B.S.ABDUR RAHMAN
U N I V E R S I T Y
B.S.ABDUR RAHMAN INSTITUTE OF SCIENCE & TECHNOLOGY
(Estd.u/s 3 of the UGC Act, 1956)
(FORMERLY B.S.ABDUR RAHMAN CRESCENT ENGINEERING COLLEGE)
Seethakathi Estate, G.S.T. Road, Vandalur, Chennai - 600 048.

REGULATIONS (2009), CURRICULUM AND SYLLABUS
FOR
M.Sc. CHEMISTRY

(Updated upto June 2011)

REGULATIONS -2009 FOR M.TECH / MCA / M. Sc DEGREE PROGRAMMES

(with modifications incorporated in 2011)

1.0 PRELIMINARY DEFINTIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires

i) **"Programme"** means Post Graduate Degree Programme (M. Tech., / MCA / M.Sc.)

ii) **"Course"** means a theory or practical subject that is normally studied in a semester, like Applied Mathematics, Structural Dynamics, Computer Aided Design, etc.

iii) **"University"** means B.S.Abdur Rahman University, Chennai, 600048.

iv) **"Institution"** unless otherwise specifically mentioned as an autonomous or off campus institution means B.S.Abdur Rahman University.

v) **"Academic Council"** means the Academic Council of the University.

vi) **"Dean (Academic Courses)"** means Dean (Academic Courses) of B.S.Abdur Rahman University.

vii) **"Dean (Students)"** means Dean(Students) of B.S.Abdur Rahman University

viii) **"Controller of Examinations"** means the Controller of Examinations of B.S.Abdur Rahman University who is responsible for conduct of examinations and declaration of results.

2.0 PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS

2.1 P.G. Programmes Offered

The various P.G. Programmes and its mode of study are as follows:

Degree	Mode of study
M. Tech.	Full Time
M. Tech.	Part Time – Day / Evening
M.C.A.	Full Time
M. Sc.	Full Time

Sl. No.	Name of the Department	P.G. Programmes offered	Qualifications for admission
01.	Civil Engineering	M.Tech. (Structural Engineering)	B.E / B.Tech. (Civil Engineering) / (Structural Engineering)
		M.Tech. (Construction Engineering and Project Management)	B.E. / B.Tech. (Civil Engineering) / (Structural Engineering)
02.	Mechanical Engineering	M.Tech. (CAD - CAM)	B.E. / B.Tech. (Mechanical / Auto / Manufacturing / Production / Industrial Engineering)
		M.Tech. (Manufacturing Engineering)	B.E. / B. Tech. (Mechanical / Auto / Manufacturing / Production / Industrial Engineering)
03.	Polymer Technology	M.Tech. (Polymer Science and Engineering)	B. E. / B. Tech. degree Mech./ Production / Polymer Science or Engg or Tech/Rubber Tech/ M.Sc(Polymer Sc./Chemistry Appl. Chemistry)
04.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engg)	B.E / B.Tech. in (EEE/ICE/EIE)
		M.Tech. (Power Electronics & Drives)	B.E / B.Tech. in (EEE/ICE/EIE)
05.	Electronics and Communication Engineering	M.Tech. (Communication Systems)	B.E./ B.Tech. in ECE / Electronics / EIE
		M.Tech. (VLSI and Embedded Systems)	B.E./ B.Tech. in ECE / Electronics / EIE
06.	ECE Department jointly with Physics Department	M.Tech. (Optoelectronics and Laser Technology)	B.E./B.Tech. (ECE/EEE/Electronics/ EIE/ICE) M.Sc (Physics/Materials Science/ Electronics/ Photonics)
07.	Electronics and Instrumentation Engineering	M.Tech. (Electronics and Instrumentation Engineering)	B.E./B.Tech. (EIE/ICE/Electronics/ ECE/EEE)
08.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. /B.Tech. (CSE/IT/ECE/EEE/EIE/ ICE/Electronics / MCA)
		M.Tech. (Software Engineering)	B.E. / B.Tech. (CSE / IT) MCA
09	Information Technology	M.Tech. (Information Technology)	B.E /B.Tech. (IT/CSE/ECE/EEE/EIE/ ICE/Electronics) MCA
10	Computer Applications	M.C.A.	Any degree. Must have studied Mathematics / Statistics /Computer oriented subject.
		M.Tech. (Systems Engineering and Operations Research)	Any degree. Must have studied Mathematics / Statistics /Computer oriented subject.
11	Mathematics	M.Sc. (Actuarial Science)	B.Sc. (Mathematics) of B.Sc. (Applied Science)
12	Chemistry	M.Sc.(Applied Chemistry)	B.Sc (Chemistry) of B.Sc. (Applied Science)

