits or careers in research, teaching, data analysis, or other math-intensive professions.
<b>Course Outcome :</b>	
1	Students get knowledge about mathematical rules, formulae and concepts for competitive examination.
2	Students were aware with the short tricks to solve the problems asked in competitive examination which are time consuming by its usual methods of solving them.

SR. NO.	UNIT	DETAILS	CREDIT	Total Hrs.
1	1	<b>Quadratic Equations</b> Important Points Related to Quadratic Equations, Methods of Solving Quadratic Equations <b>Permutations and Combinations</b> Permutation, Cases of Permutation, Combination, Cases of Combination, Factorial, Fundamental Principles of Counting <b>Probability</b> Terms Related to Probability, Event, Rules/Theorems Related to Probability, Types of Questions	1	15
2	2	<b>Area and Perimeter</b> Area, Perimeter, Triangle, Properties of Triangle, Quadrilateral, Regular Polygon, Circle <b>Volume and Surface Area</b> Volume, Surface Area, Cube, Cuboids, Cylinder, Cone, Sphere, Prism, Pyramid <b>Geometry</b> Point, Line, Angle, Triangle, Congruency of Triangles, Similarity of Triangles, Quadrilateral, Polygons, Circle	1	15
<b>References:</b>				
1	<b>Rajesh Verma, Fast Track objective Arithmetic, Arihant Publication India Ltd.</b>			
2	<b>Dr. R. S. Agrawal, Quantitative Aptitude, S. Chand Publication India Ltd.</b>			
<b>Further Reading:</b>				
1	<b>Satish Kumar, Maths in Moments, Arihant Publication India Ltd.</b>			
2	<b>Abhinay Sharma, Competitive Mathematics, Kiran Institute of Career Excellence.</b>			
3	<b>જગદીશ પટેલ, લિબર્ટી સહાયક, લિબર્ટી કેરિયર એકેડેમી.</b>			

# Semester-V

**B.Sc. (Computer Science) Semester V & VI according to N.E.P.**

<b>Semester-V</b>					
<b>Sr. No.</b>	<b>Course Type</b>	<b>Course Name</b>	<b>Course Code</b>	<b>Credit</b>	<b>Lect./Hours</b>
1	Major-I	Web Development with JavaScript	SC23MJDSCCS501	4	4
2	Major-II	Indian Knowledge System for Computational Thinking	SC23MJDSCCS501A	4	4
	Minor-I	UNIX Operating System & Shell Programming	SC23MIDSCCS502	4	4
3	SEC	Algorithm Analysis & Design	SC23SECCS506	2	2
4	Major Practical	Laboratory Experiment-I (Group-A)	SC23MJDSCPCS501	2	4
5	Major Practical	Laboratory Experiment-II (Group-B)		2	4
6	Minor Practical	Laboratory Experiment-I (Group-A)	SC23MIDSCPCS502	2	4
7	Minor Practical	Laboratory Experiment-II (Group-B)		2	4
<b>Semester-VI</b>					
1	Major-I	Software Engineering	SC23MJDSCCS601	4	4
2	Major-II	Fundamentals of Android & Flutter Programming	SC23MJDSCCS601A	4	4
3	Minor	E-Commerce Technologies	SC23MIDSCCS602	2	2
4	AEC	Language Course	SC23AEC604	2	2
5	Major Practical-I	Laboratory Experiment-I (Group-A)	SC23MJDSCPCS601	2	2
6	Major Practical-II	Laboratory Experiment-II (Group-B)		2	2
7	Minor Practical	Laboratory Experiment	SC23MIDSCPCS602	2	4
8	Internship	Internship in a Major Specific Course	SC23INTCS607	4	4

Sr. No.	CourseCode	StudyComponents	Instruction Hrs.	Examination			Credit	Exam Duration
				Internal	University	Total		
<b>Semester-V Programme Code: SCIUG101</b>								
<b>Theory Course (DSC)</b>								
1	SC23MJDSCCS501	Major-1: Discipline Specific Core Course (MJDSC-1)	04	50	50	100	4	02:30
2	SC23MJDSCCS501A	Major-2: Discipline Specific Core Course (MJDSC-2)	04	50	50	100	4	02:30
3	SC23MIDSCCS502	Minor Course (MDC)	04	50	50	100	4	02:30
<b>Practical Course (PDSC)</b>								
4	SC23MJDSCPCS501	Major-1: Discipline Specific Core Course (Group-A)	04	25	25	50	2	2:30
		Major-2: Discipline Specific Core Course (Group-B)	04	25	25	50	2	2:30
5	SC23MDSCPCS502	Minor Course (PMIDC) (Group-A)	02	25	25	50	2	2:00
		Minor Course (PMIDC) (Group-B)	02	25	25	50	2	2:00
<b>Skill Enhancement Course (SEC)</b>								
6	SC23SECCS506	Skill Enhancement Course (SEC)	02	25	25	50	2	1:30
<b>Total</b>			<b>28</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

