SANJAY GHODAWAT UNIVERSITY KOLHAPUR

Sanjay Ghodawat University (SGU) is established in the Academic Year 2017-18, as a State Private University under Govt. of Maharashtra Act No. XL of 2017 dated 3rd May 2017, with the approval of the UGC and the state Government. "For the true measure of giving is giving without measure." Spread across 150 Acres, Sou. Sushila Danchand Ghodawat Charitable Trust's Sanjay Ghodawat University (SGU) is situated in serene atmosphere amidst idyllic hills and lush green meadows to study in harmony with Nature. The Institution aspires to run along the lines of best-in- the-world education and become a world-class institution where teaching-learning process gets a far deeper meaning. SGU always stands as the guiding star of brilliance, quality and deliverance beyond expectations. Innovativeness and Creativity are the hallmarks of a genius enterprise and SGU stands to be a stage where these qualities would be nurtured, encouraged and blossomed. The genius is incomplete without the sense of social responsibility and SGU's ultimate goal remains the development of an attitude of gratitude that freely gives back without expectations.

The Sanjay Ghodawat University stands as a beacon of light to guide the younger generation of the day on the right path to fulfillment in career and life. The USP of the University is its research based curriculum and academically oriented teaching staff. The world class ambience and infrastructure helps the students to easily accommodate themselves in an environment that is conducive to the teaching-learning process. Hands on experience, challenge based case studies, maximum participation of students in the classroom, use of modern digital technology, smart classrooms, solution oriented thinking promotion, stress on research and innovation, international tie ups, choice based credit system for flexibility in choosing areas of interest etc. are some of the features of the University.

The university will help students develop as a unique individual-to be educated as a whole person, intellectually, emotionally, socially, ethically, and spiritually. The educational program designs are worked out meticulously in line with best in class universities with special focus on:

- Flexible Choice Based Credit System
- OBE - Outcome Based Education System
- Experiential Learning
- Project Based Learning
- Case Based Learning

- Training need analysis based on Performance Appraisal System
- Active Learning tools for effective delivery
- Mentoring / Proctorship
- On line learning /Self learning platforms
- Flipped Classroom concept
- Effective Student Feedback Mechanism

VISION

Internationally recognized university of excellence in creating and disseminating knowledge through value-based quality education leading to betterment of mankind.

MISSION

- To prepare students for life-long learning and leadership in a global academic culture
- To create intellectual manpower relevant to the industry and society at large
- To collaborate with institutions of international repute for academic excellence
- To promote research and development through conducive environment
- To encourage entrepreneurship and skill development programs

CORE VALUES

- Integrity
- Transparency
- Accountability
- Equality
- Empathy
- Stewardship

QUALITY POLICY

Sanjay Ghodawat University is committed to establish high standards in value-based quality education to enhance and nurture young minds to excel in their chosen profession and develop into socially responsible citizens through resourceful collaboration, innovation and research

About School of Science

Since inception of Sanjay Ghodawat Institute in 2009, now Sanjay Ghodawat University has made constant efforts to provide quality education and a platform for development of students. School of Science currently offers BSc, MSc and PhD programs in but not limited to Physics, Chemistry and Mathematics. These programs have right blend of academia, research and industry providing an excellent opportunity for students to learn and flourish their career. Because of collaborations of School of Science with institutes, research laboratories and industries, students get number of opportunities of live projects, internships and placements. Our programs aim to provide skill based theoretical, practical and scientific knowledge to students. Our courses are focused towards development of following skills of students. Our courses are focused towards development of following skills of students.

Intellectual skills:

1. Ability to demonstrate understanding of a broad set of knowledge concerning the fundamentals in the basic areas of the discipline.
2. Ability to apply their knowledge to design, carries out, record and analyze the results of experiments.
3. Skills to communicate the results of their work.

Practical skills:

1. Skills in the monitoring of properties by observation and measurement, and the systematic and reliable recording and documentation.
2. Skills in the operation of standard instrumentation.
3. Skills required for the conduct of documented laboratory procedures involved.

Transferable skills:

1. Skills of both oral and written communication.
2. Problem solving skills.
3. Mathematical skills, correct use of units and data presentation.
4. Information retrieval skills.
5. IT skills.
6. Interpersonal skills such as interaction with others and team work.
7. Time management and organizational skills.
8. Skills related to ethical, social and professional understanding.

About Department of Physics

The Department of Physics is established in Academic Year 2017-18 under School of Science in the Sanjay Ghodawat University, Kolhapur. The department runs three courses under graduate, post graduate and Ph.D. The department consists of well-equipped laboratories and well qualified faculty members to handle the UG as well as PG courses. The department aims at developing the practical approach through skill enhancement courses, certifications course and project oriented learning. The research attitude is developed among students through research inclined courses and projects. The continuous development of quality research areas and exposure to research at reputed Institutes or Universities through internship would help in developing the careers of the next generation Physicists.

About Department of Chemistry

Chemistry is central science that deals with everyday life. Chemistry is all about knowing, measuring and making material. It can be making molecules, modifying and studying their properties. Department of Chemistry, Sanjay Ghodawat University aims to become world class teaching and Research Centre. Students can make their bright career in chemistry with our graduate, post graduate and PhD programs in chemistry. Deep understanding of chemistry can enable our graduates to take up new challenges in all aspects of chemistry that includes organic synthesis, chemical analysis, catalysis, nanotechnology, biochemistry etc. Our focused skill enhancement courses develop intellectual, practical and transferable skills of students.

About Department of Mathematics

The Department of Mathematics in Sanjay Ghodawat University was established in the year 2017. The Department offers Bachelor of Science (B.Sc.) and Master of Science (M.Sc.) in Mathematics with the major objective of developing a center of excellence especially in Mathematical Sciences and Applications.

The department offers opportunities for the education and research in a wide range of areas in Mathematics such as: Algebra and Analysis, Differential Equations and their applications, Discrete Mathematics and applications, Operations Research and Mathematical Software's etc.

The department has qualified and well experienced faculty members. Also the department has a computer lab where students can develop their programming skills by practicing in various software's viz. MATLAB, Sage, WxMaxima, C/C++, GAP, GeoGebra, LaTex etc. The department of Mathematics aims to prepare students who are oriented towards research and teaching in both fundamental and advanced areas of Mathematical Sciences.

CHOICE BASED CREDIT SYSTEM (CBCS)

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

University Grants Commission has come up with the Choice Based Credit System (CBCS) programme in which the students have a choice to choose from the prescribed courses, which are referred as core, elective or minor or soft skill courses and they can learn at their own pace and the entire assessment is graded-based on a credit system. The basic idea is to look into the needs of the students so as to keep up-to-date with development of higher education in India and abroad. CBCS aims to redefine the curriculum keeping pace with the liberalization and globalization in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world along with the facility of transfer of credits earned by students.

Where the students can choose the prescribed courses, as the core, and elective or soft skill courses, from a range of options, rather than to simply consume what the curriculum offers. They can learn at their own pace and the assessments are graded based on a credit system. It provides an opportunity for students to have a choice of courses or subjects within a programmed resembling a buffet, against the mostly fixed set of subjects now being offered (except for the limited choice of electives in professional degrees and postgraduate programmers) with the flexibility to complete the programmed by earning the required number of credits at a pace decided by the students.

The UGC has always initiated measures to bring efficiency and excellence in the Higher Education System of India. The basic motive is to expand academic quality in all aspects, right from the curriculum to the learning-teaching process to examination and evaluation systems. However, so far multiple methods are followed by different universities across the country towards examination, evaluation and grading system. Considering this diversity, the implementation of the choice based credit system seems to be a good system in assessing the overall performance of a student in a universal way of a single grading system.

OUTCOME BASED EDUCATION (OBE) MODEL

Sanjay Ghodawat University (SGU) has implemented OBE model of education, which is a learner centered approach. SGU has witnessed a sea change in the entire academic systems with implementation of all three components of OBE – Design, Delivery and Assessment. The SGU model of autonomy focuses on experiential learning which believes in learning by doing. This is achieved through hands on experience, industrial assignments, mini projects and live problem solving and collaboration with industries.

SGU is set in to dynamics of transformation and witnessing a shift in focus from teaching to learning and entire academic system of SGU is designed to provide multiple learning opportunities for students to acquire and demonstrate the Knowledge, Skills and Attitudes (KSA) for rewarding career.

The Vision and Mission of the Management, contribution from eminent BOG members and knowledgeable members of Academic Council and Board of Studies, the motivation and drive of the Director, the relentless efforts of the fellow Deans and Head of Departments and all teaching and non-teaching staff along with commitment to learning of students made it possible to successfully transform the institute and stand out to carve a niche for itself as an Institute of repute.

OBE is an approach of curriculum design and teaching that focuses on what students should be able to do (attained) at the end of course/ program. Outcome based education (OBE) is student-centered instruction model that focuses on measuring student performance through outcomes. Outcomes include knowledge, skills and attitudes (KSA). Its focus remains on evaluation of outcomes of the program by stating the knowledge, skill and behavior a graduate is expected to attain upon completion of a program and after 4 – 5 years of graduation. In the OBE model, the required knowledge and skill sets for a particular degree is predetermined and the students are evaluated for all the required parameters (Outcomes) during the course of the program.

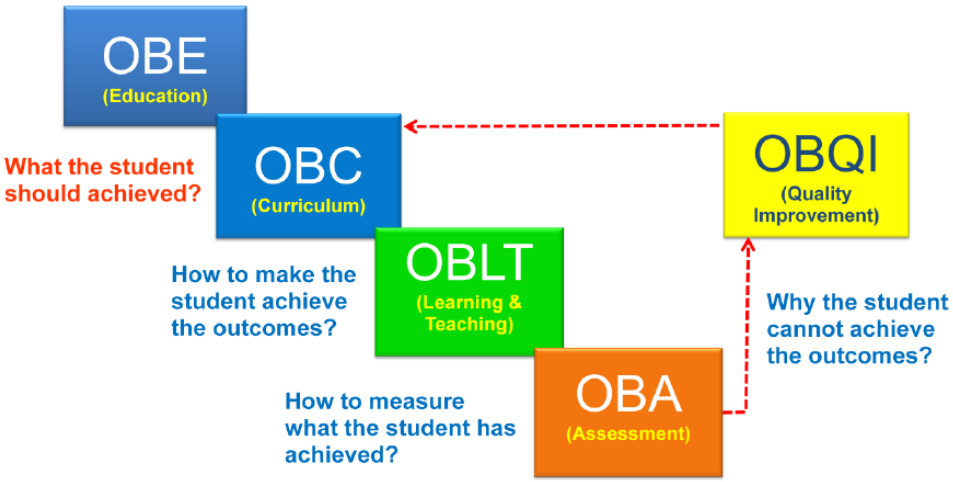
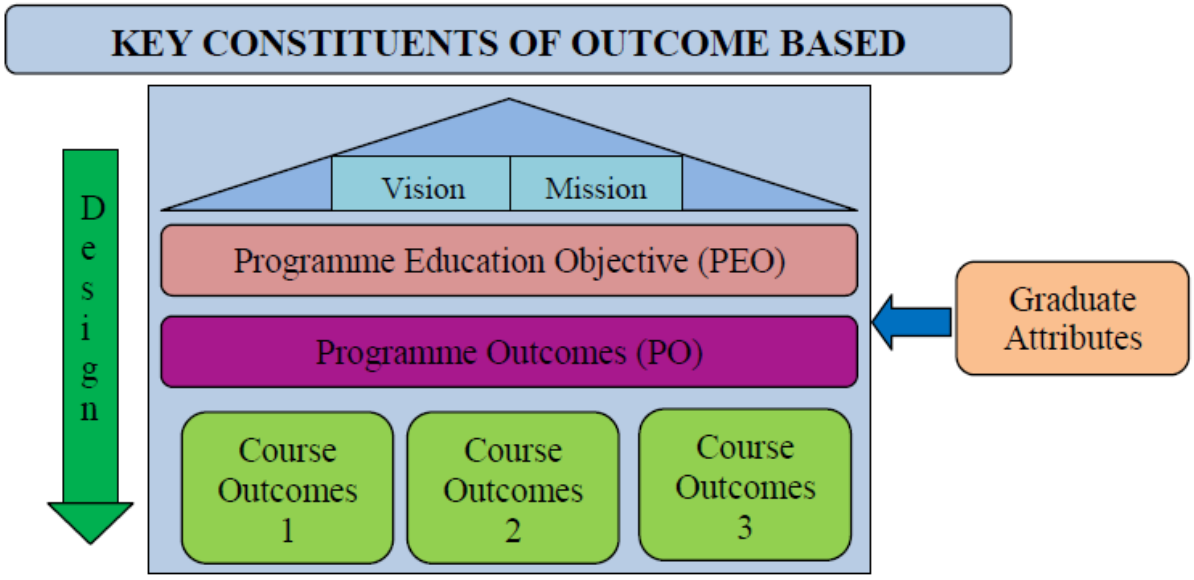


