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.

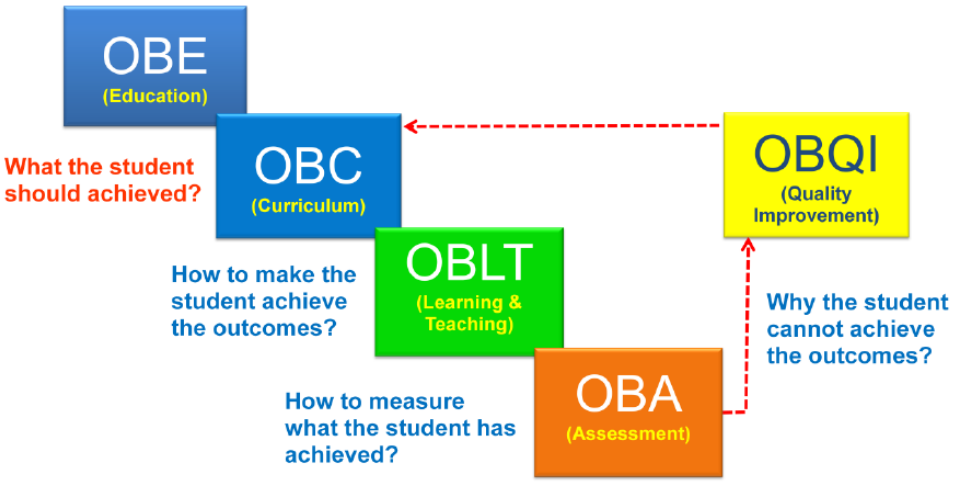
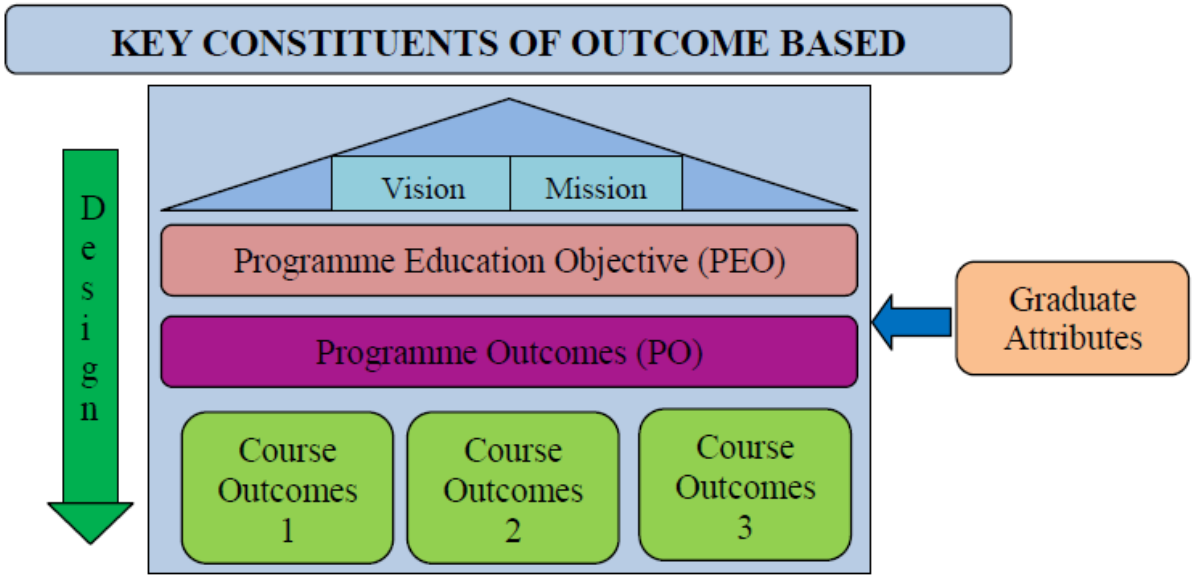


Figure 1: OBE flows and desciption

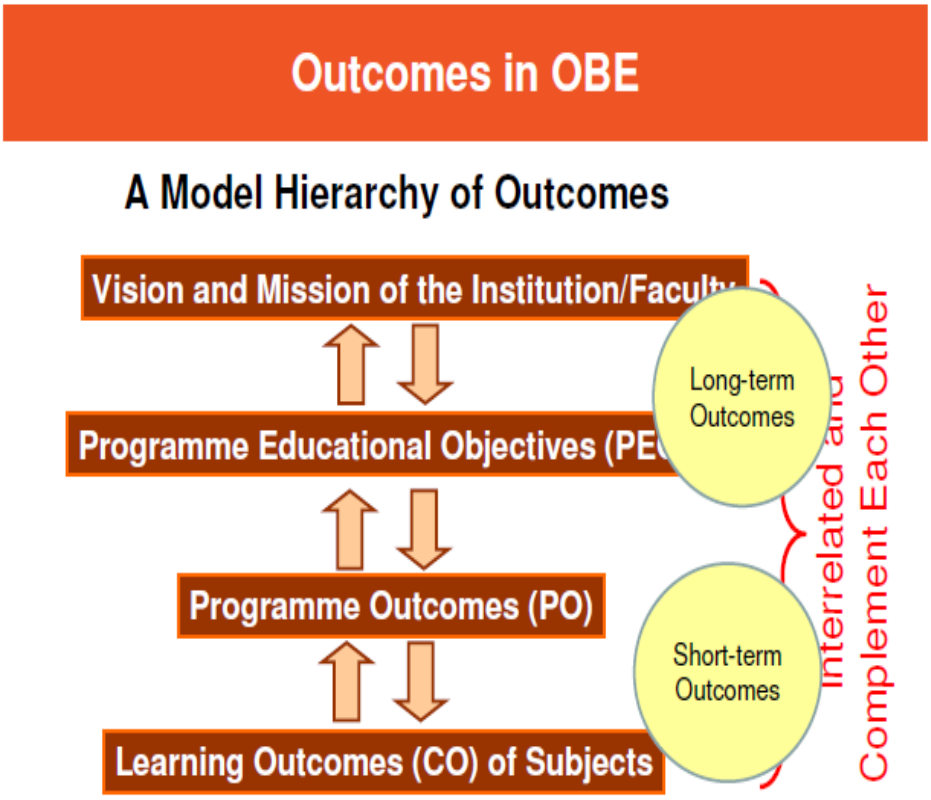


The OBE model measures the progress of the graduate in three parameters, which are

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

Program Educational Objectives (PEO) are 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 semesterand 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 activity of the Universityare regulated by Academic Calendar and is 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 creditscourse's 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.

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 4^{th} 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.