Sr. No.	CourseCode	StudyComponents	Instruction Hrs.	Examination			Credit	Exam Duration
				Internal	University	Total		
<b>Semester-VI Programme Code: SCIUG101</b>								
<b>Theory Course (DSC)</b>								
1	SC23MJDSCCS601	Major-1: Discipline Specific Core Course (MJDSC-1)	04	50	50	100	4	02:30
2	SC23MJDSCCS601A	Major-2: Discipline Specific Core Course (MJDSC-2)	04	50	50	100	4	02:30
3	SC23MIDSCCS602	Minor Course (MIDC)	02	25	25	50	2	02:00
<b>Practical Course (PDSC)</b>								
4	SC23MJDSCPCS601	Major-1: Discipline Specific Core Course (PMJDSC-1)	04	25	25	50	2	2:30
		Major-2: Discipline Specific Core Course (PMJDSC-2)	04	25	25	50	2	2:30
5	SC23MIDSCPCS602	Minor Course (PMIDC)	04	25	25	50	2	2:00
<b>Ability Enhancement Course (AEC)</b>								
6	SC23AEC604	Ability Enhancement Course (AEC)	02	25	25	50	2	1:30
<b>Internship</b>								
7	SC23INTERNCS607	Internship in a Major Specific Course	04	50	50	100	4	2:30
<b>Total</b>			<b>28</b>	<b>275</b>	<b>275</b>	<b>550</b>	<b>22</b>	

<b>Course Code</b>	SC23MJDSCCS501
<b>Course Title</b>	Web Development with JavaScript
<b>Credits</b>	4
<b>Course Category</b>	Major Course
<b>Level of Course</b>	Higher Level Courses (300-399)
<b>Teaching Per Week</b>	4 Hrs./Week
<b>Minimum number of weeks per Semester</b>	15 (Including class work, examination, preparation etc.)
<b>Purpose Of Course</b>	This course aims to provide students with the foundational and practical knowledge needed to build dynamic, modern web applications using JavaScript and its major ecosystems—Node.js for server-side development and React.js for client-side interactivity. The course blends theoretical concepts with hands-on implementation to ensure industry readiness.
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>● To develop a strong foundation in JavaScript programming, including ES6+ features.</li> <li>● To enable students to build server-side applications using Node.js and Express.</li> <li>● To teach the fundamentals of modern frontend development using ReactJS.</li> <li>● To integrate frontend and backend using RESTful APIs.</li> <li>● To prepare students for real-world full-stack development projects and internships.</li> </ul>
<b>Prerequisite</b>	HTML, CSS, Any Programming Experience
<b>Course Outcome</b>	<p>After completing this course, students will be able to:</p> <ul style="list-style-type: none"> <li>● Write efficient JavaScript code using modern syntax and features.</li> <li>● Create scalable server-side applications using Node.js and Express.</li> <li>● Build dynamic user interfaces using React components, hooks, and state management.</li> <li>● Connect frontend and backend applications using REST APIs and JSON.</li> <li>● Deploy a full-stack web application on a cloud or local server.</li> </ul>

## Course Content

### UNIT I: Core JavaScript and ES6+

- Introduction to JavaScript (History, Use Cases)
- Variables (var, let, const), Data Types  
Functions, Arrow Functions, Callbacks
- Objects, Arrays, and JSON
- ES6 Features: Destructuring, Spread/Rest, Template Literals
- Asynchronous JavaScript: Promises, async/await  
DOM Manipulation & Event Handling

*Outcome: Ability to write modern JavaScript code and understand async programming patterns essential for React and NodeJS.*

### UNIT II: Server-side Development with NodeJS and ExpressJS

- Introduction to NodeJS: V8 Engine, npm, modules
- Creating a simple HTTP server
- Understanding ExpressJS: routing, middleware
- File handling with Node.js (fs module)
- Connecting to a database (MongoDB basics with mongoose or SQLite)
- Building a simple RESTful API

*Outcome: Develop REST APIs and backend services using NodeJS and Express.*

### UNIT III: ReactJS Fundamentals

- Introduction to ReactJS and Single Page Applications (SPAs)
- Components (Class vs Functional), JSX
- State and Props
- React Router for navigation
- Hooks (useState, useEffect, useContext)
- Event handling, Forms, Conditional Rendering
- Simple project: To-do App or Weather App

*Outcome: Build basic interactive interfaces with ReactJS using functional components and hooks.*

### UNIT IV: Integrating Frontend with Backend

- Fetching data from APIs using fetch/axios
- CORS and communication between client and server
- Building a full-stack app: MERN-lite (React + Node + Express + MongoDB)

	<p>State lifting and component communication</p> <ul style="list-style-type: none"> <li>● Deployment basics (Netlify, Vercel, or Node hosting)</li> <li>● Version control with Git and GitHub</li> </ul> <p><i>Outcome: Build and deploy a full-stack JavaScript-based web application.</i></p>
<p><b>Reference Books</b></p>	<ol style="list-style-type: none"> <li>1. <b>"Eloquent JavaScript"</b> by Marijn Haverbeke – (<a href="https://eloquentjavascript.net/">https://eloquentjavascript.net/</a>)</li> <li>2. <b>"You Don't Know JS" Series</b> by Kyle Simpson – O'Reilly</li> <li>3. <b>"Node.js Design Patterns"</b> by Mario Casciaro – Packt</li> <li>4. <b>"Learning React"</b> by Alex Banks and Eve Porcello – O'Reilly</li> <li>5. <b>"Full-Stack React Projects"</b> by Shama Hoque – Packt Publishing</li> </ol> <p><b>Online Resources</b></p> <ul style="list-style-type: none"> <li>● <b>MDN JavaScript Documentation</b> – <a href="https://developer.mozilla.org/en-US/docs/Web/JavaScript">https://developer.mozilla.org/en-US/docs/Web/JavaScript</a></li> <li>● <b>ReactJS Official Docs</b> – <a href="https://reactjs.org">https://reactjs.org</a></li> <li>● <b>NodeJS Official Docs</b> – <a href="https://nodejs.org">https://nodejs.org</a></li> <li>● <b>freeCodeCamp JavaScript/Node/React Curriculum</b> – <a href="https://www.freecodecamp.org">https://www.freecodecamp.org</a></li> </ul>
<p><b>Teaching Methodology</b></p>	<p>Class Work/ Project/ Discussion/ Self-Study/ Seminars/ field works/ practical training/ fieldwork, and/or assignments.</p>
<p><b>Evaluation Method</b></p>	<p>As per Hemchandracharya North Gujarat University, Patan Rules &amp; Regulations. 50% Continuous Internal Assessment 50% University Assessment</p>