Figure 1: OBE flows and desciption

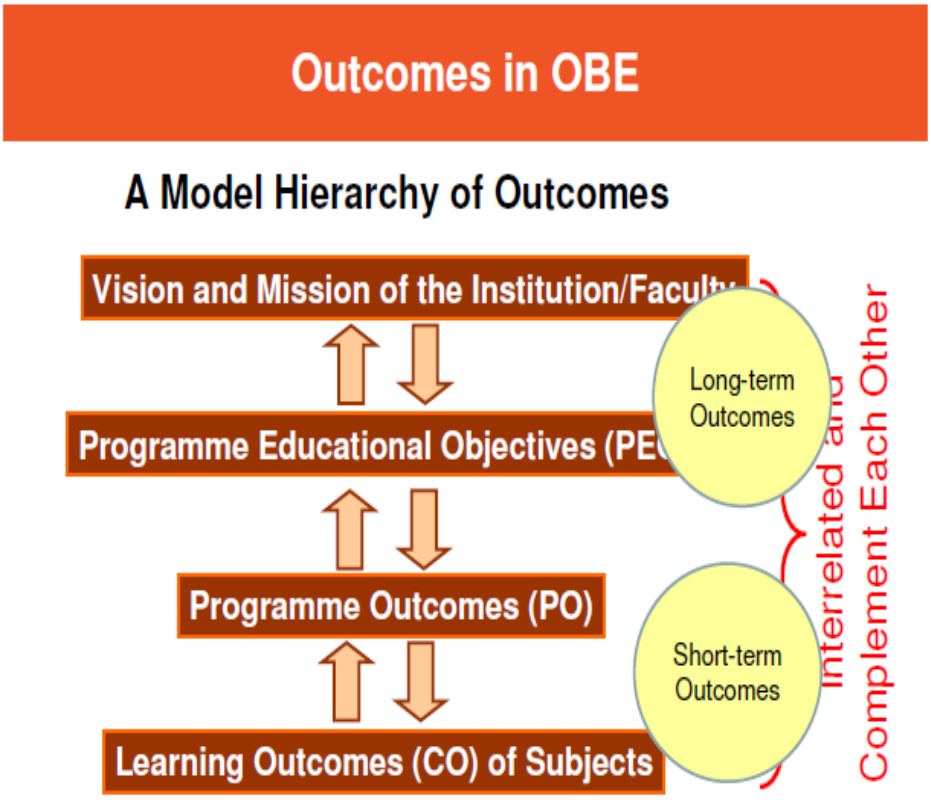


The OBE model measures the progress of the graduate in three parameters, which are

- Program Educational Objectives (PEO)
- Program Outcomes (PO)
- Course Outcomes (CO)

Program Educational Objectives (PEO) is broad statements that describe the career and professional accomplishments that the program is preparing the graduates to achieve. PEO's are measured 4-5 years after graduation. Program outcomes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. They must reflect the Graduate attributes. Course outcomes are the measurable parameters which evaluates each student's performance for each course that the student undertakes in every semester.

The various assessment tools for measuring Course Outcomes include Tests and End Semester Examinations, Tutorials, Assignments, Project work, Labs, Presentations, Employer/Alumni Feedback etc. These course outcomes are mapped to Graduate attributes and Program outcomes based on relevance. This evaluation pattern helps Institutions to measure the Program Outcome. The Program Educational Objective is measure through Employer satisfaction survey (Yearly), Alumni survey (Yearly), Placement records and higher education records.



Special Features of OBE

- OBE is an educational process that focuses on what students **can do**or the **qualities** they should develop after they are taught.
- OBE involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of high order learning and mastery rather than accumulation of course credits.
- Both structures and curricula are designed to achieve those **capabilities** or **qualities**.
- Discourages traditional education approaches based on direct instruction of facts and standard methods.
- It requires that the students demonstrate that they have learnt the required skills and content.

Sanjay Ghodawat University Kolhapur

(Established as a State University under Government of Maharashtra Act No XL dated 3rd May 2017)

Academic and Examination Rules and Regulations

Approved in the sixth Academic Council Meeting held on 17th February, 2020
and to be implemented from academic year 2020-21. [Version R1]

Sanjay Ghodawat University Kolhapur

Kolhapur - Sangli Highway, A/p Atigre - 416 118,
Tal. - Hatkanangale, Dist. Kolhapur,
Maharashtra, India

(Implemented from Academic year 2020-21)

Academic and Examination Rules and Regulations

1.0 Preamble

The Sanjay Ghodawat University (SGU) stands as a beacon of light to guide the younger generation of the day on the right path to fulfillment in career and life. Outcome Based Education (OBE) model is adopted to enhance the effectiveness of teaching learning process and Credit Based semester system is implemented.

The focus of the University is its research based curriculum and academically oriented teaching staff. The world class ambience and infrastructure helps the students to easily accommodate themselves in an environment that is conducive to the teaching- learning process. Hands on experience, challenge based case studies, maximum participation of students in the classroom, use of modern digital technology, smart classrooms, solution oriented thinking promotion, stress on research and innovation, international tie ups, choice based credit system for flexibility in choosing areas of interest etc. are some of the features of the University.

Vision of SGU is internationally recognized university of excellence in creating and disseminating knowledge through value-based quality education leading to betterment of mankind. To achieve the vision SGU will develop state-of-the-art infrastructure that promotes conducive ambience promoting innovation and research. Create intellectual manpower relevant to the industry and society at large. Foster mutually beneficial partnership with alumni, industry and academia. Inculcate ethics and values to develop socially responsible citizens and promote entrepreneurship.

SGU is offering various programs through schools such as School of Technology, School of Commerce and Management, School of Sciences and School of Arts.

SGU has implemented the outcome based Education (OBE) system and Credit based Evaluation System in all the schools.

The rules and regulations mentioned in this document are applicable to all the Under Graduate (UG) and Post Graduate programs offered by the Sanjay Ghodawat University from the academic year 2018-19. The rules and regulations stated here under are subjected to revisions / refinements, updates and modifications and amendments by academic council (AC) from time to time and applicable to all batches including those already undergoing programs at different year and are binding on all stakeholders including students, faculty, parents and University authorities.

The academic programs of the University shall be governed by rules and regulations approved by the academic council from time to time. Academic council is the supreme and statutory academic body that governs all academic matters of the university and the decisions of the academic council are final and binding in the matters related to academics.

2.0 Definition of Terms

1. University: University means Sanjay Ghodawat University, Kolhapur
2. Academic Year: The period of the year during which students attend university for all academic activities, usually it starts from first of July and ends on 30th of June next year.
3. Semester: Academic Year is divided in to 2 parts called Semester, Odd Semester which starts from July and Even Semester which starts from January.
4. Duration of Semester: Total duration of semester is usually 20 weeks per semester including instructions, examination and evaluation. Total instructional days are 90 per semester.
5. Course: It is a Subject that is offered in a semester. The course may consist of Theory/Practical/Project/Seminar during semester. Usually taught by instructor in a class. e.g. Physics, Chemistry, Engineering Mechanics, Workshop etc.
6. Program: Collection of Courses is called Program. For example, B Tech in Mechanical Engineering, M Tech in Civil Engineering, Bachelor of Business Administration. Bachelor of Science etc.
7. Department: Department is a unit of the school which offers one or more programs.
8. Contact Hours: Time of students in class/laboratory with instructor. Usually in the range of 20-30 Hrs./Week. For the purpose of uniformity one contact hour is measured as 60 minutes
9. Academic Council (AC): Means apex academic body governing the academic programs responsible for framing policy, rules and regulations.
10. Board of Examination (BOE): Central body responsible for framing policy, rules and regulations for Examination.
11. Board of Studies (BOS): Departmental academic body to govern the academics of programs (BOS) offered by department.

3.0 Curriculum:

Every program has a prescribed structure which, in general, is known as Curriculum. It prescribes courses to be studied in each semester. The booklet containing courses structure along with detail syllabus for each course of each program is updated periodically and made available on the website.

3.1 Semesters:

SGU implements a credit based semester system. The academic year is divided into two regular semesters. The semesters that begin in July are known as Odd semester and the semester that begin in January are known as even semesters. Total duration of each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

3.2 Course Credit System/Structure:

In general, a certain quantum of work measured in terms of credits is laid down as the requirement for a particular program. Calculation of number of credits for a course in any semester is as per Table 3.1

Table 3.1: Calculation of number of credits for a course

Sr. No.	Course	Credits
1	Lecture of 1 hour/week	1
2	Tutorial of 1 hour/week	1
3	Practical / Laboratory / Drawing/mini-project of two hours/ week	1
4	Seminar (1 hour per week)	1

There are mainly two types of courses- viz. Theory courses and Laboratory courses. Generally a theory course consists of Lecture hours (L) and Tutorial hours (T). Tutorial hours may not be assigned to a particular theory course if it has a separate laboratory course. Laboratory course consists of practical hours (P) for which a student works in a Laboratory/Drawing Hall/Workshop. The other courses required to be taken by a student include seminar, mini project, and project at various levels of the program.

A student shall earn credits for a particular course by fulfilling the minimum academic requirements for attendance and evaluation. No credits shall be awarded if a student satisfies the minimum attendance requirements but fails to meet minimum evaluation requirements.

The total number of credits required for completing a program shall be mentioned in the course structure. The total number of credits in a semester which a student registers shall generally be 20--25. The maximum number of credits per semester shall not exceed 30

3.3 Audit Course:

3.3.1 A student may have to register for an audit course in a semester which could be institute requirement or department requirement.

3.3.2 An audit course may include either a) a regular course required to be done as per structure or required as pre-requisite of any higher level course or b) the programs like practical training, industry visits, societal activities etc.

3.3.3 Audit course shall not carry any credits but shall be reflected in Grade Card as "PP"/"NP" depending upon the satisfactory performance in the semester evaluation as per the course curriculum structure.

4.0 Course Registration:

4.1 Every student must register for the courses that he/she wants to study for earning credits at the beginning of each semester on the prescribed dates announced from time to time and shall be mandatory for every student till he/she completes the program. Only after registration his/her name shall appear in the roll list of each of such courses.

4.2 Students shall be required to fill up a Course Registration Form which shall be made available to them by the Student section of Administration office after payment of required fees.

4.3 Registration, according to rules, should be carried out as per the schedule given in academic calendar. Late registration may be permitted only for valid reasons and on payment of late registration fees. In any case, registration must be completed before the prescribed last date for registration, failing which his/her studentship shall be liable to be cancelled. Students having dues outstanding towards the institute or hostel shall be permitted to register only after clearing such dues.

4.4 In-absentia registration may be allowed only in rare cases at the discretion of the Dean Academics and with prior permission.

4.5 For registration in an odd semester, the student must have earned all the credits of the pre-previous year and at least 75% 2/3rd of the credits previous year. For example, for registration of the 5th semester courses (i.e. 3rd year of program), a student must have earned all the credits of the first year and 2/3rd of the credit second year. Similarly, for registration of the 7th semester courses (i.e. 4th year of program), a student must have earned all the credits of the second year and 2/3rd of the credits third year. However, if 2/3rd of the calculation turns out to be a mixed number (integer + fraction) then only the integer part of that number shall be considered for taking decision related with this clause.

4.6 A student registered in odd semester shall be eligible to register for the courses offered in the even semester of that year irrespective of his/her SGPA or the number of credits earned by him/her in that odd semester.

5 .0 Lateral Entry for B Tech Programs

Post diploma students in engineering and B.Sc. Graduates can have lateral entry at third semester of the program. Such admissions are governed by the rules of regulatory bodies like AICTE New Delhi and Directorate of Technical Education Maharashtra state and Sanjay Ghodawat University for Admission criteria and shall undergo all academic requirements as specified by the Academic council.

For such students there shall not be First Year Performance Index (FYPI). Semester Performance Index (SGPA) and Cumulative Performance Index (CGPA) shall be calculated from the third semester onwards taking into consideration the courses undergone by them at Sanjay Ghodawat University Kolhapur.

Registration of the students not covered by the cases mentioned above shall be decided by the Academic Council. Such students shall undergo the academic program as specified by the Academic Council. Such odd entry students shall not be eligible for any medals or awards instituted by the institute.

6.0 Change of Program:

This is applicable to B Tech Programs only. Students shall be eligible to apply for Change of Program after completing the first two semesters. The following rules/ guidelines shall be used for considering their applications for change:

6.1 The change of program shall be permitted strictly on merit basis subject to the rules of admissions prevailing at the time of such change.

6.2 Students without fail grades and/or backlogs shall be eligible to apply for change of program and can give their choices in the order of preference.

6.3 The request for change of program by a student from program A to program B shall be considered if number of students of program B does not exceed the sanctioned capacity of program B and also the minimum strength required to run the program as decided by Academic Council.

6.4 All such transfers can be effected only once at the beginning of the second academic year of the 4-year UG program. No application for change of program during subsequent academic years shall be entertained.

7. Facilitation to Students:

7.1 Faculty Advisor:

On joining the institute, a student or a group of students shall be assigned to a faculty advisor who shall be mentor for a student throughout his/her tenure in the institute. A student shall be expected to consult the faculty advisor on any matter relating to his/her academic performance and the courses he/she may take in various semesters / summer term. A faculty advisor shall be the person to whom the parents/guardians should contact for performance related issues of their ward. The role of a faculty advisor is as outlined below:

The role of the Faculty Adviser is outlined below:

a. Guide the students about the rules and regulations governing the courses of study for a particular degree.
b. Advise the students for registering courses as per curriculum given. For this purpose, the Faculty Adviser has to discuss with the student his/her academic performance during the previous semester and then decide the number and nature of the courses for which He/ She can register during the semester as per the curriculum.
c. Approve the registration of the students.
d. Advice students to overload/ drop one or more courses/activities based on her/his academic performance as per the prescribed rules.
e. At the end of the first semester/year, the Faculty Adviser may even advise a reduced load program for a poorly performing student.
f. Pay special attention to weak students and carefully monitor performance of students recommended for slow track option.

g. Advice students for Course Adjustment / Dropping of courses during the Semester within the stipulated time frame given in the Academic calendar.
h. Advice students seeking semester drop either during the ongoing semester or before the commencement of the semester. FA has to ensure strict compliance of rules and regulations laid down for this purpose. Recommend the cases to the appropriate authorities for consideration.
i. Make revised plan of study for weak/bright students based on their semester wise performance.
j. Suggest modalities for course/credit requirements for the students recommended for exchange program.
k. Guidance and liaison with parents of students for their performance.
l. To ensure that students are not permitted to reregister for courses, which they have already passed.
m. Inform students that any academic activity (course / Lab. / seminar / project / noncredit requirement etc.) undergone without proper registration will not be counted towards the requirements of his/her degree.
n. Strictly warn students that if she/he fails to register during any semester without prior approval, his/her studentship is liable to be cancelled.
o. Keep the students updated about the Academic Administration of the University.