2.2 MODES OF STUDY

2.2.1 Full-time

Candidates admitted under "Full-Time" shall be available in the institution during the complete working hours for curricular, co-curricular and extra-curricular activities assigned to them.

2.2.2 A full time student, who has completed all non-project courses desiring to do the Project work in part-time mode for valid reasons, shall apply to the Head of the Institution through the Head of the Department, if the student satisfies the clause 2.3.5 of this Regulations. Permission may be granted based on merits of the case. Such conversion is not permitted in the middle of a semester.

2.2.3 Part time - Day time

In this mode of study, the candidates are required to attend classes for the courses registered along with full time students.

2.2.4 Part time - Evening

In this mode of study, the candidates are required to attend only evening classes.

2.2.5 A part time student is not permitted to convert to the full time mode of study.

2.3. ADMISSION REQUIREMENTS

2.3.1 Candidates for admission to the first semester of the Master's Degree Programme shall be required to have passed an appropriate degree examination of this University as specified in Table 1 or any other examination of any University or authority accepted by the University as equivalent thereto.

2.3.2 Notwithstanding the qualifying examination the candidate might have passed, he/she shall have a minimum level of proficiency in the appropriate programme/courses as prescribed by the institution from time to time.

2.3.3 Eligibility conditions for admission such as class obtained, number of attempts in qualifying examination and physical fitness will be as prescribed by the Institution from time to time.

2.3.4 All part-time candidates should satisfy other conditions regarding experience, sponsorship etc., which may be prescribed by the institution from time to time.

2.3.5 A candidate eligible for admission to M.Tech. Part Time - Day Time programmeshall have his/her permanent place of work within a distance of 65km from the campus of the institution.

2.3.6 A candidate eligible for admission to M.B.A. Part Time - Evening programme shall have a working experience of 2 years at least at supervisory level. He/ she shall have his/her place of work within a distance of 65 km from the campus of the institution.

3.0 DURATION AND STRUCTURE OF THE P.G. PROGRAMME

3.1. The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech. (Full Time)	4	8
M.Tech.(Part Time)	6	12
M.C.A. (Full Time)	6	12
M.Sc. (Full Time)	4	8

3.2 The P.G. programmes will consist of the following components as prescribed in the respective curriculum

i. Core courses

ii. Elective courses

iii. Project work / thesis / dissertation

iv. Laboratory Courses

v. Case studies

vi. Seminars

vii. Practical training

3.3 The curriculum and syllabi of all the P.G. programmes shall be approved by the Academic Council.

3.4 The number of credits to be earned for the successful completion of the programme shall be specified in the curriculum of the respective specialization of the P.G. programme.

3.5 Each academic semester shall normally comprise of 75 to 80 working days spread over sixteen weeks. End-semester examinations will follow immediately after these working days.

3.6 The curriculum of P.G. programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall lie within the limits specified below:

Programme	Minimum prescribed credit range
M.Tech.	70 to 80
M.C.A.	100
M.Sc	74 to 80

3.7 Credits will be assigned to the courses for all P.G. programmes as given below:

* One credit for one lecture period per week
* One credit for one tutorial period per week
* One credit each for seminar/practical session of two or three periods per week
* One credit for four weeks of practical training

3.8 The number of credits registered by a candidate in non-project semester and project semester should be within the range specified below:

P.G. Programme	Non-project Semester	Project semester
M.Tech. (Full Time)	15 to 23	12 to 20
M.Tech. (Part Time)	6 to 12	12 to 16
M.C.A. (Full Time)	12 to 25	12 to 20
M.Sc. (Full Time)	15 to 25	12 to 20

3.9 The electives from the curriculum are to be chosen with the approval of the Head of the Department.

3.10 A candidate may be permitted by the Head of the Department to choose electives offered from other P.G. Programmes either within a Department or from other Departments up to a maximum of three courses during the period of his/her study, provided the Heads of the Departments offering such courses also agree.