<b>Course Code</b>	SC23MJDSCCS501A
<b>Course Title</b>	Indian Knowledge System for Computational Thinking
<b>Credits</b>	4
<b>Course Category</b>	Indian Knowledge System (IKS)
<b>Level of Course</b>	Higher Level Courses (300-399)
<b>Teaching Per Week</b>	4 Hrs./Week
<b>Minimum number of weeks per Semester</b>	15 (Including class work, examination, preparation etc.)
<b>Purpose Of Course</b>	This course introduces students to the foundational principles of the Indian Knowledge System (IKS), especially those relevant to computing disciplines. It bridges ancient Indian logic, reasoning systems, Vaidik mathematics, and critical thinking with modern computer science. The course aims to foster holistic education, cultural roots, and interdisciplinary thinking in line with NEP 2020.
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>● To expose students to the rich heritage of Indian contributions in logic, mathematics, and computing.</li> <li>● To integrate IKS principles in the development of analytical and computational thinking.</li> <li>● To enhance reasoning, pattern recognition, and problem-solving skills through Vaidik mathematical techniques.</li> </ul> <p>To encourage critical thinking and ethical reasoning using classical Indian texts and philosophies.</p> <ul style="list-style-type: none"> <li>● To explore ancient Indian algorithms and formal systems relevant to Computer Science.</li> </ul>
<b>Prerequisite</b>	Basic School Mathematics and Algorithms
<b>Course Outcome</b>	<p>By the end of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>● Understand the fundamental components of Indian logic (Nyaya, Navya-Nyaya) and their relevance to computer science.</li> <li>● Apply Vaidik mathematics techniques to improve mental computation and algorithmic thinking.</li> <li>● Analyze classical texts and principles with a critical and scientific mindset.</li> <li>● Draw parallels between traditional Indian thought systems and modern computational models.</li> <li>● Demonstrate improved reasoning and critical thinking abilities in</li> </ul>

	problem-solving tasks.
<b>Course Content</b>	<p><b>Unit I: Foundations of Indian Knowledge System and Logic</b></p> <ul style="list-style-type: none"> <li>● Introduction to IKS: Philosophy, Epistemology, and Science in Ancient India.</li> <li>● Nyaya System: Pramanas (Means of knowledge), Anumana (Inference), Tarka (Reasoning).</li> <li>● Navya-Nyaya and its symbolic logic: Introduction to Navya-Nyaya language structure and logic operators.</li> <li>● Comparative study with Boolean Logic and Predicate Logic.</li> </ul> <p><i>Outcome: Understand ancient Indian logic systems and their correspondence to formal systems in computer science.</i></p> <p><b>Unit II: Vaidik Mathematics for Algorithmic Thinking</b></p> <ul style="list-style-type: none"> <li>● Origin and Significance of Vedic Mathematics.</li> <li>● Sutras for Fast Calculation: Ekadhikena Purvena, Nikhilam Navatashcaramam Dashatah, Urdhva Tiryak Sutra.</li> <li>● Application of Sutras in Computer Algorithms, Coding Theory, and Data Encryption.</li> <li>● Binary operations and pattern recognition using Vedic methods.</li> </ul> <p><i>Outcome: Develop faster computation skills and understand algorithm design through ancient mathematical techniques.</i></p> <p><b>Unit III: Reasoning, Pattern Recognition, and Critical Thinking</b></p> <ul style="list-style-type: none"> <li>● Cognitive Models in Indian Philosophy: Sankhya, Yoga, and Logic.</li> <li>● Problem-solving using Indian Puzzle Literature (e.g., Bhaskaracharya’s Lilavati).</li> <li>● Case studies from Panini’s grammar as a formal system (precursor to rule-based programming).</li> <li>● Critical evaluation methods from Indian dialectical traditions (e.g., debate models like Purva Paksha and Uttara Paksha).</li> </ul> <p><i>Outcome: Enhance reasoning and critical analysis skills using indigenous knowledge paradigms.</i></p> <p><b>Unit IV: Indian Contributions to Computer Science Foundations</b></p> <ul style="list-style-type: none"> <li>● Concept of Zero, Infinity, and Decimal System. Panini’s Ashtadhyayi and Formal Grammar—applications in NLP and automata theory.</li> <li>● Ancient algorithms: Examples from Aryabhata, Pingala (binary system), and Kautilya’s logic in Arthashastra.</li> <li>● Ethical considerations and Dharma-based reasoning in AI and digital</li> </ul>

	<p>ethics.</p> <p><b>Outcome:</b> <i>Recognize Indian roots of foundational computing concepts and their modern relevance.</i></p>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. <i>Vedic Mathematics</i> by Bharati Krishna Tirthaji.</li> <li>2. <i>Nyaya Sutras of Gautama</i> – English translations by S.C. Vidyabhusana.</li> <li>3. <i>The Ashtadhyayi of Panini</i> – Translation and commentary by S.D. Joshi and J.A.F. Roodbergen.</li> <li>4. <i>Lilavati</i> by Bhaskaracharya – English translation by K.V. Sarma.</li> <li>5. <i>History of Hindu Mathematics</i> (Vol 1 &amp; 2) by B.B. Datta and A. Singh.</li> </ol>
<b>Teaching Methodology</b>	Class Work/ Project/ Discussion/ Self-Study/ Seminars/ field works/ practical training/ fieldwork, and/or assignments.
<b>Evaluation Method</b>	<p>As per Hemchandracharya North Gujarat University, Patan Rules &amp; Regulations.</p> <p>50% Continuous Internal Assessment</p> <p>50% University Assessment</p>