7.2. Helping Weaker Students:

A student with backlog/s should continuously seek help from his/her faculty advisor, Head of the Department and the Dean of respective schools. Additionally, he/she must also be in constant touch with his/her parents/local guardians for keeping them informed about academic performance. The university also shall communicate to the parents/guardians of such student at-least once during each semester regarding his/her performance in in-in various tests and examination and also about his/her attendance. It shall be expected that the parents/guardians too keep constant touch with the concerned faculty advisor or Head of the Department, and if necessary - the Dean of the respective school.

8.0 Discipline and Conduct:

8.1 Every student shall be required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity, which shall tend to bring down the prestige of the university.

8.2 Any act of indiscipline of a student reported to the Dean, Student Development, shall be discussed in a Disciplinary Action Committee of the institute. The Committee shall enquire into the charges and recommend suitable punishment if the charges are substantiated.

8.3 If a student while studying in the university is found indulging in anti-national activities contrary to the provisions of acts and laws enforced by Government, he/she shall be liable to be expelled from the institute without any notice.

8.4 If a student is involved in any kind of ragging, the student shall be liable for strict action as per provisions in the Maharashtra anti-ragging act.

8.5 If any statement/information supplied by the student in connection with his/her admission is found to be false/ incorrect at any time, his/ her admission shall be cancelled and he/she shall be expelled from the university and fees paid shall be forfeited.

8.6 If a student is found guilty of malpractice in examinations, then he/she shall be punished as per the recommendations of the Grievance Redressed Committee (CRC) constituted by Board of Examinations.

8.7 Every admitted student shall be issued photo identification (ID) card which must be retained by the student while he/she is registered at Sanjay Ghodawat University Kolhapur. The student must have valid ID card with him/her while in the University Campus.

8.8 Any student who alters or intentionally mutilates an ID card or who uses the ID card of another student or allows his/her ID card to be used by another, student shall be subjected to disciplinary action.

8.9 The valid ID card must be presented for identification purpose as and when demanded by authorities. Any student refusing to provide an ID card shall be subjected to disciplinary action.

8.10 Students should switch off the Mobiles during the Instructional hours and in the academic areas of university Building, Library, Reading room etc. Strict action will be taken if students do not adhere to this.

8.11 During the conduct of any Tests and Examination students must not bring their mobiles. A student in possession of the mobile whether in use or switched off condition will face disciplinary action and will be debarred from appearing for the Test / Examination.

9.0 Academic Calendar

The academic activities of the University are regulated by Academic Calendar and are made available to the student's/ faculty members and all other concerned in electronic form or hard copy. It shall be mandatory for students / faculty to strictly adhere to the academic calendar for completion of academic activities.

10. Attendance:

10.1 Regular 100% attendance is expected from all students for every registered course in lectures, tutorial, laboratory, projects, mini-projects and other courses mentioned in program curriculum. Hence, attendance is compulsory and shall be monitored during the semester rigorously. Students shall be informed at the end of every month if they are failing short of attendance requirements.

10.2 A Maximum of 25% absence for the attendance may be permitted only on valid grounds such as illness, death in family of blood relations (Father, Mother, Sister, and Brother) and any other emergency reason which is beyond the control of the student and shall be approved by the authorities in respective departments.

10.3 If a student fails to put up 75% attendance individually in each course, the student will be put under X grade category and student will be debarred form attending the End Semester

Examination (ESE) and Re-Exam for that semester in that course. However, student has an option to re-register for the course whenever it is offered next time or he can appear for 100% examination for which he will be awarded two grade penalties. Student's FET, CAT1 and CAT2 marks are treated as null and void.

10.4 The maximum number of days of absence for students participating in Co-curricular activities /Sports/ Cultural events during a semester shall not exceed 10. Any waiver in this context shall be on the approval of the Academic council only after the recommendation by Dean Academics of the university.

The HOD and Dean of the respective school shall report and recommend to Academic council the cases of students not having 75% attendance as per the records of course instructor. After rigorously analyzing these cases AC may take a decision to debar such student from End-Semester Examination (ESE) for that course. Such a student shall re-register for that course as and when it is offered next. ISE and MSE evaluations of such a student for this course during regular semester shall be treated as null & void.

10.5 A student remaining absent during ESE of a course either on medical ground (Accident and/or hospitalization of a student) or any other emergency circumstances (death of immediate close relative i.e. father, mother, brother and sister) or due to representing University at university/state level in sports/co-curricular activities shall be treated as per the rules of Sec 13.6.2 and 12.1.2

The critical cases of absenteeism which are not covered by any of the above clauses shall be reported by concerned Head of Department to Academic dean and all such cases the decision of Academic council is final.

11. Modes of Assessment:

11.1Assessment of Theory Courses:

11.1.1 A student shall be evaluated for his/her academic performance in a theory course through Faculty Evaluation Theory (FET), Continuous Assessment Tests (CAT1 and CAT2) and End Semester Examination (ESE).

11.1.2 The relative weightage for the theory courses having ESE shall be generally as shown in the Table 11.1.2

Table 11.1.2: Weightage for the theory courses in %

Exam→ / Credits↓	FET	CAT1	CAT 2	ESE
4	20	15	15	50
2	20	-----	30	50

The details of the weightage of each course shall be listed in the structures of each program

11.1.3 FET shall be based on student's performance in assignments, quizzes, seminars, Course projects and field assignments, term papers, etc. The mode of FET shall be decided and announced by the Course Instructor at the beginning of the course.

11.1.4 CAT1 shall generally be of one-hour duration for each course and shall be held as per the schedule declared in the Academic calendar for that Semester.

11.1.5 CAT2 shall generally be of one-hour duration for each course and shall be held as per the schedule declared in the Academic calendar.

11.1.6 ESE is of three hours' comprehensive examination for 4 credit courses. ESE is of two hours' comprehensive examination for 2creditscourse.

Table 11.1.6: Unit wise distribution in exams will be based on following table.

Total Number of Units	Units for CAT1	Units for CAT 2	Mark weightage for units in ESE
6	1 & 2	3 & 4	Equal weightage for all unit
5	1	2 & 3	Equal weightage for all unit
4	1	2	Equal weightage for all unit
3	Nil	1	Equal weightage for all unit
2	Nil	1	Equal weightage for all unit

11.1.7 All examinations and evaluations shall be compulsory. Credits for a course shall be awarded only if a student satisfies evaluation criteria and acquires the necessary minimum grade.

11.1.8 There shall be no re-examination for CAT1 and CAT2 of the courses having all the three components of evaluation viz. FET, CAT1 CAT2 and ESE. However, a student remaining absent for CAT1 and CAT2 for representing the University in state level or university level sports/co-curricular activities. (on prior recommendation and approval) or on valid grounds such as illness, death in family or other emergency reason which is beyond control of a student (on approval by the head of department and dean of respective school shall be considered for Make- up examinations).

11.1.9 A student remaining absent for ESE of a course either due to medical reason (Accident

and/or hospitalization of a student) or other emergency circumstances (death of immediate close relative i.e. father, mother, brother and sister) or due to representing Sanjay Ghodawat University at University/State/National/International level in sports/co-curricular activities shall be awarded with grade "I". Such a student shall be allowed to appear for make-up examination scheduled along with re-examinations of other courses. The student shall apply to COE with proper documentary evidence to appear for make-up examination. After make-up examination, a student shall be entitled to an appropriate grade as per Table I of Sec. 11.1.2 based on his/her performance during the regular semester and in make-up examination.

11.2 Assessment of Laboratory Courses:

11.2.1 The assessment of laboratory course shall be continuous and based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in viva-voce examinations uniformly distributed throughout the semester. Where ESE for the laboratory course is specified ESE shall be based on performing an experiment followed by an oral examination. The relative weightage for FEP and ESE for assessment of laboratory courses shall be 50% each for FEP and ESE and a minimum performance of 40% in both ISE and ESE separately shall be required to get the passing grade.

11.2.2 ESE for laboratory course shall normally be held before the ESE for theory courses and shall be conducted by a panel of examiners appointed by COE from the panel of experts approved by BOS. This activity shall be coordinated by Department Examination Coordinator (DEC) in consultation with HOD of the respective department.

11.2.3 Student failed in ESE of a laboratory course in a regular semester shall be eligible to appear for 100% examination conducted along with ESEs of laboratory courses of the subsequent semester. Such examination shall be fairly comprehensive (generally of 3 hours similar to POE i.e. Practical-Oral-Examinations) to properly judge his/her practical skill and theoretical knowledge for that laboratory course. He / She shall suffer one grade penalty.

12.0 The Grading System:

Absolute Grading System (AGS) is adopted based on absolute numerical marks obtained by the student during all stages of evaluation for a course.

12.1 Award of Grade (Regular Semester):

12.1.1 For every course registered by a student in a semester, he/she shall be assigned a grade based on his/her combined performance in all components of evaluation scheme of a course as per the structure. The grade indicates an assessment of the student's performance and shall be associated with equivalent number called a grade point.

12.1.2 The academic performance of a student shall be graded on a ten-point scale. The Absolute Grading System is followed. Letter grades, the guidelines for conversion of marks to letter grades and their equivalent grade points are as given in Table.

Table 12.1.2: Grade Table for Regular Semester

Marks Obtained	Grade Letter GL	Grade Point GP	Performance Description
90-100	O	10	Outstanding
80-89	A+	09	Excellent
70-79	A	08	Very Good
60-69	B+	07	Good
50-59	B	06	Above Average
45-49	C	05	Average
40-44	P	04	Pass
00-39	F	00	Fail
-	AB	00	Absent
-	X	00	Detained (Failed)
-	Satisfactory	-	Pass in Non-Credit Courses
-	Un Satisfactory	-	Failed in Non-Credit Courses

12.1.3 A student shall pass the course if he/she gets any grade in the range "O" to “P".

12.1.4 “FF" grade shall be awarded to a student in a course if he/she gets less than 40% marks jointly in the FET, CAT1, and CAT2 & ESE for a theory course and in FEP& ESE for a laboratory course. A course shall then be eligible to apply for re-examination. A student failed in laboratory course shall be eligible to apply only for 100% examination conducted with the laboratory examinations of the subsequent semester. In both cases, a student has to suffer one grade penalty.

13 Assignment of X Grade

Grade "X" in a regular course shall be given to a student if he/she falls in any of the following categories.

13.1 A student does not maintain the minimum 75% attendance in any of the theory or laboratory courses.

13.2 A student has not completed most of the Evaluations like FET, CAT1 and CAT2 due to non-medical reasons (for example when a student has missed all or most of the components of internal evaluation conducted by the instructor in that semester).

13.3 The performance of a student is less than 40% in FET, CAT1 and CAT2 Combined.

13.4 A student is guilty of any academic malpractice during semester (Such cases shall be dealt by Grievance Redressed and Discipline Committee).

In above four cases grade "X" shall be declared one week before ESE and intimated to the Academic Office and COE immediately thereafter. Such a student shall not be permitted to take the ESE of that course.

13.5 Grade "X" may be given to a student if

13.5.1 A student eligible for ESE remains absent for ESE of a course with no written intimation to Exam Cell within four days after the respective ESE is over.

13.5.2 A student is guilty of any academic malpractice during examination. (Such cases shall be dealt by Grievance Redressal Committee).

In 13.5.2 grade "X" in that course shall be declared after Grievance Redressed Committee confirms the academic malpractice.

In above two cases when a student gets "X " grade in a course, then this shall be treated as "FF" for the purpose of calculation of Semester Performance Index (SGPI) and First Year Performance Index (FYPI) or Cumulative Performance Index (CGPI).

13.6 Following rules apply to the student who has obtained grade "X" in a regular semester:

13.6.1 A student obtaining grade "X" in a course in a regular semester or during examination shall be not be allowed to appear for End semester examination and also Re ESE conducted before the beginning of the next semester. His/her FET, CAT1 and CAT2 evaluations for all courses shall be treated as null and void. His/her needs to re-register for courses of that semester in the next academic year whenever they are offered and undergo all evaluations along with fresh regular students for which he will get one grade penalty.

13.6.2 Grade "I" shall be declared in a theory/laboratory course if a student has satisfactory performance FET, CAT1, CAT2 and has fulfilled the 75% attendance requirement, but has not appeared for ESE due to genuine reasons. Such students shall be eligible for the make-up examination of ESE only on medical grounds/valid reasons and on production of authentic medical certificate or other supporting document/s (as required by the University) to the COE within ten days after the respective examination is over. The application form

with requisite amount of fees must be submitted to the Exam Cell before the last date of filling such application forms for make-up examinations. These examinations shall be based on 100% syllabus and shall be scheduled before the commencement of the subsequent semester for theory courses and along with ESEs of laboratory courses of the subsequent semester. A student with "I" grade when appears for the make-up examination shall be eligible to obtain a regular performance grade ("O" to "F") as per Table 11.1.2 depending on his/her overall performance in FET, CAT 1, CAT 2 and make-up examination. If a student fails to appear for make-up examination too, a grade "XX" shall be awarded to him/her. Thus "I" is only a temporary grade and shall be replaced by a valid grade only after make-up examination.