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

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.: 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
							CAT I	15	
							CAT II	15	
							ESE	50	40
CHS 503 (PC|SS)	Inorganic Chemistry I	4	-	-	4	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CHS 505 (PC|SS)	Physical Chemistry I	4	-	-	4	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CHS 507 (PC|SS)	Analytical Chemistry I	4	-	-	4	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
REM 501 (UC|SS)	Research Methodology I	2	-	-	2	Theory	FET	20	40
							CAT	30	
							ESE	50	40
CHS 509 (PC|SS)	Organic Chemistry Lab I	-	-	4	2	Practical	FEP	50	40
							POE	50	40
CHS 511 (PC|SS)	Inorganic Chemistry Lab I	-	-	4	2	Practical	FEP	50	40
							POE	50	40
CHS 513 (PC|SS)	Physical and Analytical Chemistry Lab I	-	-	4	2	Practical	FEP	50	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.: 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**			

Second Year M.Sc. Analytical Chemistry										
Semester III										
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	**Component**	**Evaluation Schemefor (L T P)**			
							Exam	**WT**	**Min Pass (%)**	
CHS 619 (PC|SS)	Introduction to Analytical Chemistry	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 621 (PC|SS)	Electrochemical Methods of Analysis	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 603 (PC|SS)	Advanced Spectroscopic Methods	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS623/ CHS625 (PC|SS)	Fundamentals of Analytical Chemistry / Recent Advances in Analytical Chemistry	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 627 (PC|SS)	Analytical Chemistry Lab I	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 629 (PC|SS)	Analytical Chemistry Lab II	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 631 (PC|SS)	Analytical Chemistry Lab III	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 633 (PC|SS)	Project Phase I	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
Total		16	0	16	24		Hrs.: 32, Credits: 24			

Second Year M.Sc. Analytical Chemistry										
Semester IV										
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	**Component**	**Evaluation Scheme**			
							Exam	**WT**	**Min Pass (%)**	
CHS 618 (PC|SS)	Selected Techniques of Chemical Analysis	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 620 (PC|SS)	Advanced Methods of Chemical Analysis	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 622 (PC|SS)	Pollution Monitoring and Control	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 624/ CHS 626 (PC|SS)	Analytical Methods in Chemical Industries / Analytical Techniques in Agro, Food and Pharmaceuticals	4	-	-	4	Theory	FET	20	40	40
							CAT I	15		
							CAT II	15		
							ESE	50	40	
CHS 628 (UC|SS)	Analytical Chemistry Lab IV	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 630 (PC|SS)	Analytical Chemistry Lab V	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 632 (PC|SS)	Analytical Chemistry Lab VI	-	-	4	2	Practical	FEP	50	40	40
							POE	50	40	
CHS 634 (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 PG degree.

Total credits: 96

Sanjay Ghodawat University Kolhapur

School of Science Program: M. Sc.

Syllabus Structure for First Year B. Sc. R0

CHS 501: 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 course is at odd semester of first year of MSc. This course is a course in organic chemistry and pre-requisite for advanced organic chemistry. It covers fundamental concepts of reaction mechanism, organic reactions and stereochemistry.

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

CO1	Understand[2] concepts of reaction mechanism
CO2	Explain[2] nucleophilic and electrophilic substitution reactions.
CO3	Explain[2] orientation, reactivity and selectivity in organic reactions
CO4	Discribe[2] orientation and reactivity in elimination reactions and name reactions in context of reaction mechanism.
CO5	Apply[3] the concepts of stereochemistry for organic compounds.

Syllabus (Theory)

Units	Description	Hours
I	**a) Reaction Mechanism: Structure and Reactivity** Introduction, types of reactions, strength of acids and bases. Effect of structure on reactivity, resonance and field, steric effects. Generation, structure, stability and reactivity of carbocation's and carbanion's, free radicals, carbenes, arynes, nitrenes and ylides. **b) Aliphatic Nucleophilic substitutions** The SN^2, SN^1 and SN^i reactions with respect to mechanism and stereochemistry. Nucleophilic substitutions at an allylic, aliphatic trigonal, benzylic, aryl and vinylic carbons. Reactivity effect of substrate structure, effect of attacking nucleophiles, leaving groups and reaction medium. SN reactions at bridge head carbon, competition between SN^1 and SN^2, Ambident nucleophiles, Neighboring Group Participation.	15
II	**a) Aromatic Electrophilic Substitutions** Introduction, the arenium ion mechanism, orientation and reactivity in Nitration, Sulphonation, Friedel-Crafts reaction and Halogenation of aromatic systems, energy	15

profile diagrams. The ortho/para ratio, ipso attack, concept of aromaticity, orientation in their ring systems. Diazo-coupling, Vilsmeier- Haack reaction, Von Richter rearrangement.

b) Addition to Carbon–Carbon Multiple Bonds

Mechanism and stereo-chemical aspects of the addition reactions involving electrophiles and free radicals, regio-selectivity and chemo-selectivity, orientation and reactivity. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Michael addition reaction.

III **a) Elimination Reactions**

Introduction, E1, E2 and E1cB mechanisms. Orientation in Elimination reactions. Hoffman versus Saytzeff elimination, Pyrolytic syn-elimination, and competition between substitution and elimination reactions, Reactivity: effects of substrate structures, attacking base, the leaving group, the nature of medium on elimination reactions. Pyrolytic elimination reactions. 15

b) Study of following reactions

Beckman, Fries, Benzilic acid, Hoffman, Schmidt, Curtius, Lossen, Witting, Hofmann-Martius and Demjanov reaction.

IV **Stereochemistry:** Introduction, Representation of three dimensional molecules and interconversion,Concept of chirality and molecular dissymmetry, Recognition of symmetry elements and chiral centers, Prochiral relationship, homotopic, enantiotopic and disteriotopic groups and faces. Recemic modifications and their resolution, R and S nomenclature. Geometrical isomerism: E and Z nomenclature. Conformational analysis: Cyclohexane derivatives, stability and reactivity, Conformational analysis of substituted cyclohexenes. 15

References

1.Jagdamba Singh, L D. S. Yadav, Advanced Organic Chemistry (PragatiPrakashan)
2. R. Breslow, Organic reaction mechanism (Benjamin)
3. Peter Sykes A guide book to mechanism in Organic chemistry (Orient-Longmens).
4. Organic chemistry (McGraw-Hill) Hendrikson, Cram and Hammond.
5. J. D. Roberts and M. C. Caserio, Basic principles of Organic chemistry (Benjamin).
6. N. S. Issacs, Reactive Intermediates in Organic chemistry (John Wiley).
7. E.L.ElielStereochemistry of Carbon compounds. (McGraw-Hill)
8. Hallas.OrganicStereochemistry (McGraw-Hill)
9. R. K. Bansal, Organic reaction mechanism (McGraw-Hill)
10. R. T. Morrison and R. N. Boyd, Organic chemistry- (Prentice Hall.)
11. H. O. House Modern organic reactions (Benjumin).
12. R.O.C. Norman and J. M. Coxon. (ELBS), Principle of organic synthesis
13. S. M. Mukharji and S. P. Singh, Reaction mechanism in organic chemistry.
14. D. Nasipuri, Stereochemistry of organic compounds.
15. J. March, Advanced organic chemistry (McGraw-Hill).
16. K. Mislow, Introduction to stereochemistry (Benjumin).
17. P. S. Kalsi, Stereochemistry(New Age International)
18.S. N. Sanyal, Reactions, Rearrangements and Reagents (BharatiBhawan).

CHS 503: Inorganic 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 course is at odd semester of first year of MSc. It is a course in inorganic chemistry and may be pre-requisites for advanced organic chemistry. It covers fundamental concepts of bonding, main group chemistry and properties of inorganic materials.

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

CO1	Explain[2] the bonding fundamentals for both ionic and covalent compounds and lattice energy.
CO2	Solve[3] wave equations of hydrogen atom.
CO3	Discribe[2] the chemistry of main group elements.
CO4	Explain[3] electronic and optical properties, doping effects and junctions between n- and p-type semiconductor materials.
CO5	Explain[2] the basic principles of quantum mechanics that will serve as a foundation to understand the fundamental concepts of materials science.