<b>Course Code</b>	SC23MIDSCCS502
<b>Course Title</b>	UNIX Operating System & Shell Programming
<b>Credits</b>	4
<b>Course Category</b>	Minor Course
<b>Level of Course</b>	Higher Level Courses (300-399)
<b>Teaching Per Week</b>	4 Hrs./Week
<b>Minimum number of weeks per Semester</b>	15 (Including class work, examination, preparation etc.)
<b>Purpose Of Course</b>	The course aims to introduce Computer Science students to the UNIX operating system, focusing on its architecture, commands, and shell programming. The goal is to equip students with the skills to effectively utilize UNIX for system management, automation, and scripting tasks.
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>● Understand UNIX Basics: Learn the fundamental concepts and architecture of the UNIX operating system.</li> <li>● Master UNIX Commands: Develop proficiency in using UNIX commands for file management, process control, and system monitoring.</li> <li>● Learn Shell Programming: Acquire the ability to write and debug shell scripts to automate tasks and manage systems efficiently.</li> <li>● Explore Advanced Features: Gain insights into advanced UNIX features like networking, process management, and security.</li> <li>● Practical Application: Apply UNIX and shell scripting knowledge to solve real-world system administration problems.</li> </ul>
<b>Prerequisite</b>	Fundamentals of Computer & Hardwares, Programming, Basics of Computer Networks
<b>Course Outcome</b>	<p>By the end of the course, students will be able to:</p> <ul style="list-style-type: none"> <li>● Operate the UNIX System: Navigate and manage the UNIX environment using essential commands.</li> <li>● Automate Tasks: Create and execute shell scripts to automate routine tasks.</li> <li>● Handle System Administration: Perform basic system administration tasks such as user management, file permissions, and process control.</li> <li>● Troubleshoot UNIX Systems: Identify and resolve common issues in UNIX systems.</li> <li>● Utilize Advanced UNIX Features: Implement advanced UNIX features like networking and security.</li> </ul>

## Course Content

### Unit 1: Introduction to UNIX (8 Hours)

- **Overview of UNIX:**
  - History and features of UNIX
  - UNIX architecture and file system
- **UNIX Commands:**
  - Basic commands: file handling, directory management, and text processing
  - File permissions and ownership
- **Working with the Shell:**
  - Shell types (Bourne, C, Korn, Bash)
  - Command-line operations and utilities

### Unit 2: Shell Programming Basics (10 Hours)

- **Introduction to Shell Scripting:**
  - Writing and executing shell scripts
  - Variables, operators, and control structures
- **Script Execution and Debugging:**
  - Script execution methods and error handling
  - Debugging techniques in shell scripting
- **Working with Files and Directories:**
  - File and directory operations in scripts
  - Input/output redirection and piping

### Unit 3: Advanced Shell Programming (12 Hours)

- **Functions and Loops:**
  - Creating and using functions in shell scripts
  - Implementing loops (for, while, until) and conditional statements (if-else, case)
- **Process Management:**
  - Managing processes and jobs in UNIX
  - Background processes, signals, and traps
- **Shell Script Optimization:**
  - Performance tuning of shell scripts
  - Best practices for writing efficient scripts

### Unit 4: Advanced UNIX Concepts (10 Hours)

- **UNIX Networking:**
  - Basic networking commands (ifconfig, netstat, ping)
  - Remote access and file transfer (SSH, SCP, FTP)
- **System Administration:**
  - User and group management, disk quotas, and backups
  - System security and permissions management
- **UNIX Utilities:**
  - Using grep, awk, sed, and other text processing tools

	<ul style="list-style-type: none"> <li>○ Cron jobs and scheduling tasks</li> </ul>
<b>Reference Books</b>	<ul style="list-style-type: none"> <li>● UNIX and Linux System Administration Handbook by Evi Nemeth, Garth Snyder, Trent R. Hein, and Ben Whaley</li> <li>● The UNIX Programming Environment by Brian W. Kernighan and Rob Pike</li> <li>● Learning the bash Shell by Cameron Newham</li> <li>● Advanced Programming in the UNIX Environment by W. Richard Stevens and Stephen A. Rago</li> </ul> <p><b>Reading Materials:</b></p> <ul style="list-style-type: none"> <li>● The Linux Command Line by William E. Shotts Jr. - Available as a free PDF online.</li> <li>● UNIX Shell Programming by Stephen G. Kochan and Patrick Wood</li> <li>● Bash Guide for Beginners by Machtelt Garrels - Available online for free.</li> <li>● UNIX Network Programming by W. Richard Stevens - For advanced UNIX networking concepts.</li> </ul>
<b>Teaching Methodology</b>	Class Work/ Project/ Discussion/ Self-Study/ Seminars/ field works/ practical training/ fieldwork, and/or assignments.
<b>Evaluation Method</b>	As per Hemchandracharya North Gujarat University, Patan Rules & Regulations. 50% Continuous Internal Assessment 50% University Assessment

Semester	Course Type	Course Name	Course Code	Credit	Lab-Hours
5	Major Practical	Laboratory Experiment-I	SC23MJDSCPCS501	2	4