13.6.3 There shall be a few audit courses as per the policies of the institute or as decided by DPC of respective program. The grade "PP" (Passed)/ "NP" (Not Passed) shall be awarded for such courses depending upon the performance of a student evaluated by the faculty in-charge. No grade points shall be associated with these grades and performance in these courses shall be not taken into account in the calculation of the performance indices (SGPI, CGPI). However, the award of the degree shall be subject to obtaining a "PP" grade in all such courses.

14. Award of Grades for Re-Examination:

14.1 A student who has obtained grade "F" in regular semester shall be eligible to appear for re-examination conducted before the commencement of the next regular semester. In such cases FET, CAT1 and CAT2 marks are carried forward and a student has to suffer one grade penalty

14.2 A student shall apply for re-examination before the last date of such application and shall appear for re-examination.

14.3 50% weightage similar to ESE shall be given to re-examination and there is one grade penalty.

14.4 A student who has obtained "F" grade in ESE of a regular semester and has not availed re-examination option or a student who has obtained "F" grade in both ESE and re-examination shall be eligible to choose one of the two options below to clear his/her backlog:

- Re-registration for the next regular semester course whenever that course is offered.
- Appearing for ESE of the course when conducted...
  A student detained in a regular semester due to either a) by obtaining "X" grade or b) by involvement in academic malpractice or c) by breaking the institute code of conduct and discipline can re-register for the course when offered next.

Following rules apply for these cases:

14.5 In first case i.e. Re- registration the earlier performance of a student in all the evaluations of that course shall be treated as null and void. The student has to undergo all the evaluations after re-registration.

15. Grades for Third and Subsequent attempts:

If A student opts for ESE or Re ESE who previously had obtained grade "F" in a course in two attempts, his/her FET, CAT1 and CAT2 performance of the regular semester shall be considered for evaluation and His/her has to suffer two grade penalty for the third attempt and for 4th and subsequent attempts shall be awarded a grade "P" or "F" or "X" based on his/her performance. However, if a student takes more than three chances (regular examination being the first chance, re-examination being the second chance, to clear a course, then the maximum passing grade that he/she can get shall be only "P". Thus a student has to suffer a grade penalty by accepting a lower grade than that obtained in the regular examination, re-examination, or examination for a re-registered course.

16. CALCULATION OF PERFORMANCE INDICES:

16.1. Semester Grade Point Average (SGPA)

The performance of a student in a one specific semester is indicated by SGPA. SGPA is a weighted average of the grade points obtained in all courses registered by the students during the semester. SGPA can be calculated by following equation.

$$SGPA = S_i = \frac{\sum_{i=1}^{n} C_i P_i}{\sum_{i=1}^{n} C_i}$$

Where, i = 1, 2, 3……. n is number of courses during semesters. C = No of credits associated with that course and P = Grade point earned in that course. SGPA will be rounded off to two decimal places.

16.2 Cumulative Grade Point Average (CGPA)

The total cumulative performance of a student at the end of specific semester is indicated by CGPA. An up-to-date assessment of the overall performance of a student for the courses from the first semester onwards till completion of the program shall be obtained by calculating Cumulative Grade Point Average (CGPA).

CGPA is a weighted average of the SGPA obtained in all semesters by the students during the semesters. CGPA can be calculated by following equation.

$$CGPA = \frac{\sum_{j=1}^{n} C_j S_j}{\sum_{j=1}^{n} C_j}$$

Where, j = 1, 2, 3……. n is number of semester during program. C = Total No of credits in the semester for which CGPA is to be calculated.

CGPA will be rounded off to two decimal places.

Conversion of CGPA to percentage marks for CGPA ≥ 4.5 can be obtained using equations. Percentage marks = (CGPA x 10) – 7.5.

16.3 For the students acquiring "I" grade (which is only a temporary grade) in any of the courses, SGPA, CGPA shall be calculated only after make-up examination.

17. First Year Performance Index (FYPI): (Applicable for B. Tech Programs Only)

17.1 For a student registered in Sanjay Ghodawat University Kolhapur right from the First semester, First-Year-Performance-Index (FYPI) shall be calculated as weighted average of the grade points obtained in all the courses registered by him/her in semesters I and II only.

$$\text{FYPI} = \frac{\sum_{1} C_i g_i}{\sum_{1} C_i}$$

Where summation is for all the courses registered by a student in first two semesters. FYPI shall be calculated when for the second semester is calculated. FYPI shall be rounded off to two decimal places.

17.2 FYPI shall reflect all the courses undergone by a student in the first year including the courses in which he/she has failed. FYPI may get modified in the subsequent semesters whenever a student clears his/her first year backlog courses.

17.3 If a student has been awarded "I" grade in the regular semester course of the first year then, FYPI shall be calculated after the make-up examination on the basis of the grade obtained by that student in a make-up examination.

17.4 If a student has obtained grade "F" or "X" at any time in any of the courses registered by him, then zero grade points corresponding to these grades shall be taken into consideration for calculation of FYPI.

18 Maximum Duration for Completing the Program

Maximum duration for completing any program UG/PG offered by Sanjay Ghodawat University is respective program duration plus two additional years.

Maximum duration for getting the B. Tech degree for students admitted in the first semester of UG program is, program duration plus two additional years (i.e. 12 Semesters and 6 academic years) For lateral entry student academic admitted in the third semester shall be (10 Semester and 5 Years).

The maximum duration of the program includes the period of withdrawal, absence and different kind of leaves permission to student but excludes the period of rustication of the student from the university however genuine case a confidential of valid reason may be referred to academic council for extending this limit by additional criteria

19 NFTE (Not Fit for Technical Education) (Applicable to B Tech program only)

It is mandatory for the student to earn all credits of first year specified for semester I & II or eligible for ATKT as per the rules to seek admission to semester III of second year in three years from the date of admission to avoid NFTE. If a student fails to become eligible for admission to Semester III in three year form the date of his admission, he shall be declared as "Not Fit for Technical Education" leading to discontinuation of his/her registration with the university. Such cases should be put up in the academic council.

20. Academic Progress Rules (ATKT Rules):

20.1 A student shall be allowed to register for the courses of the next year's odd semester only if he/she has earned all the credits of the previous year and has earned at least 2/3rd credits of the current year. If 2/3rd calculation turns out to be a mixed number (integer + fraction) then only the integer part of that number shall be considered for deciding the eligibility for ATKT.

(a) At the end of 1st year a student shall be allowed to keep terms (ATKT) to 2nd year of study provided he/she attends course work prescribed for 1st year with prescribed attendance and successfully earned at least 2/3rd of the total credits specified for 1st year program.
For Example: Total credits for B. Tech first year 2017-18, are 45 (Total of Semester I and II). A Student should earn minimum 2/3rd of the 45 Credits i.e. A student can go to next higher class with a maximum backlog of 1/3rd credits of semester I & II of the first year.
Student, who fails to earn those credits, cannot register for next semester, either it can re-registrar for the course and credits or can use the next opportunity to earn the credits when exams are conducted.

(b) At the end of 2nd year a candidate shall be allowed to keep terms to 3rd year of study provided he/she attends course work prescribed for 2nd year with prescribed attendance, and successfully cleared 1st year program and at least 2/3rd of total credits prescribed for 2nd year program.

(c) At the end of 3rd year a candidate shall be allowed to keep terms to final year of study provided he/she attendants course work prescribed for 3rd year with prescribed attendance, and should have completed 2nd year program and 2/3rd of total credits prescribed for 3rd year program.

All such candidates fulfilling the above criteria shall be declared as FAILED, ATKT.

A student shall be allowed to take admission for odd semester of next academic year only if he/ she have earned all the credits of the previous year and 2/3rd happens to be a decimal, it is rounded to only integer part.

21. Semester Grade Report:

21.1 Semester grade report reflects the performance of a student in that semester (SGPI) and also his/her cumulative performance for the first year (FYPI) and also the cumulative performance since the third semester of his/her study (CGPA).

21.2 The semester grade card issued at the end of each semester/ summer term to each student shall contain the following.

- The credits for each course registered for that semester.
- Any audit course/s undertaken by a student in a Semester.
- The letter grade obtained in each course.
- The total number of credits earned by a student for the first year separately.
- The total number of credits earned by a student since the 3rd semester onwards.
- SGPI, FYPI, CGPI.
- A list of backlog courses, if any.
- Remarks regarding eligibility of registration for the next semester.

21.3 Semester grade card shall not indicate class or division or rank however a conversion from grade point index to percentage based on CGPI shall be indicated on the final grade card of the program.

22 Award of Degree:

Following rules prevail for the award of degree.

- A student has registered and passed all the prescribed courses under the general institutional and departmental requirements.
- A student has obtained CGPI $\geq$ 4.75.
- A student has paid all the institute dues and satisfied all the requirements prescribed.
- A student has no case of indiscipline pending against him/her.
- Academic Council shall recommend the award of degree to a student who is declared to be eligible and qualified for above norms.

23 Grace Marks

- Maximum total grace marks will be 1 % of the total theory credit courses x 100 subjected
- To maximum 6 marks in that semester.
- Grace marks will be given candidate for change in grades for theory credit courses.
- Fail to pass grade only and will be reflected in final ESE marks.
- The grace marks are applicable only for maximum 1/3rd courses (rounded to higher Integer part i.e. if there are 4 theory courses then 4/3 = 1.33 = 2 courses).
- Maximum grace marks will be distributed in maximum courses

- Benefit of grace marks is not applicable for any medal/award.
- Applicable to theory and (Theory + Practical Courses). If is not applicable for Practical courses.
- Scheme for grace marks only can be used when the student will pass in all courses of that semester.

24. CGPA Improvement Policy for Award of Degree:

An opportunity shall be given to a student who has earned all the credits required by the respective program with CGPA greater than or equal to 4.00 but less than 4.75 to improve his/her grade by allowing him/her to appear for ESE examinations of maximum two theory courses of seventh semester. Such examinations shall be scheduled along with re-examinations/make-up examinations. However, CGPA shall be limited to 4.75 even though the performance of a student as calculated through modified CGPA becomes greater than 4.75.

Conclusions:

The academic policies regarding conduct of programs in Sanjay Ghodawat University Kolhapur are published in this document. The Academic Council shall reserve the right to modify these policies as and when required from the point of view of achieving academic excellence. In special and abnormal cases (i.e. the cases not covered through above rules) the decision of the (Chairman, Academic Council shall be final and shall be binding on all concerned.

Chairman
Academic Council

First Year M.Sc. Chemistry: Semester I										
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	**Component**	**Evaluation Scheme**			
							Exam	**WT**	**Min Pass (%)**	
CHS 501 (PC|SS)	Organic Chemistry I	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 503 (PC|SS)	Inorganic Chemistry I	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 505 (PC|SS)	Physical Chemistry I	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 507 (PC|SS)	Analytical Chemistry I	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
REM 501 (UC|SS)	Research Methodology I	2	-	-	2	Theory	FET	20	40	40
							CAT	30		
							ESE	50	40	
CHS 509 (PC|SS)	Organic Chemistry Lab I	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 511 (PC|SS)	Inorganic Chemistry Lab I	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 513 (PC|SS)	Physical and Analytical Chemistry Lab I	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
Total		**18**	**00**	**12**	**24**			**Hrs: 30, Credits: 24**		

L: Lecture, T: Tutorial, Pr: Practical, C: Credits, Th.: Theory, WT: Weightage; PC: Program Core, PE: Program Elective, UC: University Core, UE: University Elective; ST: School of Technology, SS: School of Sciences, SC: School of Commerce, SM: School of Management, SA: School of Arts, FET: Faculty Evaluation Theory, CAT: Continuous Assessment Test, ESE: End Semester Examination, FEP: Faculty Evaluation Practical.

First Year M.Sc. Chemistry: **Semester II**										
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	**Component**	**Evaluation Scheme**			
							Exam	**WT**	**Min Pass (%)**	
CHS 502 (PC|SS)	Organic Chemistry II	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 504 (PC|SS)	Inorganic Chemistry II	4	-	-	4	Theory	FET	20	40	Min 40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 506 (PC|SS)	Physical Chemistry II	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 508 (PC|SS)	Analytical Chemistry II	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
REM 502 (UC|SS)	Research Methodology II	2	-	-	2	Theory	FET	20	40	40
							CAT	30		
							ESE	50	40	
CHS 510 (PC|SS)	Organic Chemistry Lab II	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 512 (PC|SS)	Inorganic Chemistry Lab II	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 514 (PC|SS)	Physical and Analytical Chemistry Lab II	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
Total		**18**	**00**	**12**	**24**		**Hrs.: 30; Credits: 24**			

Second Year M.Sc. Organic Chemistry										
Semester III										
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	**Component**	**Evaluation Scheme**			
							Exam	**WT**	**Min Pass (%)**	
CHS 601 (PC|SS)	Organic Reaction Mechanism and Natural products	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 603 (PC|SS)	Advanced Spectroscopic Method	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 605 (PC|SS)	Advanced Synthetic Methods & Developments in Organic Chemistry	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 607/ CHS 609 (PC|SS)	Heterocyclic & bioactive molecules/ Green chemistry & Industrial Engineering	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 611 (PC|SS)	Organic Chemistry Lab I	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 613 (PC|SS)	Organic Chemistry Lab II	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 615 (PC|SS)	Organic Chemistry Lab III	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 617 (PC|SS)	Project Phase I	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
Total		**16**	**00**	**16**	**24**		**Hrs.: 32, Credits: 24**			

Second Year M.Sc. Organic Chemistry										
Semester IV										
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	**Component**	**Evaluation Scheme**			
							Exam	**WT**	**Min Pass (%)**	
CHS 602 (PC|SS)	Theoretical Organic Chemistry, Pericyclic reactions and Photochemistry	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 604 (PC|SS)	Stereochemistry	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 606 (PC|SS)	Natural Products & Dye Intermediates	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 608/ CHS 610/ CHS 624 (PC|SS)	Catalysis, Polymers & Petrochemicals /Bioorganic chemistry/ Analytical Methods in Chemical Industries	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 612 (UC|SS)	Organic Chemistry Lab IV	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 614 (PC|SS)	Organic Chemistry Lab V	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 616 (PC|SS)	Organic Chemistry Lab VI	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 618 (PC|SS)	Project Phase II	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
Total		**16**	**00**	**16**	**24**		**Hrs.: 32, Credits: 24**			

Note: Student should complete at least one NPTEL/SWAYAM/MOOC course for the completion of UG degree.