Syllabus (Theory)

Units	Description	Hours
I	**Covalent and Ionic Bonding** V.B. approach to covalent bonding –Heitler -London, Pauling- Slater refinements, Hybridization and structure of molecule. VSEPR theory -shapes of molecules. M.O. approach to covalent bonding -symmetry and overlap of atomic orbitals -symmetry of molecular orbitals -sigma- pi-and delta -bondings -energy levels in homo -and hetero nuclear diatomic molecules -bond length, bond order and bond energy -ionic character in a covalent bond. The concept of multi center bonding. Structure and bonding in fluorine and oxygen compounds of xenon and krypton. Bonding in simple tri atomic molecules/ions. Lattice energy and its calculations by Born-lande and Born-Meyer equations –Determinations by Born–Haber cycle- Kapustinski equation, Energetics of dissolution of ionic compounds in polar solvents. Properties of ionic compounds-Hardness and electrical conductivity.	15
II	**Wave mechanics** Origin of quantum theory, black body radiation, Bohr atomic model, atomic spectra, photoelectric effect, Heisenberg uncertainty principle, matter waves, Compton effect, wave nature of the electron, the wave equation of hydrogen atom, the theory of hydrogen atom, particle in one dimensional box, transformation of coordinates, Separation of variables and their significance.	15

III Main group chemistry

General discussion on the properties of the non – transition elements, special features of individual elements, synthesis, properties and structure of halides and oxides of the non- transition elements. Polymorphism in carbon, phosphorous and sulphur, Synthesis, properties and structure of boranes, carboranes, silicates, carbides, phosphazenes, sulphur – nitrogen compounds, peroxo compounds of boron, carbon, sulphur, structure and bonding in oxyacids of nitrogen, phosphorous, sulphur and halogens, interhalogens, pseudohalides. 15

IV Electronic, Electric and Optical behavior of Inorganic materials

Classification of solids**,** Metals, Insulators and Semiconductors, Electronic structure of solid, band theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping of semiconductors and conduction mechanism, the band gap, temperature dependence of conductivity, carrier density and carrier mobility in semiconductors, synthesis and purification of semiconducting materials, single crystal growth, zone refining, fractional crystallization, semiconductor devices, rectifier transistors, optical devices, photoconductors, photovoltaic cells, solar batteries. 15

Recommended Books:

1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984)
2) J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972).
3) J. D. Lee, Concise Inorganic Chemistry, (Elbs with Chapman and Hall, London).
4) A. R. West, Plenum Solid State Chemistry and its applications.
5) N. B. Hanney, Solid State Physics.
6) H. V. Keer, Principles of Solid State.
7) S. O. Pillai, Solid State Physics.
8)W. D. Callister, Material Science and Engineering: An Introduction (Wiley).
9) R. Raghwan, First Course in Material Science.
10) R. W. Cahan, The coming of Material Science.
11) Basic Solid State Chemistry, 2nd edition-A. R. West.
12) U. Schubest and N. Husing, Synthesis of Inorganic Materials, Wiley VCH (2000).
13)M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP.
14) A. H. Hanney, Solid State Chemistry, A. H. Publications.
15)John Wulff, The structure a properties of materials.
16) L. V. Azoroff, J. J. Brophy, Electronic processes in materials, Mc Craw Hill.
17)F. A. Cotton, R. G. Wilkinson, Advanced Inorganic chemistry.
18) Willam L. Jooly, Modern Inorganic Chemistry.
19)ManasChanda, Atomic Structure and Chemical bonding-.
20) N. N. Greenwood and A. Earnshaw, Chemistry of elements, Pergamon.
21)Chakraburty, Soild State Chemistry, New Age International.
22) B.Vishwanathan and R. Gopalan, Coordination Chemistry.

CHS 505: Physical 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 course is at odd semester of first year of MSc. It is a course in physical chemistry and may be pre-requisites for advanced organic chemistry. It covers fundamentals thermodynamics, kinetics of reactions and properties of biomolecules.

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

CO1	Understand[2] thermodynamic properties of solutions.
CO2	Apply[3] the steady state approximation to chemical reactions.
CO3	Calculate[3] partition functions of molecules.
CO4	Describe[1] classification of biomolecules and their physical interactions.

Syllabus (Theory)

Units	Description	Hours
I	**Thermodynamics** Introduction, revision of basic concepts: Ideal and non-ideal solutions, Rault's law. Duhem-Margules equation and its applications to vapor pressure curves (Binary liquid mixture). Henry's law. Excess and mixing thermodynamic properties. Entropy and third law of thermodynamics. Evaluation of Absolute entropies from heat capacity data for solids, liquids and gases. Free energy and Maxwell's relation. Thermodynamic equation of state. *Partial molar properties*: Physical significance, determination of partial molar volume. The chemical potential: variation of chemical potential with temperature and pressure, Gibbs-Duhem equation and its applications to study of partial molar quantities.	15
II	**Chemical Kinetics** Recapitulation- zero, first, second, third, nth order rate equation, molecularity and how to determine order of reaction, fractional order reactions. *Theories of reaction rates*: Arrhenius theory, Collision theory, steric factor, transition state theory, activated complex, Erying equation, enthalpy, free energy and entropy of activation. Unimolecular reactions and Lindmann's theory. Steady state approximation and study of decomposition of ozone and nitrogen pentoxide. Homogeneous catalysis: acid and base catalyzed reactions, Michaelis–Menten enzyme catalysis, Lineweaver-Burk Plots, enzyme inhibition, competitive, uncompetitive and Non-competitive inhibition. Heterogeneous catalysis: Adsorption of gas on a surface and its kinetics, Catalyzed hydrogen-deuterium exchange reaction.	20

Primary and secondary salt effect.

III Statistical Thermodynamics

Weights and configurations, the most probable configuration, thermodynamic probability and entropy: Boltzmann – Planck equation. Ensembles, ensemble average and time average of property. Maxwell-Boltzmann (MB) distribution law and its application to viscosity and diffusion of gases, Bose-Einstein and Fermi-Dirac statistics. Partition function and its significance. Rotational, translational, vibrational and electronic partition functions. Use of spectroscopic data for evaluation of various partition functions. 15

IV Biophysical Chemistry

Introduction to biophysical chemistry: Amino acids, peptide, proteins, Enzymes, nucleic acids: Introduction to primary, secondary, tertiary and quaternary structures, acid base properties. Intermolecular forces: H-bonding, Van der Waals forces, Lenard-Jones potential, columbic interactions, 1-4 interactions, hydrophobic hydration and interaction. Hydrodynamic and equilibrium thermodynamic methods for determination of molar mass of biological macromolecules. 10

Reference books:

1. P. W. Atkins, Physical Chemistry Oxford University press, 8th edition, 2006.
2. S. Glasstone, Text book of Physical Chemistry.
3. Marron and Pruton, Principles of Physical Chemistry.
4. G. M. Barrow,Physical Chemistry –Tata-McGraw Hill, Vth edition, 2003.
5. S. Glasstone, D. Van Nostrand, Thermodynamics for Chemists, 1965.
6. R. C. Srivastava, S. K. Saha and A. K. Jain, Thermodynamics: A Core Course Prentice-Hall of India, IInd edition, 2004.
7. L. K. Nash, Elements of statistical thermodynamics, 2 nd Ed. Addison Wesley 1974.
8. S. Glasstone, D. Van Nostrand Company, Theoretical Chemistry: An introduction to quantum mechanics, statistical mechanics, and molecular spectra for chemists, Inc., 1944.
9. T.L. Hill, An Introduction to Statistical Thermodynamics, Addison, Wesley. 1960.
10. Donald A., McQuarrie Statistical Mechanics, 2000.
14. J.P.Allen, Biophysical Chemistry, Wiley, Blackwell, 2008.
15. A. Cooper, Biophysical Chemistry, RSC, 2004.
16. R.A. Alberty, Thermodynamics of Biochemical Reactions–Wiley-Interscience, 2003.
17. U.N. Dash,Textbook of Biophysical Chemistry, McMillan India, 2006.
18. K. J. Laidler, Chemical Kinetics- Pearson Education, 2004.
19. G. L. Agarwal, Basic chemical Kinetics, Tata-McGraw Hill.