3.11 To help the students to take up special research areas in their project work and to enable the department to introduce courses in latest/emerging areas

in the curriculum, "Special Electives" may be offered. A candidate may be permitted to register for a "Special Elective" up to a maximum of three credits during the period of his/her study, provided the syllabus of this course is recommended by the Head of the Department and approved by the Dean (AC) before the commencement of the semester, in which the special elective course is offered. Subsequently, such course shall be ratified by the Board of Studies and Academic Council.

3.12 The medium of instruction, examination, seminar and project/thesis/ dissertation reports will be English.

3.13 Practical training or industrial attachment, if specified in the curriculum shall be of not less than four weeks duration and shall be organized by the Head of the Department.

3.14 PROJECT WORK/THESIS/DISSERTATION

3.14.1 Project work / Thesis / Dissertation shall be carried out under the supervision of a qualified teacher in the concerned Department.

3.14.2 A candidate may however, in certain cases, be permitted to work on the project in an Industrial/Research Organization, on the recommendation of Head of the Department, with the approval of the Head of the Institution. In such cases, the project work shall be jointly supervised by a supervisor of the Department and an Engineer / Scientist from the organization and the student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress.

3.14.3 Project work / Thesis / Dissertation (Phase - II in the case of M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester, following the preliminary work carried out in Phase-1 during the previous semester.

3.14.4 The Project Report/Thesis / Dissertation report / Drawings prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the Head of the Institution.

3.14.5 The deadline for submission of final Project Report / Thesis / Dissertation is 30 calendar days from the last working day of the semester in which Project / Thesis / Dissertation is done.

3.14.6 If a candidate fails to submit the Project Report / Thesis / Dissertation on or before the specified deadline he / she is deemed to have not completed the Project Work / Thesis / dissertation and shall re-register the same in a subsequent semester.

3.14.7 A student who has acquired the minimum number of total credits prescribed in the Curriculum for the award of the Masters Degree will not be permitted to enroll for more courses to improve his/her cumulative grade point average (CGPA).

4.0 FACULTY ADVISER

To help the students in planning their courses of study and for getting general advice on academic programme, the concerned department will assign a certain number of students to a faculty member who will be called the Faculty Adviser.

5.0 CLASS COMMITTEE

5.1 Every class of the P.G. Programme will have a Class Committee, constituted by the Head of the Department as follows:

i. Teachers of all courses of the programme

ii. One senior faculty preferably not offering courses for the class, as chairperson.

iii. One or two students of the class, nominated by the Head of the Department.

iv. Faculty Advisers of the class - Ex-Officio Members

v. Professor in-charge of the P.G. Programme - Ex-Officio Member.

5.2 The Class Committee shall be constituted on the first working day of a semester or earlier.

5.3 The basic responsibilities of the Class Committee are to review periodically the progress of the classes, to discuss problems concerning curriculum and syllabi and the conduct of the classes. The type of assessment for the course will be decided by the teacher in consultation with the Class Committee and will be announced to the students at the beginning of the semester. Each Class Committee will communicate its recommendations to the Head of the Department and the Head of the Institution. The class committee, **without the student members,** will also be responsible for finalization of the semester results.

5.4 The Class Committee is required to meet at least thrice in a semester, once at the beginning of the semester, another time after the end-semester examination to finalise the grades, and once in between.

6.0 COURSE COMMITTEE

Each common theory course offered to more than one group of students shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as Course coordinator. The nomination of the Course coordinator shall be made by the Head of the Department / Head of the Institution depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

7.0 REGISTRATION AND ENROLMENT

7.1 For the first semester every student has to register and enroll for the courses he/she intends to undergo on a specified day notified to the student. The concerned Faculty Adviser will be present and guide the students in the registration/enrolment process.

7.2 For the subsequent semesters registration for the courses will be done by the student during a specified week before the end-semester examination of the previous semester. The curriculum gives details of the core and elective courses, project and seminar to be taken in different semester with the number of credits. The student should consult his/her Faculty Adviser for the choice of courses. The Registration form is filled in and signed by the student and the Faculty Adviser.

7.3 Late registration will be permitted with a prescribed fine up to two weeks from the last date specified for registration.