Total credits: 96

Sanjay Ghodawat University Kolhapur

School of Science Program: B. Sc.

Syllabus Structure for First Year B. Sc. R1

CHS 601: Organic Reaction Mechanism and Natural Products

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is a core course in advanced organic chemistry. It covers methods of determination of reaction mechanism, reactive intermediates, named organic reactions, and introduction to natural products.

Course Outcomes: At the end of this course students will be able to

CO1	Identify[1] suitable methods of determining reaction mechanism.
CO2	Describe[2] reactive intermediates.
CO3	Recpgnize[1] mechanism of reaction.
CO4	Relate[2] principles of photochemistry to reactions.
CO5	Explain[2] natural products and their synthesis.

Syllabus (Theory)

Units	Description	Hours
I	**Methods of determining reaction mechanism:** Introduction, Concept of transition state and reaction coordinate energy profile diagram, rate determining step, and Intermediate and transition state. Hammond postulate, Curtin-Hammett principle, Thermodynamics of the reaction, Kinetic & non-kinetic methods of determining reaction mechanism. Hammet equation & Taft equations. Methods of determining reaction mechanism: Identification of product, Detection of intermediates. Crossover experiments, isotopic effect and labelling, stereo-chemical studies, Thermodynamic and kinetic control: Reactions of naphthalene, Wittig reaction, enolization, Friedel-Crafts reactions, Diels Alder.	15
II	**Reactive Intermediates:** Carbenes, nitrenes, arynes reactions, Phosphorous, nitrogen and Sulphur yields, methods of generation and reactivity and applications.	15

Non-classical carbocation's.

Neutral High energy intermediates:

Ketenes, Carbenes, Nitrenes, Singlet oxygen Generation, structure and reactions.

III **Study of following reaction:** 15

Mechanism, Stereochemistry, migratory aptitude, (application using complicated example): Favorskii, Sharp, Paterson, McMurry coupling, Chichibabin, Dienone‑Phenol , Baylis-Hilman Mukaiyama esterification, Mitsunobu, Suzuki and Heck Coupling, Wolff, Smiles & Michael reactions (aza, thia and carba Michael).

IV **Natural products:** Introduction, 15

Alkaloids: Structure, stereochemistry, synthesis and biosynthesis of the following Structure of morphine, reserpine, ephedrine, (+) Conin.

Terpenoids: Introduction, classification, isoprene rules, methods of structure determination. Structural elucidation & synthesis of Geraniol, Menthol, α-piene, camphor, santonin.

References

1. Peter Sykes, A guide book to mechanism in organic chemistry (orient- Longmans).
2. R. Breslow, Organic Reaction Mechanism (Benjumin).
3. B. S. Gould, Mechanism and structure in Organic Chemistry (Holt Reinhartwinston).
4. Hendrikson, Cram and Hammond, Organic chemistry (McGraaw Hill).
5. J. D. Roberts and M. C. Caeserio, Basic principles of organic chemistry (Benjamin).
6. N. S. Issacs, Reactive intermediates in organic chemistry, (J. Wiley).
7. R. K. Bansal, Organic reaction mechanism (Mc Graw Hill).
8. K. K. Rohtagi- Mukherji, Fundamentals of photochemistry, Wiley- Eastern.
9. A. Gilbert and J. Baggott, Essentials of molecular photochemistry, Blackwell Scientific Publication.
10. N.J. Urro, W. A. Benjamin, Molecular photochemistry.
11. Cox and T. Camp, Introductory Photochemistry, Mc Graw‑Hill.
12. R.P. Kundall and A. Gilbert, Photochemistry, Thomson Nelson.
13. J. Coxon and B. Hallon, Organic photochemistry, Cambridge University press.
14. Jie Jack Li, Name Reactions: A Collection of Detailed Reaction Mechanism (2^{nd} Edition Springer).
15. Ahliwalia, V K Terpenoids, (Ane Books Pvt Ltd).
16. Ahliwalia, V K Alkaloids, (Ane Books Pvt Ltd).
17. Kar, A, Chemistry of Natural Products, CBS Publishers & Disctributers Pvt. Ltd.

CHS 603: Advanced Spectroscopic Methods

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is a core course in advanced organic and analytical chemistry. This course introduces the basic of spectroscopy and takes to the deeper understanding of complex concepts of spectroscopy, interpretation of spectrum, and use of combination of spectroscopic methods for identification of structure of organic molecules.

Course Outcomes: At the end of this course students will able to

CO1	Memorize[1] basics for identification of structures.
CO2	Describe[1] basic principles of spectroscopy.
CO3	Interpret[3] the spectrum.
CO4	Describe[2] advanced spectroscopic techniques.
CO5	Apply[4] basic knowledge of spectroscopy for structure elucidation.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction:** Background of structure identification of compounds and Molecular formula, Calculation of elements, molecular weight, molecular formula, degree of unsaturation, rule of thirteen. **Spectroscopy:** Electromagnetic radiation, characteristic features of absorption and emission spectrum, fluorescence phenomenon, principles and differences. **UV/Electronic Spectroscopy**: Basic principles, Beer-Lambert law, types of absorption bands, Factors affecting the positions of UV bands. Theoretical prediction of λ-max for polyenes, α, β-unsaturated aldehydes, ketones (Woodward-Fieser rules) and substituted benzenes. Problems.	15
II	**IR Spectroscopy** Principles of IR spectroscopy, origin of spectrum, normal modes of vibration, factors affecting vibrational frequencies, IR instrument, Four Transform Infrared instrument. Characteristic vibrational frequencies of alkanes; alkenes; alkynes; aromatic compounds; alcohols; ethers; phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds [ketones; aldehydes; esters; amides; acids; anhydrides; lactones; lactams and conjugated carbonyl compounds] Effect of hydrogen bonding and solvent effect on vibrational frequencies; overtones; combination bands and Fermi resonance. FT-IR of gaseous; solids and polymeric materials. Problems.	15

III **NMR Spectroscopy** 15

General introduction and definition; chemical shift; spin-spin interaction; shielding mechanism of measurement; chemical shift values and correlation for protons bonded to carbons [aliphatic; olefinic; aldehydic and aromatic] and other nuclei [alcohols; phenols;enols; acids; ammines; amides and mercapto]; chemical exchange; effect of deuteration, Anisotropy, Complex spin-spin interaction between two; three; four; and five nuclei [first order spectra]; Coupling Constant. Stereochemistry; hindered rotation; Karplus curve variation of coupling constant with dihedral angle. Simplification of complex spectra; nuclear magnetic double resonance; shift reagent; solvent effect, Nuclear overhauser effect [NOE] Resonance of other nuclei - F; P. Determination of region/chemo and disterio/ enantioselectivity. 2D NMR spectroscopy.

IV **Carbon-13 NMR Spectroscopy** 15

General considerations; chemical shift [aliphatic; olefinic; alkyne; aromatic; heteroaromatic and carbonyl compounds]; problems associated with 13C, FT-NMR, proton decoupled off resonance. 2D NMR spectroscopy. Structural elucidation problems based on combined spectroscopic techniques.

Mass Spectrometry

Introduction, ion production- EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement, nitrogen rule. High-resolution mass spectrometry. Problems on structure elucidation of compounds.

Textbook

1. Sharma, Y. R. Elementary Organic Spectroscopy, S. Chand and Company Ltd.

Reference Books

1. Pavia, D. L., Lampman, G. M., Kriz, G. S., Vyvyan J. R. Introduction to Spectroscopy, Cengage Learning Pvt. Ltd.
2. Field, L. D. Organic Structures from Spectra, J Wiley & Sons Ltd.
3. Kalsi P.S. Spectroscopy of Organic compounds, New age publishing.
4. Kemp, W. Organic spectroscopy ELBS.

CHS 605: Advanced Synthetic Methods and Developments in Organic Chemistry

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is a core course in advanced organic chemistry. This course covers core principles of designing of organic synthesis and recent advancement in techniques of organic synthesis.

Course Outcomes: At the end of this course students will able to

CO1	Explain[2] the chemistry of reagents in organic synthesis.
CO2	Describe[2] principles of designing of organic synthesis.
CO3	Recognize[2] advancement in reagents for organic synthesis.
CO4	Describe[1] recent advancement in process of organic synthesis.

Syllabus (Theory)

Units	Description	Hours
I	**Application of following reagents & reaction in synthesis.** Complex metal hydrides, lithium dialkylcuprate, lithium diisopropylamide (LDA) Dicyclohexylcarbodiimide (DCC), Trimethyl silyl iodide (TMSI), tributyltin hydride (TBTH), NBS, peracids, lead tetra acetate (LTA), PPA, Diazomethane, ozone, phase transfer catalyst, Barton and Shapiro reaction Hoffmann - Loffler-Fretag, Cyclodextrine, Amberlyst, Selenium dioxide, crown ethers, DDQ, Dess-Martin periodinane, periodic acid & IBX, CAN, Oxone, Iodine. **Application of following metal in organic synthesis** Pd, Hg, and Rh, Tl and Si. Applications in Miyaura, Stille, Negishi, Kamada Peterson synthesis**.**	15
II	**Disconnection approach:** An introduction to Synthons and synthetic equivalents, disconnection approach, functional group interconversions. One group C-X and two group disconnections in 1,2,1,3 -,1,4-& 1,5- difunctional compounds, Retro- synthesis of Alkene, acetylenes and aliphatic nitro Alcohols and carbonyl compounds, amines, the importance of the order of events in organic synthesis, chemoselectivity, regioselectivity. Diels Alder reaction, Michael addition and Robinson annulation. Retro- synthesis of aromatic Heterocycles and 3, 4, 5 and 6 membered carbocyclic and heterocyclic rings. Reversal of polarity (Umpolung).	15
III	**Application of the following in synthesis** Merrifield resin, polymeric reagents, Clay supported reagents. Solid phase synthesis of polypeptide & oligonucleotides, electro organic synthesis, enzyme catalysed reaction in synthesis &resolution of racemic mixtures.	15

Electrochemical synthesis**:** Cathodic reductions and anodic oxidations
Multicomponent reactions, Micro reactor technology.

IV **Activation of small molecules:** CO, CO_2, O_2, CH_4, NH_3. C-C bond activation
New energy sources: Cavitation and sonochemistry, use of microwaves 15
Microorganisms and enzymes in Organic synthesis, High pressure reactions
New solvents: Water, ionic liquids, supercritical fluids
Chemicals derived from methane, carbon monoxide, synthesis gas and biomass.

References

1. S. Warren: Designing of organic synthesis
2. J. Fuhrhop& G. Penzlin.: Organic synthesis (2nd Ed.)
3. Carruthres: some modern methods of organic synthesis.
4. H.O. House: modern synthetic reaction.
5. Fieser &Fieser: Reagent in organic synthesis
6. R.O.C. Norman: principle of organic synthesis
7. CAREY &Syndharg: Advanced organic Chemistry
8. P.E. REALAND: Organic synthesis
9. Bartan and Ollis: comprehensive organic Chemistry
10. R. Admas: - organic reactions
11. Stone & west: Advances in organometallic Chemistry
12. C.W. Bird: Transition metal intermediate in organic synthesis
13. Swan & Black: organometallic in organic synthesis.
14. J. Claydon, N. Greeves, S. Warren Organic Chemistry.
15. John Apsimon: Total synthesis of natural products
16. M. K. Mathur, C. K. Narang &R.E.Williams: polymers as aid in organic synthesis
17. P. HODGE & D.C. SHERRINGTON: Polymer supported reaction in organic synthesis.
18. C.J. Gray: Enzyme catalysed reaction s
19. T.W. Green & P.G.M.Wats : Protecting groups in organic Chemistry
20. T. Shona: Electroorganic Chemistry
21. Weber & Gokel: phase transfer catalyst in organic synthesis.
22. Protecting group chemistry J. Roberton (Oxford)
23. Encyclopedia of Reagents in Organic Synthesis- M Fieser, L Fieser and Tse-Lock Ho (J. Wiley)

Developments in Organic Synthesis

1. V K Ahluwalia, Rajender S Varma, Alternate Energy Processes in Chemical Synthesis: Microwave, Ultrasonic and Photo Activation, (Alpha Science Int).
2. L. K. Doraiswamy, Organic Synthesis Engineering (Hardcover - 2001-02-15).
3. Sanjay V. Malhotra, Ionic Liquids in Organic Synthesis.

CHS 607: Heterocyclic chemistry & Bioactive Molecules

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is a core elective course in advanced organic chemistry. This course covers synthesis and chemistry of heterocyclic compounds and bioactive molecules.

Course Outcomes: At the end of this course students will be able to

CO1	Describe [1] heterocyclic compounds.
CO2	Explain [2] synthetic methods of heterocyclic compounds.
CO3	Discuss[2] synthesis of pharmacuticals.
CO4	Discuss[2] synthesis and mode of action of agrochemicals.