CHS 507: Analytical 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 course is at odd semester of first year of MSc. It is a course in analytical chemistry and may be pre-requisites for advanced organic chemistry. It covers basic concepts in analytical chemistry, classical and spectroscopic techniques.

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

CO1	Illustrate[2] errors, precision, accuracy in data analysis.
CO2	Explain[2] column chromatographic analysis.
CO3	Apply[3] spectroscopic techniques for analysis.
CO4	Describe[1] types of titration.

Syllabus (Theory)

Units	Description	Hours
I	**Errors and treatment of Analytical Chemistry** Errors, Determinant, constant and indeterminate. Accuracy and precision Distribution of random errors. Average derivation and standard derivation, Variance and confidence limit. Significance figures and computation rules. Least square method. Methods of sampling: samples size. Techniques of sampling of gases, fluid, solids, and particulates. **Water and effluent analysis:** Introduction to different terms, Classification, Representative methods of Analysis.	15
II	**Chromatographic methods:** General principle, classification of chromatographic methods. Nature of partition forces. Chromatographic behavior of solutes. Column efficiency and resolution. Gas Chromatography: Introduction, Instrumentation, detector, optimization of experimental conditions, applications of GC. HPLC:- General introduction, Principle of HPLC, Instrumentation, Applications of HPLC, Comparative Account of GC and HPLC	15
III	**Spectroscopy** Introduction, region of electromagnetic radiations, definitions and units of wavelength, frequency, energy, amplitude, wave number and their relations, Interactions of radiation with matter, rotational, vibrational, electronic energy	15

levels, types of spectroscopy methods.
Ultraviolet and visible spectrophotometry (UV-VIS): Introduction, Beer-Lambert's law, applications in estimation of mixture of elements (Cr and Ni), mixture of drugs (Paracetamol and salbutamol) and estimation of drugs at different pH.
Infrared Spectroscopy (IR): Introduction, principle of IR spectroscopy, instrumentation, fundamental modes of vibrations, types of vibrations, condition for IR absorption, IR regions, sampling technique, selection rules, characteristic of IR absorption of common functional groups and applications.

IV Titrations

Redox titration- Redox potentials, theory and feasibility of redox titration, calculation of potentials at different stages of titrations, redox indicators, their choice and applications. 15

Precipitation titrations-Theory and types, Mohr, Volhard and Fajan's methods. Adsorption indicators-theory, choice and applications.
Complexometric titrations- Theory, Stepwise and overall formation constants, Titrations involving chelates (EDTA). Metalochromic indicators- Theory and Choice. Masking and demasking and extractive methods. Direct, indirect (including substitution) titration and applications.
KalFischer titration.

References

1. G. D. Christain, Analytical Chemistry: (J.W)
2. Bobbit,Introduction to chromatography:
3. H.H. Willard, L.L. Mirrit, J.A. Dean,Instrumental Methods of analysis (CBS).
4. Chatwal and Anand,Instrumental Methods of Analysis.
5. A.I. Vogel,Instrumental Methods of Inorganic Analysis (ELBS)
6. H.A. Strobel,Chemical Instrumentation: A Systematic approch-
7. W.E.Morf,The principals of ion-selective electrodes and membrane transport.
8. P.W.Atkins,Physical Chemistry.
9. D. Skoog and D.West,Principal of Instrumental Analysis.
10. I.M. Kolthoff, Treatise on Analytical Chemistry: Vol Ito VII
11. R.M. Silverstein and G.C. Bassler, Spectroscopic identification of organic compounds.
12. D.H. Williams and I. Fleming, Spectroscopic methods in organic chemistry.
13. R. Drago,Physical Methods in Inorganic Chemistry (DWAP).

REM 501: Research Methodology-I

(Version 1.0, University Core, School of Science)

Lect.	Tut.	Pract.	Total Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
2	-	-	2	Theory	FET	20	Min 40
					CAT	30	
					ESE	50	

Course Description: This course is at odd semester of first year of MSc. It is a course in research methodology. It covers fundamentals of research and its methodologies, literature database.

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

CO1:	Explain[2] basic concepts of research and its methodologies.
CO2:	Identify[1] the research topics.
CO3:	Choose[2] appropriate research problem and parameters.
CO4:	Classify[2] types of database for literature.

Syllabus (Theory)

Units	Description	Hours
I	**Research Methodology: An Introduction:** Meaning of Research, Objectives of Research, and Motivation in Research, Types of Research, Research Approaches, Significance of Research, and Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. **Defining the Research Problem:** What is a Research Problem?	10
II	Selecting the Problem , Necessity of Defining the Problem , Technique Involved in Defining a Problem **Literature Survey**: **Print**: Sources of information: Primary, Secondary **Journals**: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents.	10
III	**Digital**: Web resources, E-journals, Journal access, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Search engines: Google Scholar, Wiki- Databases, Science Direct, Scopus, OPAC, Shodhganga, National Digital Library, NPTEL **Information Technology and Library Resources**: The Internet and World Wide Web. Internet resources for research in Physics, Chemistry (give one molecule and ask to find detail literature) and Mathematics. Finding and citing published information.	10

References

1. R C. Kothari.Research Methodology
2. D. Chawla & N. Sondhi, Research Methodology: Concepts and Cases, Vikas Publishing house, 2nd Edition, 2016)

CHS 509: 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 first year of MSc. It is a foundation course in organic chemistry laboratory and it covers learning of basic skills of organic chemistry laboratory.

List of Experiments

No **Description**

1 **Techniques: (any 4)**

Crystallization, fractional crystallization, fractional distillation, vacuum distillation, sublimation, steam distillation, column chromatography, thin layer Chromatography(purity would be checked by m.p. and mixed m.p.)

2. **Preparation of following derivatives of organic compounds: (any 6)**

Oxime,
2,4 – DNP,
acetyl,
benzoyl,
semicarbazide and aryloxyacetic acid,
Anilide,
Amide.

3. Use of Computer - Chem Draw, Chem-Sketch, ISI – Draw: (One practical)

Draw the structure of simple aliphatic, aromatic, heterocyclic compounds with Different substituents. Get the correct IUPAC name and predict the IR, ^{1}andC^{13}NMR signals.

Books recommended for Practical:

1. J. W. Zubrick, The Organic Chemistry Lab Survival Manual (J Wiley)-
2. A. I. Vogel, A. R. Tatchell, B. S. Furnis, A. J. Hannaford, P. W. G. Smith, A text book of practical organic chemistry.
3. F. C. Mann,B. C., Saunders Practical organic chemistry (Pearson).
4. H. T. Clarke, A handbook of quantitative and qualitative analysis.
5. L F Fieser, K L Williamson, Organic Experiments (D C Health & Company).