7.4 From the second semester onwards all students shall pay the prescribed fees and enroll on a specified day at the beginning of a semester.

A student will become eligible for enrolment only if he/she satisfies clause 9 and in addition he/she is not debarred from enrolment by a disciplinary action of the Institution. At the time of enrolment a student can drop a course registered earlier and also substitute it by another course for valid reasons with the consent of the Faculty Adviser. Late enrolment will be permitted on payment of a prescribed fine up to two weeks from the date of commencement of the semester.

7.5 Withdrawal from a course registered is permitted up to one week from the date of the completion of the first assessment test.

7.6 Change of a course within a period of 15 days from the commencement of the course, with the approval of Dean (AC), on the recommendation of the HOD, is permitted.

7.6.1 Courses withdrawn will have to be taken when they are offered next if they belong to the list of core courses.

7.7 SUMMER TERM COURSES

7.7.1 Summer term courses may be offered by a department on the recommendation by the Departmental Consultative Committee and approved by the Head of the Institution. A summer term course may not be offered if the number of candidates enrolled is less than five. No student should register for more than three courses during a summer term.

7.7.2 Summer term courses will be announced by the Head of the Institution at the end of the even semester before the commencement of the end semester examinations. A student will have to register within the time stipulated in the announcement. A student has to pay the fees as stipulated in the announcement.

7.7.3 Fast-track summer courses of 30 periods for 3 credit courses and 40 periods for 4 credit courses will be offered for students with I grades. They may also opt to redo such courses during regular semesters with slotted time-tables. Students with U grades will have the option either to write semester end arrears exam or to redo the courses during summer / regular semesters with slotted time-table, if they wish to improve their continuous assessment marks also.

The assessment procedure in a summer term course will also be similar to the procedure for a regular semester course.

7.7.4 Withdrawal from a summer term course is not permitted. No substitute examination will be held for the summer term courses.

8.0 TEMPORARY WITHDRAWAL FROM THE PROGRAMME

A student may be permitted by the Head of the Institution to temporarily withdraw from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. However the total duration for completion of the programme shall not exceed the prescribed number of semesters (vide clause 3.1).

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT / THESIS / DISSERTATION

9.1 A candidate is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum No. of credits to be earned to enrol for project semester
M.Tech. (Full time)	18 (III semester)
M.Tech. (Part-time)	18 (V semester)
M.C.A. (Full time)	45 (VI semester)
M.Sc. (Full-time)	28 (IV semester)

9.2 **M.Tech.:** If the candidate has not earned minimum number of credits specified, he/she has to earn the required credits (at least to the extent of minimum credit specified in clause 9.1) and then register for the third / fourth semester.

9.3 **M.C.A.:** If the candidate has not earned the required minimum number of credits specified he/she has to earn the required credits (at least to the extent of minimum credits specified in clause 9.1) and then register for the project work in subsequent semesters.

10.0 DISCIPLINE

10.1 10.1Every candidate is required to observe discipline and decorous behaviour both inside and outside the campus and not to indulge in any activity, which will tend to bring down the prestige of the institution.

10.2 Any act of indiscipline of a candidate reported to the Head of the Institution will be referred to a Discipline and Welfare Committee for taking appropriate action.

10.3 Every candidate should have been certified by the HOD that his / her conduct and discipline have been satisfactory.

11.0 ATTENDANCE

11.1 Attendance rules for all Full Time Programme and Part time - day Time Programmes are given in the following sub-clauses.

11.2 A student is **normally expected to earn 100% attendance** in the contact periods of every course, subject to a **a maximum relaxation of 25%** for genuine reasons like on medical grounds , representing the University in approved events etc., to become eligible to appear for the end-semester

examination in that course, failing which the student shall be awarded "I" grade in that course. If the course is a core course, the candidate should register for and repeat the course when it is offered next.

The following procedure will be adopted for condonation of shortage of attendance on medical grounds.

Those who have 75 % or more attendance for the period other than their medical leave be considered for condonation of shortage of attendance provided the overall attendance in the course including the period of illness does not fall below 50%

. Application for condonation recommended by the Faculty Adviser, course teacher and the HOD is to be submitted to the Dean (AC) on or before the last instructional day of the semester. The Dean (AC), depending on the merit of the case may permit the student to appear for the semester end exam.