Syllabus (Theory)

Units	Description	Hours
I	**Heterocyclic compounds:** Hantzsch-Widman nomenclature, common names and replacement nomenclature. Three membered and four membered Heterocycles-synthesis and reactions of aziridines,oxiranes, thiranes, azetidines, oxitanes and thietanes. **Benzo fused five membered Heterocycles:** Synthesis and reactions of benzopyrroles, benzofurans and benzothiophenes.	15
II	**Six membered Heterocycles with one heteroatom:** Synthesis and reactions of pyrilium salts and pyrones and their comparison pyridinium and thiopyrylium salts and pyridones. Synthesis and reactions of coumarins, chromones. **Six membered Heterocycles with two and more Heterocycles** Synthesis and reactions of diazines & triazines. **Seven membered Heterocycles** Synthesis and reactions of azepines, oxepines &thiepines	15
III	**Drugs and pharmaceuticals:** **Study of the Following types of drugs:** Antibiotics: Preparation of semi synthetic penicillin. Antimalerials: Trimethoprim Analgesic & Antipyretics: Paracetamol, Meperidine, methadone, Aminopyrine. Anti- inflammatory: Ibuprofen, Oxyphenylbutazone, Diclophenac, Indomethacin. Antitubercular & antileprotic: Ethambutol, Isoniazide& Dapsone Anaesthetics: Lidocaine, Thiopental.	15

Antihistamines: Phenobarbital, Diphenylhydramine.
Tranquilizers: Diazepam, Trimeprazine.
Cardiovascular: Synthesis of dilliazem, quinidine, methyldopa, atenolol, oxyprenol
Anti-neoplastic drugs: Cancer chemotherapy, Synthesis of mechloraethamine, cyclophosphamide, Mephalan, uracils, mustards.
Medicinal use of nanomaterials-Drug delivery.

IV **Agrochemicals:** 15

Insecticides: Introduction, classification, mode of action and synthesis of Methoxychlor, chlordane, heptachlor, Hexachlorocyclohexane, Parathion, Diazenon, Sevin and Beygon. Naturally occurring insecticides-pyrethroids-natural pyrethrins-isolation and structures, synthetic pyrethroids.
Insect Pheromones: Introduction, Classification and use in insect pest control. Synthesis of disparlure, grandisol, Periplanone-A & B and bomykol.
Fungicides: Introduction, Systemic fungicides-types & examples.
Herbicides: Introduction, study of sulfonyl ureas and heterocyclic sulphonamides. Fumigants and repellents. Mechanism of action and toxicities of insecticides, fungicides and herbicides.

References

1. R. K. Bansal: Heterocyclic chemistry (Wiley E).
2. T. Eicher and S. Hauptmann, (Thieme), The Chemistry of Heterocycles.
3. J. A. Jule, K. Mills and G. F. Smith, Heterocyclic Chemistry, Chapman and Hall.
4. T. L. Gilchrist, Heterocyclic Chemistry, Longman Scientific Technical
5. Pharmaceutical manufacturing encyclopedia.
6. R. M. Acheson: An introduction to chemistry of heterocyclic compounds (Interscience).
7. Joule &Smith: Heterocyclic chemistry (Van Nostrand).
8. R. R. Gupta, M. Kumar and V. Gupta, Heterocyclic Chemistry, (Springer Veriag) Vol-1-3.
9. L. A. Paquitte: Principals of modern heterocyclic chemistry.
10. M. H. Palamer: The structure and reactions of heterocyclic compounds.
11. A. R. Katritzky: Advances in Heterocyclic chemistry (A.P.).
12. Finar: Organic chemistry (Vol. 1& 2)
13. Cohn &Stumpt: Outline of Biochemistry.
14. Williams: Introduction to the chemistry of enzyme action.
15. R. B. Silverman, The Organic Chemistry of Drug design and Drug action, Academic Press.
16. D. Lednicer, Strategies for Organic Drug synthesis and Design, J. Willey.
17. W. O. Foye: Principals of medicinal chemistry.
18. Wilson, Gisvold & Dorque: Text book of organic medical and pharmaceutical Chemistry
19. Wahington, Synthesis and Chemistry of Agrochemicals, Vol I & II, ACS.
20. Sree Ramulu, Chemistry of Insecticides and Fungicides, Oxford & IBH, 1985.

CHS 609: Green Chemistry & Industrial Engineering Chemistry

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is a core elective course in advanced organic chemistry. This course covers aspects of green chemistry and industrial engineering chemistry with focused aspects of sustainability and current industrial processes.

Course Outcomes: At the end of this course students will be able to

CO1	Define[1] green chemistry principles.
CO2	Discuss[2] remedial measures for minimization of waste.
CO3	Classify[2] important industrial chemicals.
CO4	Describe[2] physicochemical principles in manufacturing of important chemicals.
CO5	Demonstrate[4] conceptual understanding of systems thinking.

Syllabus (Theory)

Units	Description	Hours
I	Introduction of Systems thinking, Concept of Green Chemistry, Need for Green Chemistry: Examples-Flixborough Disaster, Seveso Disaster, Manufacturing of DDT, Love Canal Incident, Manufacturing of Adipic Acid, Green Chem Chemistry Presidents awards; 12 Principles of Green Chemistry. *Concepts such* as Atom Economy, Circular economy, Sustainability, Design of experiments, Life Cycle Assessment, Toxicology, Biomimicry. Renewable feedstock: Introduction and criteria, renewable feedstock for energy. Real world cases of green chemistry.	15
II	Green chemistry and energy, Designing for recycling and degradation, catalysis, Solvents: their role and working without solvents. Green Analytical Methods, Toxicology: Chemical Exposure, dosage and Molecular toxicology, Designing products with reduced toxicity, Safe chemical Design. *Safety with respect to* – toxic chemicals, handling, storage. *Hazard identification*: Assessment and safety audit. HAZOP and HAZAN.	15
III	*Industrial Chemistry- Types of Chemicals*: Status of global and Indian Chemical Industry.. *Inherently Safer Design*: Greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol) *Examples of Green Synthesis*: Adipic Acid, Catachol, Disodium Iminodiacetate, Hoffmann elimination, Benzoic Acid from methyl benzoate. *Right fit pigment*:	15

	Synthetic azopigments to replace toxic organic and inorganic pigments. *Biodegradable plastic*: An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.	
IV	Catalysis: Homogeneous & Heterogeneous catalysis, Catalysis in fine and speciality chemicals: Green chemistry, Process optimization in API manufacturing, Concept of VTO, Scale up of speciality chemicals, Reaction and reactor engineering. Physicochemical principles of manufacturing of important inorganic and organic bulk chemicals such as sulphuric acid, nitric acid, ammonia, chlorine, BTX.	15

Reference Books

Developments in Organic Synthesis

1. Anastas, P. T. and Warner J. C, Green Chemistry: Theory and Practice: New York Oxford University Press.
2. Anastas, P. T., Green Chemistry: Frontier in Design Chemical synthesis and Process: C. Williamson New York.
3. Ahluwalia V. K., Green Chemistry, Ane Books Pvt. Ltd.

Industrial Engineering Chemistry

1. Joshi S. S., Ranade V. V. Industrial Catalytic Processes for Fine and Specialty Chemicals; Elsevier, ISBN: 9780128014578
2. B K Sharma Industrial Chemistry I, Krishna Prakashan Media Ltd.
3. Lowheim F.A and Moran, M.A. Industrial chemicals.

E resources

1. www.beyondbenign.com
2. Bakshi B R, Gutowski T G, Sekulic D P Claiming Sustanability: Requirements and Challenges, *ACS Sustainable Chem Eng* 2018, 6, 3632.
3. Reichmanis E, Sabahi M, Life Cycle Inventory Assessment as Chemistry & Engineering Education Tool *ACS Sustainable Chem Eng* 2017, 5, 9603.

CHS 611: Organic Chemistry Lab-I

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
-	-	4	2	Practical	FEP	50	Min 40
					POE	50	

Course Description: This course is at odd semester of second year of MSc. This course covers learning of techniques of separation, purification and identification of mixture of organic compounds.

Course Outcomes: At the end of this course students will be able to

CO1	Apply[3] knowledge for extraction, purification and identification of compounds.
CO2	Demonstrate[3] analytical thinking ability.

List of Experiments

No **Description**

1 **A. Qualitative Analysis:**
Separation, purification and identification of compounds of binary mixture using the TLC and column chromatography, chemical tests. IR spectra to be used for functional group identification.

2. **B. Estimations**
Estimation of equivalent weight of an acid
Estimation of glucose
Estimation of phenol
Estimation of acetone
Estimation of formaldehyde
Estimation of aniline
Estimation of ester

Books recommended for Practical's:

1. A. I. Vogel, Textbook of Practical Organic Chemistry.
2. Mann & Saunders, Practical Organic Chemistry.
3. H. T. Clarke, A Handbook of Quantitative & Qualitative Analysis.
4. Blat, Organic Synthesis Collective Volumes.

CHS 613: Organic Chemistry Lab-II

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
-	-	4	2	Practical	FEP	50	Min 40
					POE	50	

Course Description: This course is at odd semester of second year of MSc. This course help student to acquire skills related to organic synthetic chemistry and estimations.

Course Outcomes: At the end of this course students will be able to

CO1	Demonstrate[3] application of theoretical knowledge for organic synthesis.
CO2	Apply[3] knowledge for identification of compounds.

List of Experiments

No **Description**

1 Preparations of Organic Compounds
Double stage preparation
(a) m-nitro benzoic acid from ethyl benzoate
(b) p-bromobenzanilide from aniline
(c) p-nitro acetanilide from aniline

2. Preparations of Organic Compounds
Name Reactions
(a) Benzil-Benzilic acid rearrangement
(b) Cannizaro reaction
(c) Claisen condensation
(d) Beckmann rearrangement
(e) Pinacol- Pinacolone rearrangement

3. Three stage preparation
(a) Preparation of anthranilic acid
(b) Preparatin of p- Amino benzoic acid
(c) Preparation of p- chloro nitrobenzene by Sandmeyer reaction
(d) Preparation of p- Idonitrobenzene by Sandmeyer reaction
(e) Preparation of N- bromosuccinamide
(f) Preparation of phthalimide

For all preparations
1. TLC to be done and Rf values of each compound to be reported
2. Melting point of pure compounds to be found
3. A small portion should be recrystallised from suitable solvent
4. Purified products to be displayed
5. Mechanisms for each preparation should be suggested

Books recommended for Practical's:

1. A. I. Vogel, Textbook of Practical Organic Chemistry.
2. Mann & Saunders, Practical Organic Chemistry.
3. H. T. Clarke, A Handbook of Quantitative & Qualitative Analysis.
4. Blat, Organic Synthesis Collective Volumes.

CHS 615: Organic Chemistry Lab III

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
-	-	4	2	Practical	FEP	50	Min 40
					POE	50	

Course Description: This course is at even semester of second year of MSc. This course help student to acquire skills of isolation and preparation of organic compounds.

Course Outcomes: At the end of this course students will be able to

CO1	Apply[3] knowledge for extraction, purification and identification of compounds.
CO2	Interpret[3] structure of organic compounds using UV, IR, NMR and Mass spectra.

List of Experiments

No	Description
1	Separation of components from mixture of organic compounds by fractional crystallization, fractional distillation, adsorption, Paper, TLC and column chromatography. The purification and characterization of organic compounds.
2.	Determination of pKa values, molar extinction coefficients, keto-enol equilibrium, order of reactions-SN1 and SN2 reactions, salt effect and effect of acidity on reaction rates.
3	Preparation and Estimation of aryloxyacetic acids, anilinoacetic acids, Carbohydrates, Proteins.
4	Elucidation of structure of organic compounds using UV, IR, NMR and Mass spectra. Locating an organic compound by reference to literature (Chemical Abstract).

Books recommended for Practical:

1. A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hannaford, P. W. G. Smith, A text book of Practical organic chemistry.
2. F. C. Mann, B. C. Saunders, Practical organic chemistry (Pearson).
3. H. T. Clarke A handbook of quantitative and qualitative analysis.

CHS 617: Project Phase-I

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
-	-	4	2	Practical	FEP	50	Min 40
					POE	50	

List of Experiments

No	Description
1	**Project:** This may involve following stages: Research / Project interests from student will be collected. A departmental committee will evaluate research interests and based on faculty competency, project supervisor will be allotted. It may involve Literature survey and Definition of Problem, Proposing Hypothesis, Designing Experiments, Testing hypothesis and confirming results, Interpretation and Reporting Results.
2.	In the middle of semester there will be evaluation of progress. At the end of each semester the Students will present results and presentation will be evaluated.

CHS 602: Theoretical Organic Chemistry, Pericyclic reactions & Photochemistry

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is a core course in advanced organic chemistry. This course covers core theoretical principles of organic chemistry. It also covers photochemistry and pericyclic reactions.

Course Outcomes: At the end of this course students will be able to

CO1	Explain[2] molecular orbital theory for predicting stability and reactivity of organic compounds.
CO2	Explain[2] the concept of aromaticity of non-benzenoid compounds.
CO3	Describe[1] theory of pericyclic reactions.
CO4	Discuss[2] chemistry of light induced organic reactions.