### UNIT I: Core JavaScript and ES6+

**Objective:** Build a strong foundation in modern JavaScript syntax, logic building, and DOM manipulation.

Sr. No.	Practical Title	Description
1	<b>Basic JavaScript Syntax</b>	Write a script demonstrating variable declarations ( <code>var</code> , <code>let</code> , <code>const</code> ), data types, and simple arithmetic operations.
2	<b>Functions and Arrow Functions</b>	Create functions to calculate factorial, Fibonacci series, and demonstrate the difference between arrow functions and regular functions.
3	<b>Objects, Arrays, and JSON</b>	Implement a student record system using object literals and perform operations like add, update, delete, and search. Convert data to/from JSON.
4	<b>Destructuring &amp; Spread/Rest</b>	Write code snippets demonstrating array and object destructuring, and use of spread/rest operators in functions.
5	<b>Asynchronous JS: Promises and async/await</b>	Build a simple app that fetches data from a public API (like JSONPlaceholder) using both Promises and <code>async/await</code> .
6	<b>DOM Manipulation and Events</b>	Create a dynamic form (e.g., registration form) that validates user input in real-time using DOM methods and events.

### UNIT II: Server-side Development with NodeJS and ExpressJS

**Objective:** Learn backend programming with Node.js, build and expose APIs, and connect with databases.

<b>Sr. No.</b>	<b>Practical Title</b>	<b>Description</b>
1	<b>Basic NodeJS App</b>	Create a NodeJS script that reads and writes to a file using the <code>fs</code> module.
2	<b>Simple HTTP Server</b>	Create a basic HTTP server using Node's <code>http</code> module that serves HTML content.
3	<b>Intro to ExpressJS</b>	Build a server using ExpressJS that handles GET and POST routes for a simple contact form.
4	<b>CRUD Operations with Express</b>	Implement Create, Read, Update, Delete operations using Express routes and an in-memory array/database.
5	<b>Connect MongoDB (or SQLite)</b>	Create a MongoDB schema for storing user data using Mongoose and perform basic DB operations.
6	<b>Build a REST API</b>	Develop and test a RESTful API (using Postman) for managing a resource (e.g., notes, tasks).

### **UNIT III: ReactJS Fundamentals**

**Objective:** Build interactive user interfaces with component-based development.

<b>Sr. No.</b>	<b>Practical Title</b>	<b>Description</b>
1	<b>Setup React Environment</b>	Install Node.js and use <code>create-react-app</code> to scaffold a React project.
2	<b>JSX and Component Creation</b>	Create a component to display a profile card using JSX and functional components.
3	<b>Props and State</b>	Build a component to manage a counter using state and pass props to child components.
4	<b>React Router Basics</b>	Add routing to a sample app with 2-3 pages (Home, About, Contact).

5	<b>Using Hooks</b>	Create a To-Do List app using <code>useState</code> and <code>useEffect</code> hooks.
6	<b>Event Handling and Forms</b>	Create a login form with validation and event handling using React.
7	<b>Mini Project</b>	Build a simple Weather App using a public API (OpenWeatherMap) with routing and state management.

### **UNIT IV: Integrating Frontend with Backend**

**Objective:** Combine frontend and backend, fetch APIs, and deploy a full-stack app.

(Frontend – React, Backend – NodeJS + Express, Database – MongoDB)

<b>Sr. No.</b>	<b>Practical Title</b>	<b>Description</b>
1	<b>API Data Fetching</b>	Use <code>fetch</code> or <code>axios</code> in React to call a REST API and display results (e.g., user list, posts).
2	<b>CORS Configuration</b>	Set up CORS in Express backend to allow cross-origin requests from React frontend.
3	<b>MERN-lite App</b>	Build a full-stack Notes App with the following stack:
4	<b>State Lifting</b>	Create a parent-child component setup where a child form updates parent state (e.g., shopping cart).
5	<b>Deploy Frontend &amp; Backend</b>	Deploy React app on <b>Netlify</b> or <b>Vercel</b> , and backend on <b>Render/Glitch/Heroku</b> .
6	<b>Version Control with Git</b>	Initialize a Git repository, commit changes, and push to GitHub with README.md.

## Assessment:

- **Mini-Project (Individual/Group):** Build a simple MERN-lite app (e.g., Task Manager, Blog App, Student Dashboard).
- **Lab Viva:** Oral questioning on implementation logic and code explanation.
- **Code Reviews:** Peer review of practical submissions via GitHub pull requests.
- **Documentation:** Submit a brief report explaining each practical with code snippets and screenshots.

Semester	Course Type	Course Name	Course Code	Credit	Lab-Hours
5	Major Practical	Laboratory Experiment-I	SC23MJDSRPCS501A	2	4

### Unit I: Foundations of Indian Knowledge System and Logic

**Practical Objectives:** To explore traditional logical frameworks and draw parallels with formal logic.

Sr. No.	Exercise Title	Description
1	<b>Mapping Pramanas to Knowledge Models</b>	Create a concept map showing how Nyaya's 4 Pramanas (Perception, Inference, Comparison, Testimony) align with modern data acquisition or AI knowledge models.
2	<b>Truth Table Comparison</b>	Compare a Navya-Nyaya logical statement with Boolean logic using truth tables.
3	<b>Logic Statement Breakdown</b>	Decompose a classical Navya-Nyaya statement using its linguistic elements (Paksha, Hetu, Sadhya) and represent it in logical notation.
4	<b>Group Debate (Tarka Exercise)</b>	Simulate a structured debate (Tarka) session on a computing ethics topic using Indian dialectical method.