CHS 511: Inorganic 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 first year of MSc. It is a foundation course in inorganic chemistry laboratory and it covers learning of basic skills of inorganic chemistry laboratory.

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

CO1:	Explain[2] basic concepts of the preparation and characterization of metal complexes
CO2:	Discuss[3] chemical analysis of metals by qualitative and quantitative method
CO3:	Identify individual ions present in the ore or alloy and the chemistry behind it
CO4:	Explain laboratory procedures with advanced spectroscopic and analytical techniques for identification and estimation.

List of Experiments

No	Description
1.	Preparation and percentage purity determination Hexathioureaplumbus nitrate
2.	Preparation and percentage purity of cis- potassium di-aquodioxalato chromate (III) complex
3.	Ion – exchange chromatography:Separation & estimation of (Zn+2/ Cd+2) & in mixtures using Amberlite IRA 400 anion exchanger.
4.	Alloy analysis:To determine the percentage of tin and lead in given alloy.
5.	To estimate the amount of oxygen in a given sample of hydrogen peroxide
6.	Preparation of hexathiocyanato chromate (III) complex
7.	Ore analysis:To estimate the amount of iron and silica from the given sample of iron ore
8.	Preparation of solid state materials
9.	Preparation of semiconductor materials

Books recommended for Practical's:

1) A. I. Vogel, A text book of Quantitative Inorganic Analysis.
2) W. G. Palmer, Experimental Inorganic Chemistry.
3) W. R. Schoeller and A.R.Powell, Charles,The analysis of minerals and ores of the rarer elements Griffin and Company Limited
4) D. A. Skoog and D.M. West, Fundamentals of Analytical Chemistry.
5) H. T. Clarke, A handbook of quantitative and qualitative analysis.

CHS 513: Physical and Analytical 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 first year of MSc. It is a foundation course in physical and analytical chemistry laboratory. It covers learning of basic laboratory skills of analytical chemistry and computer tools.

List of Experiments

No **Description**

Physical Chemistry

1. **Chemical Kinetics:**
   To study reaction between acetone and iodine.
2. **Partial Molar Volume:**
   To determine the partial molar volume of ethyl alcohol in a mixture of ethyl alcohol and water.
3. **Conductometry:**
   To determine the normality of each acid in a given mixture of strong acid and weak acid conductometrically.
4. **Potentiometry:**
   To determine the solubility product and solubility of a sparingly soluble salt of silver (AgCl, AgBr and AgI).
5. **Potentiometry:**
   To determine the normality of each acid in a given mixture of strong acid and weak acid potentiometrically.
6. Determination of hydrolysis constant of aniline hydrochloride/ CH_3COONa.
7. **pH Metry:**
   To determine the dissociation constant of tribasic acid (phospheric acid).
8. **Use of Computer** – Microsoft excel and Origin software.
   To draw a plot from data obtained in experiments.
9. Determination of thermodynamic parameters of solutions.

Analytical chemistry

1. To estimate the quantity of ibuprofen from the given pharmaceutical tablet.
2. **Solubility:**
   To determine the solubility of calcium oxalate in presence of different concentration of KCl/HCl.

3. Colorimetry:

To verify the Beer-Lambert's law for $KMnO_4$ solution and hence to determine the molar extinction coefficient and unknown concentration of given solution by colorimetrically.

4. Estimation of drugs by colorimetric method.

5. Standard Deviation

To calculate the standard deviation from various results obtained by redox titration of Fe^{2+} against standard $K_2Cr_2O_7$.

5 Estimation of chloride from detergent.

6. To determine the chloride content in the given bleaching powder sample.

Books recommended for Practical:

1 J.A. Kitchner, Findlay's Practical Chemistry.

2 A.I. Vogel, Text Book of Quantitative inorganic analysis.

3 R.C.Das and B. Behera, Experimental Physical Chemistry.

4 B. Viswanathan and P.S. Raghavan, Practical Physical Chemistry.

5 V. D. Athawale and ParulMathur, Experimental Physical Chemistry.

6 S.W. Rajbhoj and T.K. Chondhekar, Systematic Experimental Physical Chemistry.

7. Gurtu and Gurtu, Advanced Physical Chemistry Experiments.

8. D. A. Skoog and D.M. West, Fundamentals of Analytical Chemistry.

CHS 502: 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 course is a course in organic chemistry and pre-requisite for advanced organic chemistry. It covers named organic reactions, hydroboration, reagents used for oxidation and reduction.

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

CO1	Explain[2] mechanism of organic reactions.
CO2	Describe[2] hydroboration and oxidation reactions.
CO3	Apply[2] knowledge of chemistry for protection and de-protection of functional groups.
CO4	Explain[2] chemistry of organometallic compounds.
CO5	Understand[2] Basics of retro-synthesis

Syllabus (Theory)

Units	Description	Hours
I	**Study of following reactions:** Study of following name reactions: Mechanism of condensation reaction involving enolatesMannich, Benzoin, Stobbe, Dieckmann, Diels-Alder, Robinson annulation, Reimer-Tieman, Chichibabin, Baeyer-Villiger oxidation, Simon-Smith, Mc-Murry, Dakin reactions. Applications of reactions in total synthesis. **Alkylation and Acylation:** Introduction, Types of alkylation and alkylating agents: C-Alkylation and Acylation of active methylene compounds and their applications.	15
II	**Hydroboration:** Brown Hydroboration**,** Mechanism and Synthetic Applications. **Enamines**: Formation and reactivity of enamines **Oxidation:** Applications of oxidizing agents like KMnO4, chromium trioxide (Jones reagent, Collins reagent, PDC, PCC), manganese dioxide, Osmium tetraoxide, Woodward-Prevost hydroxylation, Chloranil, hydrogen peroxide.	15
III	**Reductions:** Study of following reductions- Catalytic hydrogenation using homogeneous and heterogeneous catalysts. Study of following reactions: Wolff-Kishner, Birch, Clemmensen, Sodium borohydride, Lithium Aluminium hydride (LAH) and Sodium in alcohol.	15

Protection of functional group:
Concept of protection and deprotection, protection of alcohol, amine, carbonyl and carboxyl groups.

IV **Study of Organometallic compounds:** 15
Introduction of Organometallic compounds, Organo-lithium, organo cobalt, Fe, Ce, Ti, Cd. Use of lithium dialkylcuprate, their addition to carbonyl and unsaturated carbonyl compounds.

Methodologies in organic synthesis:
Introduction, Ideas of synthones and retrones, Retro-synthesis, Functional group transformations and inter-conversion of simple functionalities.

References

1.H. O. House, Modern synthetic reactions-(Benjamin)
2.Fieser and Fieser, Reagents in organic synthesis-(John Wiley)
3.R. O. C. Norman, Principles of organic synthesis-(Methuen)
4.H. C. Brown, Hydroboration.
5.F. C. A. Stone and R. West,Advances in Organometallic Chemistry- (A.P.).
6.Finar,Organic Chemistry (Longman)Vol. I & Vol. II-
7.Augustin,Oxidation by-(Marcel Dekker)
8.R R. Carey and R. J. Sundburg, Advanced Organic chemistry 2nd Ed.
9. Tetrahedron reports in organic chemistry- Vol.1, No. 8.
10.R. E. Ireland, Organic Synthesis-(Prentice Hall)
11.B. R. James,Homogeneous Hydrogenation-(J. K.).
12.Barton and Ollis,Comprehensive Organic Chemistry- (Pargamon) (Vol. 1-5).
13.R. Adams,Organic reactions- various volumes-.
14.W. Carruthares,Some modern methods of Organic synthesis-(Cambridge).
15. G Tojo, M., Fernandez,Oxidation of Alcohols to Aldehydes and Ketones: A guide to current Common practice(Springer).