Syllabus (Theory)

Units	Description	Hours
I	**Molecular Orbital Theory:** Aromaticity in benzenoids, alternant and non-alternant hydrocarbon, Huckels rule, energy level of pi molecular orbital and concept of aromaticity, calculation of energies of orbitals in cyclic and acyclic systems. Determination energies and stabilities of different systems calculation of charge densities PMO theory and reactivity index.	15
II	**Non benzenoid aromatic Compounds:** Aromaticity in Non- benzenoids compounds Annulenes and hetroannulenes, fullerenceC60, Tropone, tropolone azulene, fulvene, tropylium salts, ferrocene, Three and five membered systems. Crown ether complexes, cyclodextrins, cryptands, catenanes and rotaxanes, bonding in fullerenes.	15
III	**Pericyclic Reactions:** Introduction, Characteristics and classification of pericyclic reactions- Electrocyclic, cycloaddition & cycloreversions and sigmatropic reactions. Aromatic Transition States (ATS)/Perturbation Molecular Orbitals (PMO) approach for the interpretation of mechanism of pericyclic reactions. Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl systems. Woodward-Hoffmann correlation diagram and FMO approach. Electrocyclic Reactions: Introduction, Con-rotatory and dis-rotatory Process, 4n and 4n+2 systems. Reactions of cations and anions, formation and cyclisation of dipolar molecules. Cycloaddition reaction: Suprafacial and Antrafacial addition, notation of cycloadditions, 2+2 and 4+2 systems, 2+2 additions of ketones, secondary effects of substitutes on the rates of	15

cycioadditions and chelotropic reactions. 1,3-dipolar cycloaddition reactions and their applications in the synthesis of five membered heterocycles, nitrile oxid and sydnones. Sigmatropic reactions: FMO approach and perturbation of molecular (PMO) approach for the explanation of sigmatropic rearrgements under thermal and photochemical conditions. Suprafacial and Antrafacial shift of H, [1, 3] [1, 5] [1, 7] and [3, 3]-sigmatropic shifts. Walk Claisen, Cope, Oxy-Cope and Aza-Cope rearrangements.

IV **Photochemistry:** 15

General principles – Fate of excited state – Jablonsky diagram - chemical process – Photochemistry of alkenes, dienes and polyenes, Carbonyl compounds, Norrish type 1 and Type 2, Patterno –Buchi reaction, photochemistry of aromatic compounds, miscellaneous photochemical reactions, photo fries reactions of anilides, photo fries rearrangements. Singlet molecular oxygen reactions, photochemistry of vision.

References

1. Lehar and Merchant: Orbital Symmetry.
2. R. B. Woodward and Hoffman: Conservation of orbital symmetry.
3. Kan, Organic Photochemistry.
4. Cixon and Halton: Organic photochemistry
5. O.L. Chapman (Marcel Decker), Organic Photochemistry- Vol I & II.
6. Mukherji Singh and Kapoor, Organic Chemistry- Vol 1-3, (Wiley Eastern)
7. Rohatgi- Mukherji, Fundamentals of photochemistry.
8. Ginsburg: Nonbenzenoid aromatic compound
9. A. Streitwieser: Molecular orbital theory for organic chemistry.
10. E. Cler: The aromatic sextet.
11. Lloyd: Carbocyclic non- benzenoid aromatic compounds.
12. W. B. Smith; Molecular orbital methods in organic chemistry.
13. Grratt; Aromaticity.
14. S.M Mukherji, Pericyclic Reactions, (McMillan) .1979.

CHS 604: Stereochemistry

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is a core course in advanced organic chemistry. This course covers concepts of stereochemistry in synthesis, conformational analysis of cyclic and fused ring compounds.

Course Outcomes: At the end of this course students will be able to

CO1	Discuss[2] methods of stereo-selective organic synthesis.
CO2	Demonstrate[3] knowledge of stereochemistry in conformational analysis of cyclic compounds.
CO3	Describe[2] stereochemistry of fused and bridgehead rings.
CO4	Demonstrate[3] knowledge of stereochemistry for assignment of configuration to allens, spirans and biphenyls.

Syllabus (Theory)

Units	Description	Hours
I	**Newer methods of stereo-selective synthesis:** Introduction and stereo-selective and stereospecific reactions. Enantio-selective Synthesis (chiral approach) reactions with hydride donors, hydroboration, catalytic hydrogenation via chiral hydrazones and oxazolines. Sharpless epoxidation. Asymmetric catalysis- Grubb's catalyst, Wilkinson's catalyst Diels Alder selective synthesis, use of calculations of optical purity and enantiomeric excess.	15
II	**Conformation and reactivity in acyclic compounds and of cyclohexanes.** Stability and reactivity of diasterio-isomers. Curtin- Hammett principle, **Some aspects of the stereochemistry of ring systems:** Stereoisomerism and determination of configuration Stability of rings and ease of rings formation) **The shapes of the rings other than six membered:** Shapes of five, six, and seven membered rings. Conformational effects in Medium sized rings, Concept of I strain.	15
III	**Fused and bridged rings:** Fused bicyclic ring systems: Cis and trans decalins and perhydrophenanthrene. Bridged rings, Nomenclature stereoichemical restrictions, and The Bredt' s rule, Reactivities. **O.R.D. and C.D.:** Types of curves, the axial haloketone rule. The Octant rule. Determination of conformation and configuration.	15
IV	**Stereochemistry of Allenes, Spiranes and Biphenyls**	

Assignment of configuration 15

Configuration of diastereomers based on physical and chemical methods.

References

1. E.L. Eliel, Stereochemistry of carbon compounds (TataMcGrawHill).
2. D. Nasipuri, Stereochemistry of organic compounds (New edge International).
3. P.S. Kalsi, Stereochemistry: conformation and Mechanism (J Wiley).

CHS 606: Natural Products & Dye Intermediates

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is a core course in advanced organic chemistry. This course covers chemistry and synthetic methods of vitamins, steroids, carbohydrates and dyes.

Course Outcomes: At the end of this course students will be able to

CO1	Explain[2] biogenesis of vitamins.
CO2	Discuss[2] chemistry and synthesis of steroids.
CO3	Describe[2] properties and synthesis of carbohydrates.
CO4	Describe[1] types, properties and synthesis of dyes.

Syllabus (Theory)

Units	Description	Hours
I	**Vitamins** Synthesis and structure of biotin and vitamin B2, synthesis of vitamin B1, biological functions of B6, B12, folic acid and thiamin. **Biogenesis** Alkaloids (pyridine, morphine and indole type) terpenoids of classes with examples, cholesterol, flavones, coumarins, carbohydrates and proteins.	15
II	**Steroids** Occurrence, nomenclature, basic skeleton, Diels hydrocarbon and study of the following hormones, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone and cartisone. Biosynthesis of steroids. **Prostaglandins** Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2	15
III	**Carbohydrates and nucleic acids**: Nomenclature – aldoses, ketoses, furanoses, pyranoses. Classification – monosaccharides, disaccharides and polysaccharides. Structure (Fischer, Haworth and chair projection) of ribose, glucose, fructose, maltose, sucrose, lactose, starch, cellulose and cyclodextrins. Preparation of alditols, glycosides, deoxysugars. Biosynthesis of vitamin C from glucose. Structure and synthesis of nucleic acids, genetic code, recombinant DNA. biosynthesis of shikimic acid	15

IV	**Dyes:** Introduction, modern theories of colour and chemical constitution. Classification of dyes, methods of applying dyes to the fabrics. A general study of Azo dyes- Orange –II, Rosanthrene O, Naphthol blue black 6B, Mordant brown, Congo red, Methyl orange, Chrysoidin G, Bismark brown. Triphenylmethane dyes- Malachite green, Rosaniline, Crystal violet and Phenolphthalein; Cyanin dyes- Ethyl Red, Cyanin blue and Quinaldine, Reactive dyes and Optical brighteners-Tinapal and Blankophor. Pigments: Fast violet, Lake red and Orange R.	15

References

1. G R Chatwal, Organic Chemistry of Natural Products –(Himalaya Publications).
2. A. A. Newmen: Chemistry of Terpenes.
3. P. D B. Mayo: The chemistry of natural products.
4. Simonson: Terpenes.
5. T.W. Goddwin: Aspects of terpenoid chemistry and biochemistry
6. Woguer: Vitamins and Co enzymes.
7. P. W. Bently: Chemistry of Natural products,
8. Fieser and Fieser: Steriods
9. I. Finar: Organic chemistry Vol. II and I
10. O.D. Tyagi & M. Yadav, A Textbook of Synthetic Dyes- (Anmol Publications) 2002.
11. Venkataraman, Synthetic Dyes Vol-I –1999,
12. R.T. Slickenstaff A.C. Ghosh and G.C. Wole, Total synthesis of steroids.
13. K. C. Nicolaou, Eric J. Sorensen, Classics in Total synthesis, Wiley, 1996.
14. Ashutosh kar, Chemistry of Natural Products, (Volume I and II), CBS

CHS 608: Catalysis, Polymers & Petrochemicals

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is an elective course in advanced organic chemistry. This course covers chemistry of catalysis, synthetic polymers and petrochemicals.

Course Outcomes: At the end of this course students will be able to

CO1	Describe[2] the fundamental concepts of catalysis, structural aspect of different heterogeneous catalysts and their characterizations.
CO2	Explain[2] activity and applications of homogenous catalysis.
CO3	Discuss[2] synthetic methods for preparation of polymers.
CO4	Analyze[3] the chemistry, reactivity involved in petroleum process and important applications produced on the industrial scale
CO5	Describe[3] the designing and development green catalyst for industrial process

Syllabus (Theory)

Units	Description	Hours
I	**Types of catalysis:** Heterogeneous and Homogeneous catalysis. Catalytic cycles **Heterogeneous catalysis:** **Introduction:** preparation methods, conversion and selectivity, catalyst deactivation and regeneration **Catalysis by surfaces:** Characterization and quantification of surface active sites, adsorption isotherms, kinetics of heterogeneous catalytic reactions. Structure of adsorbed species, supported catalysts and metal support interaction. **Catalysis in molecular scale:** Zeolites, mesoporous materials and clays as catalysts, shape selectivity **Characterization of catalysts:** Surface area, surface acidity and basicity, XPS, UPS, AES, EXAFS, XANES, XRD TPD etc.	18
II	**Homogeneous catalysis:** Advantages and disadvantages, homogeneous acid base catalysis. Hydrogenation, hydroformylation, hydrocyanation, hydrosilylation, Wilkinson catalysts, Chiral ligands and chiral induction, Ziegler-Natta catalysts **Organometallics as catalysts:** Bonding and structure transition metal complexes, applications in reactions such as hydrogenation, carbonylation, coupling reactions - Suzuki coupling, Heck coupling and related cross coupling reactions. Alkene oligomerization and metathesis. Catalytic oxidations and reductions, epoxidation, dihydroxylations, decarbonylation, olefin isomerization, arylation, polymerization, asymmetric synthesis, heterogenised homogeneous catalysts, phase transfer catalysis,	12

catalysis in green chemistry.

III	**Synthetic polymers:** Classification and Nomenclature. Methods of polymerization, Mechanism and Stereochemistry, Addition polymerization (Anionic, Cationic and Free radical process), Condensation and Stepwise polymerization, Coordination polymerization, Ring opening polymerization. Mechanism of co polymerization. Properties, Structure and applications of Polythene, Polypropylene, PVC, Polystyrene & Acrylic polymers, Teflon, polyesters, polyamides, Phenol-Formaldehyde resins, Urea-Formaldehyde resins, Epoxy resins, Polyurethanes, Polycarbonates, Synthetic rubber. Structural features and manufacture of natural rubber and Regenerated cellulose. Ziegler-Natta catalyst.	15
IV	**Petrochemicals:** Origin and formation of Petroleum, Composition of crude Petroleum and natural gas, Petroleum refining, reforming, fractionation, cracking, knocking, octane and cetane numbers. Ion, different types of petroleum products and their applications. Ignition point, flash point and octane number. Manufacture of synthetic petrol - Bergius and Fischer Tropsh processes. Origin of coal, coal carbonisation, coal gasification and coal tar based chemicals. Chemistry of coal conversions. **Manufacture of petrochemicals:** Preparation of methanol, chlorinated methanes and carbon disulphide from methane, Preparation of Ethyl chloride, ethanol, ethylene oxide from ethylene, anufacture of the following from propylene - Isopropanol, cumene, glycerine and acrylonitrile. Manufacture of vinyl chloride, chloroprene, acrylonitrile and acetaldehyde from acetylene.	15

References

Catalysis:

1. J.M.Thomas and W.J.Thomas, Principles and practice of heterogeneous catalysis -VCH Publications, NY
2. Gadi Rothenberg, Catalysis- concepts and green applications-Wiley VCH
3. S.Bhaudri and D.Mukesh, Homogeneous catalysis- mechanism and industrial applications- John Wiley and sons
4. U.S.Ozkan, Design of heterogeneous catalysts, Wiley VCH
5. G.A. Somarjai, Introduction to surface chemistry and catalysis- Wiley and sons.

Polymers:

6. V.R.Gowariker, N.V.Vishwanathan&T.Shridhar, Polymer Science- (Wiley Eastern) 2008.
7. Fred W. Billmeyer, Textbook of Polymer Science, 3rd Edition, (Wiley) 1984.

Petrochemicals:

8. S. Maiti, Introduction to Petrochemicals, 2nd ed. (Oxford and IBH) 2002.
9. B. K. B. Rao, Modern Petroleum Refining Processes, 4th ed. (Oxford and IBH) 2005.
10. G. N. Sarkar, Advanced Petroleum Refining, 1st ed., (Khanna Publishers) 1998.
11. . S. G James, the Chemistry and Technology of Petroleum (Marcel Dekker) 1991.

CHS 610: Bioorganic Chemistry

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: This is an elective course in advanced organic chemistry. This course covers chemistry of catalysis, synthetic polymers and petrochemicals.

Course Outcomes: At the end of this course students will be able to

CO1	Explain[2] chemistry and biological actions of carbohydrates.
CO2	Describe[2] biological activity of peptides, proteins and nucleic acids.
CO3	Predict[2] activity of vitamins.
CO4	Recognize[1] biological activity of enzymes.