### Unit II: Vaidik Mathematics for Algorithmic Thinking

**Practical Objectives:** To apply Vedic sutras for fast computation and link them with algorithmic paradigms.

<b>Sr. No.</b>	<b>Exercise Title</b>	<b>Description</b>
1	<b>Implementing Vedic Sutras in Code</b>	Write Python/JavaScript programs to implement algorithms based on: <ul style="list-style-type: none"> <li>• Ekadhikena Purvena</li> <li>• Nikhilam Navatashcaramam Dashatah</li> <li>• Urdhva Tiryagbhyam</li> </ul>
2	<b>Speed Comparison</b>	Measure and compare the performance (time complexity) of Vedic math-based multiplication vs. traditional multiplication algorithms.
3	<b>Binary from Pingala's Chandas Shastra</b>	Translate a Chhanda pattern into binary using Pingala's method and build a binary-to-decimal converter.
4	<b>Cryptographic Experiment</b>	Create a basic encoding scheme inspired by Vedic pattern recognition for string encryption.

### **Unit III: Reasoning, Pattern Recognition, and Critical Thinking**

**Practical Objectives:** To develop higher-order thinking and rule-based reasoning inspired by Indian knowledge systems.

<b>Sr. No.</b>	<b>Exercise Title</b>	<b>Description</b>
1	<b>Puzzles from Lilavati</b>	Solve and implement at least 3 arithmetic puzzles from Bhaskaracharya's Lilavati using code.
2	<b>Sankhya-Yoga Thought Mapping</b>	Create a flowchart mapping the 25 Sankhya elements and analyze it as a layered decision-making model.
3	<b>Panini Grammar to Syntax Trees</b>	Model one of Panini's rules (sutras) as a syntax tree similar to compiler parsing.

4	<b>Debate Analysis using Purva Paksha-Uttara Paksha</b>	Analyze a contemporary tech controversy using this Indian logical method of thesis-antithesis-synthesis.
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### Unit IV: Indian Contributions to Computer Science Foundations

**Practical Objectives:** To explore algorithmic and computational ideas found in ancient Indian texts.

Sr. No.	Exercise Title	Description
1	<b>Designing Finite Automata using Panini Rules</b>	Translate a set of Sanskrit grammar rules into a finite automaton model (DFA/NFA).
2	<b>Zero and Infinity in Programming</b>	Explore behavior of zero, undefined, and infinity in programming languages like Python/JavaScript and reflect on the Indian philosophical treatment.
3	<b>Aryabhata's Algorithm in Code</b>	Implement Aryabhata's algorithm for finding multiplicative inverses or square roots.
4	<b>Ethical Dilemma Simulation</b>	Present an AI ethics dilemma and discuss resolutions using Dharma-based reasoning (case study approach).

### Assessment:

- **Mini-Project (Group):** Build a web-based or console-based application that uses Vedic math for user calculations.
- **Report:** Submit a comparative analysis between a modern and an ancient logical system.
- **Oral Presentation:** Present insights on Panini's formal grammar and its relevance to compilers or NLP.

Semester	Course Type	Course Name	Course Code	Credit	Lab-Hours
5	Minor Practical	Laboratory Experiment-I (Group-A)	SC23MDSCPCS502	2	4

## Unit 1: Introduction to UNIX

1. **Exploring the UNIX File System:**
    - Navigate through the UNIX directory structure using commands like `ls`, `cd`, and `pwd`.
  2. **File and Directory Management:**
    - Create, delete, and rename files and directories using `mkdir`, `rmdir`, `touch`, and `rm`.
  3. **File Permissions and Ownership:**
    - Change file permissions and ownership using `chmod`, `chown`, and `chgrp`.
  4. **Using UNIX Text Editors:**
    - Create and edit text files using editors like `vi` or `nano`.
  5. **Basic Text Processing:**
    - Perform text processing tasks using commands like `cat`, `more`, `less`, `head`, and `tail`.
  6. **File Content Searching:**
    - Search for patterns within files using `grep` and `find` commands.
  7. **File Compression and Archiving:**
    - Compress and decompress files using `gzip`, `gunzip`, `tar`, and `zip`.
  8. **Redirection and Piping:**
    - Practice input/output redirection and piping with commands like `>` and `|`.
  9. **Environment Variables:**
    - Work with environment variables using `echo`, `export`, and `env`.
  10. **Using Wildcards and Metacharacters:**
    - Perform operations using wildcards like `*`, `?`, and character ranges.
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## Unit 2: Shell Programming Basics

1. **Hello World Shell Script:**
  - Write and execute a simple shell script that prints "Hello World!" to the console.
2. **Basic Arithmetic Operations:**
  - Create a shell script to perform basic arithmetic operations using variables and `expr`.
3. **Conditional Statements:**
  - Implement a shell script with `if-else` statements to check for even or odd numbers.