CHS 504: Inorganic 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: It is a course in inorganic chemistry and may be pre-requisites for advanced organic chemistry. It covers chemistry of transition elements, Lanthanides and actinides, organometallic and bioinorganic compounds.

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

CO1	Discuss[2] the structure and characteristic properties of transition metal complexes.
CO2	Describe[2] the role of metal in biological system.
CO3	Understand[2] the basics of nuclear chemistry, its applications and properties of Lanthanides and Actinides.
CO4	Analyse[3] basic concept, structure and bonding and applications of organometallic compounds for homogeneous catalytic processes.
CO5	Explain[3] the periodic properties of the different groups of compounds focusing on production methods and application of selected elements and compounds.

Syllabus (Theory)

Units	Description	Hours
I	**Chemistry of transition elements** General characteristic properties of transition elements, co-ordination chemistry of transition metal ions, stereochemistry of coordination compounds, ligand field theory, Effect of ligand field on energy levels of transition metal ions, Russell- Saunders terms, strong and weak field effect, splitting of d orbitals in low symmetry environments, Jahn- Teller effect, Interpretation of electronic spectra including charge transfer spectra, spectro-chemical series, nephelauxetic series, metal clusters, sandwich compounds, metal carbonyls	15
II	**Bioinorganic Chemistry** Role of metal ions in biological processes, structure and properties of metalloproteins in electron transport processes, cytochromes, ion transport across membranes, Biological nitrogen fixation, and Nitrogenase. Metalloenzymes with Radical Intermediates, PSI, PS – II, Oxygen uptake proteins. Biochemistry of Na, K and Ca w.r.t. Na/K pumps. Biochemistry of following elements: (a) Iron: Ferritin, Transferrin, Fe-S clusters, Porphyrin based systems (b) Manganese: Photosynthesis (c) Copper: Type-I, Type-II proteins, and Zinc containing enzyme.	15

III **Studies and applications of Lanthanides and Actinides** 15

Spectral and magnetic properties, use of lanthanide compounds as shift reagents, Modern methods of separation of lanthanides and actinides, Organometallic chemistry applications of lanthanide and actinide compounds in Industries.

Nuclear and radiochemistry

Radioactive decay and equilibrium, nuclear reactions, Q value, cross-sections, types of reactions, chemical effects of nuclear transformation, fission and fusion, fission products and fission yield.

IV **Organometallic Chemistry of transition elements** 15

Ligand hapticity, electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogeneous catalytic reactions (Hydrogenation, hydroformylation, isomerisation and polymerisation), pi metal complexes, activation of small molecules by coordination.

Recommended Books:

1) A. F. Wells, Structural Inorganic Chemistry – 5th edition (1984).
2) J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harpervand Row Publisher, Inc. New York(1972).
3)J. D. Lee, Concise Inorganic Chemistry, Elbs with Chapman and Hall, London.
4) Jones, Elementary coordination Chemistry.
5) B.Vishwanathan and R. Gopalan, Coordination Chemistry.
6) Martell, Coordination Chemistry-
7) T. S. Swain and D. S. T. Black, Organometallic Chemistry.
8) F. A. Cotton, R. G. Wilkinson, Advanced Inorganic chemistry.
9) Willam L. Jooly, Modern Inorganic Chemistry.
10) P. L. Pauson, Organometallic Chemistry.
11) H. J. Arnikar, Essentials of Nuclear Chemistry.
12) Friedlander, Kennedy and Miller, Nuclear and Radiochemistry.
13) U. Schubest and N. Husing, Synthesis of Inorganic Materials, Wiley VCH (2000).
14) M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP.
15) O. A. Phiops, Metals and Metabolism.
16) Cullen Dolphin and James, Biological aspects of Inorganic Chemistry.
17) Williams, An Introduction to Bioinorganic Chemistry-.
18) M. N. Hughes, Inorganic Chemistry of Biological Processes.
19) Ochi, Bioinorganic Chemistry.
20) John Wulff, The structure and properties of materials.
21) F. A. Cotton, R. G. Wilkinson, Advanced Inorganic chemistry.
22) Willam L. Jooly, Modern Inorganic Chemistry.
23) N. N. Greenwood and A. Earnshaw, Chemistry of elements, Pergamon.
24) S. J. Lippard, J.M. Berg, Principles of bioinorganic Chemistry, University Science.
25) G. L. Eichhron, Inorganic Biochemistry, Vol I and II, Elesevier.
26) Puri, Sharma and Kalia, Principles of Inorganic Chemistry.
28) R. Gopalan, Inornaic Chemistry for undergraduates.

CHS 506: Physical 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: It is a course in physical chemistry and may be pre-requisite for advanced organic chemistry. It covers quantum chemistry, electrochemistry, surface chemistry and molecular spectroscopy.

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

CO1	Calculate[4]Eigen functions and operators.
CO2	Explain[2] the inter ionic interactions in electrolytic solutions.
CO3	Discribe[1] surface phenomenon.
CO4	Determine[3] physical significance of molecular spectroscopy.

Syllabus (Theory)

Units	Description	Hours
I	**Electrochemistry** Debye - Huckel theory of inter-ionic attraction, ionic atmosphere, time of relaxation, relaxation and electro-phoretic effects, Debye-Huckel-Onsagar equation and its validity for dilute solutions and at appreciably concentrated solutions. Abnormal ionic conductance of hydroxyl and hydrogen ions. Activity coefficients: forms of activity coefficients and their interrelationship. Debye-Huckel limiting law for osmotic and activity coefficients of dilute electrolytic solutions and its applications to concentrated solutions. Quantitative and qualitative verification of Debye-Huckel limiting law.	15
II	**Quantum Chemistry** Introduction: Operators and related theorems, algebra of operators, commutator, linear operators, uncertainty principle, postulate of quantum mechanics, properties of wave functions, Schrodinger equation, wave function and its interpretation. Normalization and orthogonality, Eigen functions and Eigen values. Solutions of wave equation for a free particle and particle in a box problem. Linear and angular momentum, Eigen function and Eigen values of angular momentum operator, Ladder operator.	8
III	**Surface Phenomena** Adsorption, adsorption isotherms, surface area determination, Gibbs adsorption equation and its verification, Surface tension, micelles, reverse micelles. Thermodynamics of micellisation, factors affecting critical micelle concentration (cmc), experimental methods of cmc determination.	7

IV Molecular Spectroscopy 30

i) Recapitulation- Electromagnetic region, units and dimensions, Width of spectral lines, collision, Doppler and natural broadening, intensity of spectral lines.

ii) Rotation spectra- Classification of molecules based on moment of inertia, rigid rotor, most intense line, isotopic effect on the rotational spectra, non-rigid rotator, diatomic molecules, linear triatomic molecules, symmetric top molecules, stark effect.

iii) Infra-red spectroscopy- Diatomic molecule, selection rule, anharmonicity, Morse potential, justifying the form of Morse potential, combinations of overtones, and hot bands in polyatomic molecules.