Syllabus (Theory)

Units	Description	Hours
I	**Carbohydrates** Configuration and conformation of monosaccharides, Hudsons rule, Mutarotation. Chemistry of important derivatives of monosaccharides-ethers, esters, acetals, ketals, deoxysugars, aminosugars, Structure of disaccharides-maltose, cellobiose and sucrose. General methods of structural degradation of polysaccharides-methylation & partial hydrolysis, Smith degradation and alkaline degradation techniques. Structures of cellulose, chitin, starch and glycogen.	15
II	**Peptides & Proteins:** Peptide bond formation and synthesis of polypeptides, Amino and carboxy protecting groups in peptide synthesis, Solid phase peptide Synthesis-Merrifield method, Peptide structure Determination-Sequence and End group anaysis (N-Terminus and C-Terminus), Secondary, Tertiary and Quaternary structure of proteins. **Nucleic acids:** Nucleosides and Nucleotides, Chemical synthesis of nucleosides and nucleotides. Poly nucleotides- Structure and functions of DNA and RNA. **Non-steroidal hormones:** Study of the Oxytocin, Vasopressin and synthetic analogs, General study of ACTH, Growth hormones, Somotropin and Insulin.	15
III	**Vitamins:** Introduction, Classification and Nomenclature-Source and Deficiency diseases, Biological, functions of Vitamins, Study of Vitamin A1, Vitamin B1, B2 and B6, Vitamin H, Vitamin C, Vitamin E, Vitamin K1. **Antibiotics:** Introduction, Classification, Chemistry of Pencillin V, Cephalosporine C, Streptomycin, Chloramphenicol and Tetracyclin. **Prostaglandins:** Introduction, Nomenclature, Classification and Biological role of	15

Prostaglandins, Structural elucidation and stereochemistry of PGE1, PGE2 and PGE3. Total synthesis of PGE1 (Corey's method & Up John's synthesis).

IV **Enzymes:** Introduction**,** Classification, Enzyme substrate complex formation models: Lock and Key model, Host-Guest and Induced- Fit model. Factors affecting enzyme activity (pH, temperature), enzyme inhibition (reversible and irreversible) and immobilised enzymes. Examples of some typical enzyme mechanisms for Triose phosphate isomerase, α- Carboxy peptidase-A and Ribonuclease. Enzymatic synthesis of α-amino acids and peptides. Transformations of lipases and esterases. Kinetic resolutions of catboxylic acids, esters and Alcohols-Transesterification. Enzymatic synthesis of α-amino acids and peptides. Transformations of lipases and esterases. 15

References

1. P. Y. Bruice, Organic Chemistry- (Pearson Education Pvt. Ltd.,New Delhi),2002.
2. S. H. Pine et al, Organic Chemistry 4th Edn., (McGraw-Hill, London) 1987.
3. R.A. Carey and R.J. Sundberg, Advanced Organic Chemistry- (Plenum, New York) 1990.
4. I. L.Finar, Organic Chemistry, Vol I & II, (Longmann ELBS, London), 1973.
5. G.R.Chatwal, Natural Products Chemistry, Vol-I & II- (Himalaya), 1990.
6. Herman Dugas and Christopher Penney, Bioorganic chemistry - A chemical approach to enzyme action

CHS 624: Analytical Methods in Chemical Industries

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
4	-	-	4	Theory	FET	20	Min 40
					CAT-I	15	
					CAT-II	15	
					ESE	50	

Course Description: Analytical methods in chemical industries consist of studying the basic aspects required for the pharma. Analysis and understanding of techniques, formulations and formulation packaging. It covers fundamentals of IR, Dissolution tester, analytical balance, GC, UV-Visible spectrophotometer, HPLC.

Course Outcomes: At the end of this course students will be able to

CO1	Explain[2]basics of pharmaceutical analysis.
CO2	Discribe[3] Dissolution tester, Karl-Fischer titration, and analysis of pharmaceutical.
CO3	Discuss[2]pharmaceutical andpesticide formulations.
CO4	Apply[3]formulations packaging.

Syllabus (Theory)

Units	Description	Hours
I	**Pharmaceuticals analysis** Overview of pharmaceuticals, Definition of pharmaceutical terms, Introduction of the basic concept and its function, importance, requirement related to manufacturing, packing & testing of all pharmaceuticals. function & roles of each section of quality control like Raw material, finished product, stability, reference & working standards, process validation, method validation, Non routine, Instrumentation. Concentration calculations in pharma. analysis, laboratory operational principles. Data integrity.	15
II	a) Basic fundamentals of Karl Fischer titrations, IR Spectrometer, Dissolution tester, Analytical Balance and its applications. b) Introduction to Gas Chromatography, UV-VIS Spectrophotometer, High performance liquid chromatography along with HPLC software. Applications of GC and HPLC in pharma. Analysis.	15
III	**Pharmaceutical and Pesticide Formulations:** Introduction to formulations: Definition, history, purpose. Types and codes. Main types of formulations. Study of conventional formulations: Dusting: (Powders/Dust	15

Formulations, Dry Powders (DP), Granules (GR), Water Dispersible powders (WDP0 OR Wettable Powders (WP), Soluble Concentrates (SC), emulsifiable Concentrates (EC), Ultra Low Volume (ULV) with respect to their ingredients, advantages and disadvantages.

IV Formulation Packaging: 15

Introduction, current trends in single trip containers, Liquid formulations: Rigid plastics, High Density Polyethylene (HDPE), Polyethylene Terephthalate (PET), Ethylene Vinyl Alcohol (EVOH) and Polyamide (PA). Solid Formulations: Polyethylene, Laminates- Low Density Polyethylene (LDPE), Aluminum foil, LDPE plus ether. Polypropylene (PP), Polyester (PET), Polyamide paper, Water soluble films, cellulose papers, and wooden materials for outer packaging. Safety in Pharmaceutical packaging, Safety in Pesticide packaging.

Text Books

01 Sethi P D, Quantitative Analysis of Drugs in Pharmaceutical Formulations.
02 Parmer B.S., Tomar S.S., Pesticides Formulations, CBS Publishers and Distributors.

Reference Books

01 Chaithanya Sudha P D, Pharmaceutical Analysis
02 VidyaSagar, Pharmaceutical Industrial Management.
03 Arman C G van, Milton A S, Pyretics and Antipyretics
04 Scher H. B. Advances in pesticides formulations Technology, ACS No. 254.
05 Valukenburg W., Pesticides Formulations (Deckker).
06 Tovy G.D., Editor of Pharmaceutical Formulations:Science and Technologyof dosage forms.Chapeter 1, Formulation Studies is written by Jones T.V.
07 Khopkar S M, Environmental Pollution Analysis, New Age International publication. (2011).
08 Bauer Edward, Pharmaceutical Packaging, Google Book.
09 Bassett, Denney-Jeffer and Mendham, Vogel's Textbook of Quantitative Inorganic Analysis,(5th edition Revised Copy) Longmann Scientific and Technical jointly with John Wiley and Sons Inc.(PDF soft Copy available free on internet)

CHS 612: Organic Chemistry Lab-IV

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
-	-	4	2	Practical	FEP	50	Min 40
					POE	50	

Course Description: This is a laboratory course in odd semester of second year of MSc. This course helps students to acquire skills related to separation, identification and confirmation of organic compounds from their mixtures.

Course Outcomes: At the end of this course students will be able to

CO1	Apply[3] knowledge for extraction, purification and identification of compounds.
CO2	Demonstrate[3] analytical thinking ability.

List of Experiments

Description

Mixture analysis: ternary mixture to be given. (S+S+S), (L+L+L), (S+L+L), (S+S+L). Type determination. Separation by physical and chemical methods. (both permitted in case of liquids)

Possible combination

1. Salicylic acid+1-Naphthol+benzaldehyde (S+S+S)
2. 2-Cresol+Aniline+Acetophenone (L+L+L)
3. Benzoic acid+3Chloroaniline+Chl;orobenzene (S+L+L)
4. 2-naphthol+3-nitroaniline+Nitrobenzene (S+S+L) and etc.

Books recommended for Practical's:

1. A. I. Vogel, Elementary Practical Organic Chemistry-Vol. III quantitative Organic Analysis.
2. Furniss et. al., Vogel's Text Book of Practical Organic Chemistry- (ELBS) 1978.
3. P. R. Singh, Experimental Organic Chemistry- Vol. I &II, (Tata McGraw-Hill) 1981.
4. Dey & Sitaraman, Practical Organic Chemistry 4th Ed- (Allied)
5. Adam, Johnson & Wicon, Laboratory Experiments in Organic Chemistry- (McMillan), 1979.
6. H. D. Durst & G. E. Goke, Experimental Organic Chemistry- (McGraw-Hill) 1980.
7. A.J. Baker et al., More Spectroscopic Problems in Organic Chemistry Heyden, 1975.
8. Davis & Wells, Spectral Problems in Organic Chemistry- (Chapman & Hall) 1984.

CHS 614: Organic Chemistry Lab-V

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
-	-	4	2	Practical	FEP	50	Min 40
					POE	50	

Course Description: This course is at even semester of second year of MSc. This course help student to acquire synthetic organic chemistry skills involved in preparation of industrially important compounds.

Course Outcomes: At the end of this course students will be able to

CO1	Demonstrate[3] application of theoretical knowledge for organic synthesis.
CO2	Apply[3] knowledge for identification of compounds.

List of Experiments

No	Description
1	Preparation of, i) Ethyl resorcinol from Resorcinol, 3-Bromo-4-methyl benzaldehyde from p-Toluedine, ε-Caprolactam from cyclohexanone, p-Aminobenzoic acid from p-Nitrotoluene, s-Tribromobenzene from aniline, o-hydroxyacetophenone from phenol, Benzanilide from Benzophenone, Benzylic acid from Benzoin, Benzopinacolone from Benzophenone, p-Chlorotoluene from p-Toludine, 2,5-Dihydroxyacetophenone from Hydroquinone, 2,4-Dinitrophenylhydrazine from Chlorobenzene, m-Nitrobenzoic acid from Benzoic acid, 2,4-Dinitrophenol from Chlorobenzene, o-Aminobenzoic acid from Phthalic acid, 2-Carbethoxycyclopentanone from Adipic acid, α-Acetylaminocinnamic acid from Glycine, p-Aminoazobenzene from Aniline.
2	Synthesis of one derivative each of Furan, Indole, Pyrazole, Quinoline, Thiazole, Acridine, Coumarin and Triazole containing heterocycles.
3	Synthesis of Picric acid, Para red, Methyl red, Methyl orange, Flourescein, Eosin, Indigo and dyeing of fabrics.

Books recommended for Practical's:

1. A. I. Vogel, Elementary Practical Organic Chemistry-Vol. III quantitative Organic Analysis.
2. Furniss et. al., Vogel's Text Book of Practical Organic Chemistry- (ELBS) 1978.
3. P. R. Singh, Experimental Organic Chemistry- Vol. I &II, (Tata McGraw-Hill) 1981.
4. Dey & Sitaraman, Practical Organic Chemistry 4th Ed- (Allied)
5. Adam, Johnson & Wicon, Laboratory Experiments in Organic Chemistry- (McMillan), 1979.
6. H. D. Durst & G. E. Goke, Experimental Organic Chemistry- (McGraw-Hill) 1980.
7. A.J. Baker et al., More Spectroscopic Problems in Organic Chemistry Heyden, 1975.
8. Davis & Wells, Spectral Problems in Organic Chemistry- (Chapman & Hall) 1984.

CHS 616: Organic Chemistry Lab-VI

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
-	-	4	2	Practical	FEP	50	Min 40
					POE	50	

Course Description: This course is at even semester of second year of MSc. This course help student to acquire skills involved in isolation of natural products.

Course Outcomes: At the end of this course students will be able to

CO1	Apply[3] knowledge for extraction, purification and identification of compounds.
CO2	Discuss[3] Isolation and Characterization of natural products.

List of Experiments

No	Description
1	**Extraction of Organic compounds from Natural sources :** Isolation of caffeine from tea leaves. Isolation of nicotine dipicrate from tobacco. Isolation of cinchonine from cinchona bark. Isolation of piperine from black pepper. Isolation of lycopene from tomatoes. Isolation of βcarotene from carrots. Isolation of oleic acid from olive oil involving the preparation of complex with urea and separation of linoleic acid). Isolation of eugenol from cloves. Isolation of (+) limonine from citrus rind. Extraction of curcumine from turmeric powder.
2	**Quantitative Analysis:** Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method. Estimation of amines/phenols using bromate bromide solution or acetylation method. Determination of lodine and Saponification values of an oil sample. Determination of DO, COD and BOD of water sample.
3	**Estimations:** Ascorbic acid, Aspirin, Caffeine

Books recommended for Practical's:

1. A. I. Vogel, Elementary Practical Organic Chemistry-Vol. III quantitative Organic Analysis.
2. Furniss et. al., Vogel's Text Book of Practical Organic Chemistry, (ELBS) 1978.
3. P. R. Singh, Experimental Organic Chemistry- Vol. I &II, (Tata McGraw-Hill) 1981.
4. Dey & Sitaraman, Practical Organic Chemistry 4th Ed- (Allied)
5. Adam, Johnson & Wicon, Laboratory Experiments in Organic Chemistry- (McMillan), 1979.
6. H. D. Durst & G. E. Goke, Experimental Organic Chemistry- (McGraw-Hill) 1980.
7. A.J. Baker et al., More Spectroscopic Problems in Organic Chemistry Heyden, 1975.
8. Davis & Wells, Spectral Problems in Organic Chemistry- (Chapman & Hall) 1984.

CHS 618: Project Phase-II

(Version 1.0, Program Core, School of Sciences)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass
-	-	4	2	Practical	FEP	50	Min 40
					POE	50	

List of Experiments

No	Description
1	**Project:** Based on research interest student will continue work for project under supervision of identified project supervisor. At the end student will submit a project report.
2.	In the middle of semester there will be evaluation of progress. At the end of each semester the Students will present results and presentation will be evaluated.

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