4. **Looping Structures:**
    - Write a shell script using a `for` loop to print numbers from 1 to 10.
  5. **User Input Handling:**
    - Create a script that takes user input and performs operations based on the input.
  6. **String Operations:**
    - Develop a shell script to manipulate strings, such as concatenation and length calculation.
  7. **File Existence Check:**
    - Write a script to check if a file exists and whether it is a regular file or directory.
  8. **Simple Calculator Script:**
    - Implement a script that functions as a basic calculator, performing addition, subtraction, multiplication, and division.
  9. **Script Debugging:**
    - Debug an intentionally flawed shell script using `set -x` and `set +x`.
  10. **Working with Arrays:**
    - Create a script to demonstrate the use of arrays and array operations in shell scripting.
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### Unit 3: Advanced Shell Programming

1. **Creating Functions in Shell Scripts:**
  - Write a shell script that includes user-defined functions for modular code.
2. **File Backup Script:**
  - Develop a script that backs up a specified directory to a backup location with a timestamp.
3. **Process Management Script:**
  - Create a script to monitor and manage system processes using commands like `ps`, `kill`, and `top`.
4. **Automating Tasks with Cron Jobs:**
  - Schedule a shell script to run automatically at specified intervals using `cron` and `crontab`.
5. **User Management Script:**
  - Write a script to automate the creation and deletion of users on a UNIX system.
6. **Log File Analysis Script:**
  - Create a script that parses system log files and reports specific events or errors.
7. **Network Configuration Script:**
  - Develop a script to configure network interfaces and test connectivity using commands like `ifconfig`, `ping`, and `netstat`.
8. **Disk Usage Monitoring Script:**
  - Write a script that monitors disk usage and sends an alert if usage exceeds a certain threshold.
9. **Advanced Text Processing with awk and sed:**
  - Create scripts using `awk` and `sed` for complex text processing tasks.
10. **Error Handling in Scripts:**
  - Implement error handling in scripts, ensuring they can gracefully handle

unexpected inputs or conditions.

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## Unit 4: Advanced UNIX Concepts

1. **Setting Up SSH and Remote Access:**
  - Configure SSH on a UNIX system and securely connect to it remotely.
2. **Transferring Files with SCP and FTP:**
  - Transfer files between systems using `scp` and `ftp` commands.
3. **Configuring a Basic Firewall:**
  - Set up and configure a basic firewall using `iptables` or `ufw`.
4. **Managing User Quotas:**
  - Implement and manage disk quotas for users on a UNIX system.
5. **Creating and Managing Cron Jobs:**
  - Write cron jobs for system maintenance tasks, like cleaning up temporary files or rotating logs.
6. **Automated Backup Script:**
  - Develop a script to automatically back up important directories to a remote server.
7. **Securing UNIX System Files:**
  - Implement security measures to protect sensitive files using encryption tools like `gpg`.
8. **Network Services Configuration:**
  - Configure and manage network services like DNS, DHCP, or HTTP on a UNIX system.
9. **Setting Up and Using Version Control with Git:**
  - Install and configure Git on a UNIX system, and perform basic version control tasks.
10. **Analyzing Network Traffic:**
  - Use tools like `tcpdump` or `wireshark` to capture and analyze network traffic on a UNIX system.

Semester	Course Type	Course Name	Course Code	Credit	Lab-Hours
5	Minor Practical	Laboratory Experiment-I (Group-B)	SC23MDSCPCS502	2	4

### Unit 3: Advanced Shell Programming

1. **Creating Functions in Shell Scripts:**
    - Write a shell script that includes user-defined functions for modular code.
  2. **File Backup Script:**
    - Develop a script that backs up a specified directory to a backup location with a timestamp.
  3. **Process Management Script:**
    - Create a script to monitor and manage system processes using commands like `ps`, `kill`, and `top`.
  4. **Automating Tasks with Cron Jobs:**
    - Schedule a shell script to run automatically at specified intervals using `cron` and `crontab`.
  5. **User Management Script:**
    - Write a script to automate the creation and deletion of users on a UNIX system.
  6. **Log File Analysis Script:**
    - Create a script that parses system log files and reports specific events or errors.
  7. **Network Configuration Script:**
    - Develop a script to configure network interfaces and test connectivity using commands like `ifconfig`, `ping`, and `netstat`.
  8. **Disk Usage Monitoring Script:**
    - Write a script that monitors disk usage and sends an alert if usage exceeds a certain threshold.
  9. **Advanced Text Processing with awk and sed:**
    - Create scripts using `awk` and `sed` for complex text processing tasks.
  10. **Error Handling in Scripts:**
    - Implement error handling in scripts, ensuring they can gracefully handle unexpected inputs or conditions.
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### Unit 4: Advanced UNIX Concepts

1. **Setting Up SSH and Remote Access:**
  - Configure SSH on a UNIX system and securely connect to it remotely.
2. **Transferring Files with SCP and FTP:**
  - Transfer files between systems using `scp` and `ftp` commands.
3. **Configuring a Basic Firewall:**

- Set up and configure a basic firewall using `iptables` or `ufw`.
- 4. **Managing User Quotas:**
  - Implement and manage disk quotas for users on a UNIX system.
- 5. **Creating and Managing Cron Jobs:**
  - Write cron jobs for system maintenance tasks, like cleaning up temporary files or rotating logs.
- 6. **Automated Backup Script:**
  - Develop a script to automatically back up important directories to a remote server.
- 7. **Securing UNIX System Files:**
  - Implement security measures to protect sensitive files using encryption tools like `gpg`.
- 8. **Network Services Configuration:**
  - Configure and manage network services like DNS, DHCP, or HTTP on a UNIX system.
- 9. **Setting Up and Using Version Control with Git:**
  - Install and configure Git on a UNIX system, and perform basic version control tasks.
- 10. **Analyzing Network Traffic:**
  - Use tools like `tcpdump` or `wireshark` to capture and analyze network traffic on a UNIX system.