iv) Vibrational rotational Spectra, fine structure in diatomic molecules, breakdown of the Born-Oppenheimer approximation, effect due to nuclear spin, parallel and perpendicular vibrations.

v) Raman Spectroscopy- Classification and Quantum theory, polarizability ellipsoid, Rotational and Vibrational Raman Spectra, structure elucidation from combined Raman and IR data

Reference books:

1. A. K. Chandra, Introductory Quantum Chemistry. Tata McGraw-Hill. 1988.
2. Donald A. McQuarrie and John D. Simon, Physical Chemistry: A molecular Approach –Viva Books, New Delhi, 1998.
3. Donald A. McQuarrie, Quantum Chemistry –Viva Books, New Delhi, 2003.
4. P. W. Atkins, Physical Chemistry –Oxford University press, VIth edition, 1998.
5. W. Kauzmann, Quantum Chemistry - Academic press.
6. S. Glasstone, D. Van Nostrand Company, Theoretical Chemistry: An introduction to quantum mechanics, statistical mechanics, and molecular spectra for chemists - Inc., 1944.
7. R.K. Prasad, Quantum Chemistry - New Age International, New Delhi.
8. R.S. Berry, S.A. Rice, J. Ross, Physical Chemistry, 2nd Ed., Oxford University Press, New York, 2000.
9. S. Glasstone, An Introduction to Electrochemistry.
10. J. O. M. Bockris and A. K. N. Reddy, Modern Electrochemistry Vol. I & I.
11. R. A. Robinson and R. H. Strokes, Electrolytic Solutions 1959.
12. S. Glasstone, D. Van Nostrand, Electrochemistry, 1965.
13. Gurdeep Raj, Advanced Physical Chemistry- Goel Publishing House.
14. G. M. Barrow,Physical Chemistry Tata-McGraw Hill, Vth edition, 2003.
15. A. W. Adamson, Physical chemistry of surfaces, 4th Ed. John Wiley, 1982.
16. D. Shaw, Butterworth Heinemann, Introduction to Colloid and Surface Chemistry –1992.
17. C.N. Banewell and E.Mc. Cash, Fundamentals of molecular spectroscopy, 4th edition (1994)

CHS 508: Analytical 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: It is a course in analytical chemistry and may be pre-requisite for advanced organic chemistry. This course involves electroanalytical techniques, colorimetric and thermal analysis, analytical techniques for nanonmaterials and advanced instrumental methods of analysis.

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

CO1	Explain[3] polarographic and amperometry techniques.
CO2	Describe[2] colorimetric and thermogravimetric analysis.
CO3	Discuss[2] characterization techniques and applications of nanomaterials.
CO4	Explain[2] AAS and ICP spectroscopic techniques.

Syllabus (Theory)

Units	Description	Hours
I	**Electroanalytical Techniques:** Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications. Amperometry: Basic principles, instrumentation, nature of titration curves, and analytical applications. Theory of Electro gravimetric analysis, electrode reactions, overpotential, completeness of deposition, electrolytic separation of metals with controlled cathode potential.	15
II	**Colorimetry** Standard series method, duplication method, photo-electric calorimeter, spectrophotometer, single beam, double beam, determination of pKa value of an indicator, simultaneous spectrophotometric determination. **Thermal Analysis:** Thermal Techniques-Introduction, types of thermo analytical methods. Thermogravimetry principle and applications of thermogravimetry, differential thermal analysis- principle and applications of DTA. Differential scanning calorimetry. DSC: Principle, and application of DSC.	15
III	**Advanced Nano Materials:** Introduction to Nanomaterials, Nanoscale building blocks and its applications, Zero dimensional, one dimensional, two dimensional and three dimensional nanomaterials, Applications of Nanomaterials in various fields.	**15**

Characterization techniques of Nanomaterials-

Optical study, Determination of band gap, Instrumentation of

X-ray diffraction, Bragg's law, Scanning Electron microscope, Instrumentation, Applications of SEM, Transmission electron microscope, instrumentation and applications, Comparative account of SEM & TEM

IV **Atomic Absorption Spectroscopy:** **15**

Introduction, Principle, difference between AAS and FES, Advantages of AAS over FES, advantages and disadvantages of AAS. Instrumentation, Single and double beam AAS, detection limit and sensitivity, Interferences and applications.

Inductively coupled Plasma Spectroscopy:

Introduction, Nebulisation Torch, Plasmas, Types of ICP-MS, Instrumentation, Interferences and Applications of ICP-MS.

References

1 G. D. Christain, Analytical Chemistry
2. Bobbit, Introduction to chromatography.
3. H.H. Willard, L.L. Mirrit, J.A. Dean. Instrumental Methods of analysis (CBS).
4. Chatwal and Anand,Instrumental Methods of Analysis.
5. A.I. Vogel, Instrumental Methods of Inorganic Analysis (ELBS).
6. H. A. Strobel, Chemical Instrumentation: A Systematic approch.
7. W. E. Morf, The principals of ion-selective electrodes and membrane transport.
8. P.W.Atkins, Physical Chemistry.
9. D. Skoog and D.West, Principal of Instrumental Analysis.
10. I.M. Kolthoff, Treatise on Analytical Chemistry: Vol Ito VII.
11. R.M. Silverstein and G.C. Bassler, Spectroscopic identification of organic compound.
12. D.H. Williams and I. Fleming. Spectroscopic methods in organic chemistry-
13. R. Drago, Physical Methods in Inorganic Chemistry (DWAP).

REM 502: Research Methodology-II

(Version 1.0, University Core, School of Science)

Lect.	Tut.	Pract.	Total Credits	Evaluation Scheme for (Th and Pr)			
				Component	Exam	WT	Pass
2	2	-	2	Theory	FET	20	Min 40
					CAT	30	
					ESE	50	

Course Description: This course is at even semester of first year of MSc. It is a course in research methodology. This course covers skills related to research process and preparation of report, data analysis and use of computer for preparing report.

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

CO1	Understand and implement [2] research processes.
CO2	Define[1] ethics in research
CO3	Describe[2] techniques of Processing and analysis of data.
CO4	Apply[3] tools in data analysis and interpretation.

Syllabus (Theory)

Units	Description	Hours
I	**Research Process**: Formulating the research problem,Extensive literature survey,Development of working hypotheses,Preparing the research design,Determining sample design-(Deliberate sampling, Simple random sampling, Systematic sampling, Stratified sampling, Quota sampling, Cluster sampling and area sampling, Multi-stage sampling, Sequential sampling) Collecting the data,Execution of the project,Analysis of data,Hypothesis-testing, Generalizations and interpretation. **Preparation of the report or the thesis** (i) Preliminary pages; (ii) the main text, and (iii) the end matter. In its preliminary pages-the title and date, acknowledgements, foreword, table of contents, list of tables and list of graphs and charts Main text: (a) Introduction: statement of the objective of the research, explanation of the methodology adopted scope of the study along with various limitations. (b) Summary of findings: statement of findings and recommendations (c) Main report (d) Conclusion: results of research Appendices, Bibliography,	10

II	1. Methods of Data Collection: Primary data, Secondary data 2. Using LaTex for Report or Thesis writing: Titles and title pages, document structure, sections-subsections, Math mode, footnotes, creating a list, table, including figures, references and bibliography, index, preparing presentations and slides using Beamer in LaTex 3. Ethics in Research	10
III	**Processing and Analysis of Data** Elements/Types of Analysis Statistics in Research: 1. Measures of Central Tendency: Mean, Median, Mode, (Geometric mean, Harmonic mean) 2. Measures ofDispersion, Range, Mean deviation, Standard deviation, 3. Measures of Asymmetry 4. Measures of Relationship: Bivariate population: (a) cross tabulation; (b) Charles Spearman's coefficient of correlation; (c) Karl Pearson's coefficient of correlation	10

References

1. D. Chawla, N. Sondhi, Research Methodology: Concepts and Cases, Vikas Publishing house, 2nd Edition, 2016.

2. R. C. Kothari, Garg Gaurav, Research Methodology: Methods and Techniques, New Age International Publishers, Daryaganj, New Delhi, Reprint 2016.