<b>Course Code</b>	SC23SECCS506
<b>Course Title</b>	Algorithm Analysis & Design
<b>Credits</b>	2
<b>Course Category</b>	Skill Enhancement Course (SEC)
<b>Level of Course</b>	Higher Level Courses (300-399)
<b>Teaching Per Week</b>	2 Hrs./Week
<b>Minimum number of weeks per Semester</b>	15 (Including class work, examination, preparation etc.)
<b>Purpose Of Course</b>	<ul style="list-style-type: none"> <li>● To develop practical algorithmic thinking and problem-solving abilities.</li> <li>● To provide skills in analyzing and designing efficient algorithms.</li> <li>● To emphasize real-world coding and implementation over theoretical derivations.</li> <li>● To prepare students for software development, competitive programming, and research in computing.</li> </ul>
<b>Course Objective</b>	<ul style="list-style-type: none"> <li>● Introduce algorithm design methodologies such as divide and conquer, greedy, and dynamic programming.</li> <li>● Apply and evaluate algorithms using code.</li> <li>● Understand trade-offs in algorithm performance.</li> <li>● Learn problem-solving through implementation and performance testing.</li> <li>● Encourage the use of best-fit algorithms for specific types of problems.</li> </ul>
<b>Prerequisite</b>	Python programming, Data Structures, Basic Problem-Solving Skills
<b>Course Outcome</b>	<p>After successful completion, students will be able to:</p> <ul style="list-style-type: none"> <li>● Analyze the time and space complexity of algorithms.</li> <li>● Implement core algorithmic strategies effectively.</li> <li>● Solve computational problems using recursion, greedy, and dynamic techniques.</li> <li>● Choose optimal algorithms for real-world problems.</li> <li>● Develop efficient, well-structured code with measurable performance.</li> </ul>
<b>Course Content</b>	<p><b>UNIT I: Fundamentals of Algorithm Design and Analysis</b></p> <ul style="list-style-type: none"> <li>● Introduction to Algorithms: What, Why, and How</li> <li>● Pseudocode Writing and Flow of Logic</li> </ul>

	<ul style="list-style-type: none"> <li>● Time and Space Complexity (with code benchmarking)</li> <li>● Recursion and Backtracking: <ul style="list-style-type: none"> <li>○ Factorial, Tower of Hanoi, N-Queens</li> </ul> </li> <li>● Divide and Conquer Paradigm: <ul style="list-style-type: none"> <li>○ Binary Search, Merge Sort, Quick Sort</li> </ul> </li> <li>● Greedy Algorithms: <ul style="list-style-type: none"> <li>○ Activity Selection, Coin Change, Fractional Knapsack</li> </ul> </li> <li>● Case Studies on Performance Comparison</li> </ul> <p><b>Outcome:</b></p> <ul style="list-style-type: none"> <li>● Understand and apply recursion, divide and conquer, and greedy methods.</li> <li>● Analyze and compare their performance practically.</li> </ul> <p><b>UNIT II: Advanced Algorithmic Techniques</b></p> <ul style="list-style-type: none"> <li>● Dynamic Programming: <ul style="list-style-type: none"> <li>○ Fibonacci (memoization &amp; tabulation), 0/1 Knapsack, LCS</li> </ul> </li> <li>● Graph Algorithms: <ul style="list-style-type: none"> <li>○ BFS, DFS, Dijkstra’s Algorithm</li> </ul> </li> <li>● String Algorithms: <ul style="list-style-type: none"> <li>○ Pattern Matching (Naive, KMP), Anagram Checks</li> </ul> </li> <li>● Sorting &amp; Searching: <ul style="list-style-type: none"> <li>○ Custom sorting logic, frequency-based sorting</li> </ul> </li> <li>● Complexity Analysis and Trade-offs (best/worst/avg case)</li> <li>● Mini Project: <ul style="list-style-type: none"> <li>○ Full implementation of an optimized algorithm for a real problem (e.g., pathfinding, scheduling)</li> </ul> </li> </ul> <p><b>Outcome:</b></p> <ul style="list-style-type: none"> <li>● Build confidence in solving complex problems.</li> <li>● Apply advanced techniques like dynamic programming and graph traversal.</li> <li>● Complete a mini-project demonstrating algorithm design and optimization.</li> </ul>
<p><b>Reference Materials</b></p>	<p><b>Suggested Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. <i>Introduction to Algorithms</i> – Cormen, Leiserson, Rivest, and Stein (CLRS)</li> <li>2. <i>The Algorithm Design Manual</i> – Steven Skiena</li> <li>3. <i>Algorithms</i> – Robert Sedgewick &amp; Kevin Wayne</li> <li>4. <i>Data Structures and Algorithms in Python</i> – Michael T. Goodrich</li> </ol>

	<p>5. <i>Elements of Programming Interviews</i> – Adnan Aziz</p> <p><b>Suggested Free Online Courses &amp; Study Materials:</b></p> <ol style="list-style-type: none"> <li>1. GeeksforGeeks – <a href="https://www.geeksforgeeks.org">https://www.geeksforgeeks.org</a></li> <li>2. LeetCode – <a href="https://leetcode.com">https://leetcode.com</a></li> <li>3. HackerRank – <a href="https://www.hackerrank.com">https://www.hackerrank.com</a></li> <li>4. VisuAlgo – <a href="https://visualgo.net">https://visualgo.net</a></li> <li>5. Python Tutor – <a href="https://pythontutor.com">https://pythontutor.com</a></li> </ol>
<b>Teaching Methodology</b>	Classwork/projects/discussions/self-study/seminars/field work/practical training/fieldwork and/or assignments.
<b>Evaluation Method</b>	<p>As per Hemchandracharya North Gujarat University, Patan Rules &amp; Regulations.</p> <p>50% Continuous Internal Assessment</p> <p>50% University Assessment</p>