CHS 510: 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	TW	50	Min 40
					POE	50	

Course Description: This course is at even semester of first year of MSc. It is a foundation course in organic chemistry laboratory and it covers learning of basic laboratory skills involved in synthesis of organic compounds.

List of Experiments

No	Description
1	Purification/Separation of organic liquids by distillation (simple, fractional, Vacuum).
2.	Separation of organic mixture by column chromatography.
3.	Demonstration of Rotary evaporator and Melting point apparatus.
4.	**Preparations: Single Stage / Double stage.** **Single Stage (any 3)** i) Cyclohexanone to adipic acid. ii) Benzaldehyde to dibenzylidene acetone and determination of % purity. iii) Benzaldehyde to cinnamic acid iv) P – aminobenzoic acid to p-chlorobenzoic acid v) 4 – Chlorobenzalehyde to 4 – Chlorobenzoic acid + -chlorobenzyl alcohol (Canninzzaro reaction) vi) Benzene to β – benzoyl propionic acid (Friedel Craft reaction) vii) N, N, Dimethyaniline to 4 – Formyl – N, N – Dimethylaniline. viii) Benzophenone to Benzpinacol. ix)Hydroboration oxidation experiment (Refer ref no 5)
5.	**Double Stage: (any 2)** 3) Phthallic anhydride – Phthallimide – Anthranillic acid. ii) Acetophenone – Oxime – Acetanillide. iii) Phthalic anhydride – o – benzoyl benzoic acid anthraquinone. iv) Chlorobenzene – 2, 4 – dinitrochlorobenzene – 2,4-dinitrophenol and its estimation. v) Benzoin – Benzil – Benzilic Acid vi) Acetanilide – p – Bromoacetanilide – p – Bromoanilineand its estimation.
6.	**Open ended experiment** **(any 1)**

Books recommended for Practical's:

1. A. I. Vogel,A text book of practical organic chemistry.
2. Mann and Saunders,Practical organic chemistry.
3. H. T. Clarke,A handbook of quantitative and qualitative analysis.
4. Blat,Organic Synthesis Collective Volumes.
5. G. W. Kabalka, P. P. Wadgaonkar, N. Chatla, An Operationally Simple Hydroboration-Oxidation Experiment, *J. Chem. Edu.* 1990, 67(11), 975;

CHS 512: Inorganic Chemistry Lab II

(Version 1.0, Program Core, School of Sciences)

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

Course Description: This course is at even semester of first year of MSc. It is a foundation course in inorganic chemistry laboratory and it covers learning of basic laboratory skills involved in preparations complex compounds and in analysis of ores and alloys.

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

CO1:	Explain[2] basic concepts of the synthesis, characterization of metal complexes
CO2:	Discuss[3] qualitative and quantitative chemical analysis of metals
CO3:	Identification of special elements present in the ore or alloy and the chemistry behind it.

List of Experiments

No	Description
1.	Preparation of potassium trioxalatoferrate (III) trihydrate.
2.	Preparation and percentage purity determination of Potassium hexathiocyanato chromate (III)
3.	Preparation of nickel –DMG complex
4.	Synthesis of Reineckes salt
4.	Fertilizer Analysis:To determine the amount of sodium from given fertilizer sample using cation exchange resin
5.	Alloy analysis: to analyze the given sample of brass alloy/high Nickel alloy/ cupronickel alloy
6.	Ore analysis:To estimate the amount of silica, iron, calcium, magnesium from given sample of Dolomite ore
8.	Synthesis of chloropentamino cobalt (III) chloride
9.	Synthesis of nitropentamino cobalt (III) chloride
10.	Synthesis of nitritopentamino cobalt (III) chloride
11.	Synthesis of copper and Zinc Ferrite Nanoparticles (Analysis by EDX, XRD & UV)

Books recommended for Practical:

1. W.G. Palmer, Experimental Inorganic Chemistry.
2. A.I. Vogel, Text Book of Quantitative inorganic analysis.
3. D.A. Skoog and D.M.West, Fundamentals of Analytical Chemistry.
4. H. T. Clarke, A handbook of quantitative and qualitative analysis.

CHS 514: Physical and Analytical Chemistry Lab II

(Version 1.0, Program Core, School of Sciences)

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

Course Description: This course is at even semester of first year of MSc. It is a foundation course in physical and analytical chemistry laboratory. It covers learning of basic laboratory skills involved in handling instruments for chemical analysis.

List of Experiments

No	Description
	Physical chemistry
1.	**Chemical Kinetics:** To investigate the reaction between bromic acid and hydroiodic acid.
2.	**Phase Equilibrium:** Three component system etc.
3.	**Polarimetry:** Kinetics of inversion of cane sugar in presence of strong acid.
4.	**Conductometry:** Titration of ternary acid mixture of acids, Verification of Onsagar Equation for 1:1 type strong electrolyte.
5.	**Conductometry:** To determine the critical micelle concentration of sodium lauryl sulphate in water.
6.	**Potentiometry:** Determination formal redox potential of system, determination of binary mixture of halides.
7.	**pH-Metry** Determination of the acid and base dissociation constant of an amino acid and hence the isoelectric point of the acid.
8.	**Spectrophotometry:** To find the composition of ferric ions-thiocyanate complex by Job's method.
	Analytical Chemistry
1.	**Determination of acid value** To determine the amount of calcium from given drug sample
2.	**Potentiometry:** Titration of ferrous ammonium sulphate with potassium dichromate.
3.	**pH Metry:** Determination of pH of buffer solutions with a pH meter and evaluation of pKa of acids.
4.	**Colorimetry:**

1. To determine the concentration of NH_3 in a given unknown solution by colorimetrically.
2. Estimate ammonia released from MgN_3.
3. Colorimetric determination of Iron in vitamin supplement tablets[8]

5. Spectrophotometer

To determine the composition of a binary mixture containing $K_2Cr_2O_7$ and $KMnO_4$spectrophotometrically

Books recommended for Practical:

1 J.A. Kitchner, Findlay's Practical Chemistry.
2 A.I. Vogel,Text Book of Quantitative inorganic analyses.
3 R.C.Das and B. Behera,Experimental Physical Chemistry.
4 B.Viswanathan and P.S. RaghavanPractical Physical Chemistry.
5 V.D. Athawale and ParulMathur,Experimental Physical Chemistry.
6 S.W. Rajbhoj and T.K. Chondhekar,Systematic Experimental Physical Chemistry.
7. Gurtu and Gurtu,Advanced Physical Chemistry Experiments.
8. Colorimetric determination of iron in vitamin supplement tablets A General Chemistry Experiment: J Chem Edu 1975, 52, 550.

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