A student will be eligible for this concession at most two semesters during the entire degree programme.

Application for medical leave, supported by medical certificate with endorsement by University Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

12.0 ASSESSMENTS AND EXAMINATIONS

12.1 The following rule shall apply to all full-time and part-time P.G. programmes (M.Tech./ M.C.A. / M.Sc.)

For lecture-based courses, normally a minimum of **two assessments** will be made during the semester. The assessments may be combination of tests and assignments. The assessment procedure as decided at the Class Committee will be announced to the students right at the beginning of the semester by the teacher and informed to Dean(AC)

12.2 There shall be one **examination** of three hours duration, at the end of the semester, in each lecture based course.

12.3 The evaluation of the Project work will be based on the project report and a Viva-Voce Examination by a team consisting of the supervisor concerned, an Internal Examiner and External Examiner to be appointed by the Controller of Examinations.

12.4 At the end of practical training or industrial attachment, the candidate shall submit a certificate from the organization where he/she has undergone training and also a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a Departmental Committee constituted by the Head of the Department.

13.0 WEIGHTAGES

13.1 The following shall be the weightages for different courses:

i)	**Lecture based course**		
	Two sessional assessments	-	50%
	End-semester examination	-	50%
ii)	**Laboratory based courses**		
	Laboratory work assessment	-	75%
	End-semester examination	-	25%
iii)	**Project work**		
	Periodic reviews	-	50%
	Evaluation of Project Report by External Examiner	-	20%
	Viva-Voce Examination	-	30%

13.2 The markings for all tests, tutorial assignments (if any), laboratory work and examinations will be on absolute basis. The final percentage of marks is calculated in each course as per weightages given in clause 14.1.

14.0 SUBSTITUTE EXAMINATION

14.1 A student who has missed for genuine reasons any one of the three assessments including end-semester examination of a course may be permitted to write a substitute examination. However, permissions to take up a substitute examination will be given under exceptional circumstances, such as accident or admissions to a hospital due to illness.

14.2 A student who misses any assessment in a course shall apply in a prescribed form to the Dean(AC) through the Head of the department within a week from the date of missed assessment. However the substitute tests and examination for a course will be conducted within two weeks after the last day of the end-semester examinations.

15.0 COURSEWISE GRADING OF STUDENTS AND LETTER GRADES:

15.1 Based on the semester performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and the corresponding grade points are as follows, but grading has to be relative grading

Letter grade	Grade points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
I	-
W	-

Flexible range grading system will be adopted

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevention from End Semester examination.

"U" denotes unsuccessful performance in a course.

15.2 A student is considered to have completed a course successfully and earned the credits if he / she secure five grade points or higher. A letter grade U in any course implies unsuccessful performance in that course. A course successfully completed cannot be repeated for any reason.

16.0 METHOD OF AWARDING LETTER GRADE:

16.1 A final meeting of the Class Committee without the student member(s) will be convened within ten days after the last day of the end-semester examination. The letter grades to be awarded to the students for different courses will be finalized at the meeting.

16.2 Three copies of the results sheets for each course, containing the final grade and three copies with the absolute marks and the final grade should be submitted by the teacher to the concerned Class Committee Chairman. After finalisation of the grades at the class committee meeting the Chairman will forward two copies of each to the Controller of Examinations and the other copies to the Head of the Department in which course is offered.

17.0 DECLARATION OF RESULTS:

17.1 After finalisation by the Class Committee as per clause 17.1 the Letter Grades awarded to the students in the each course shall be announced on the departmental notice board after duly approved by the Controller of Examinations. In case any student feels aggrieved, he/she can apply for revaluation after paying the prescribed fee for the purpose, within two weeks from the commencement of the semester immediately following the announcement of results. A committee will be constituted by the Controller of Examinations comprising the Chairperson of the concerned Class Committee (Convener), the teacher concerned and another teacher of the department who is knowledgeable in the concerned course. If the Committee finds that the case is genuine, it may jointly revalue the answer script and forward the revised mark to the Controller of Examinations with full justification for the revision if any.

17.2 The **"U"** grade once awarded stays in the grade sheet of the students and is not deleted when he/she completes the course successfully later. The grade acquired by the student later will be indicated in the grade sheet of the appropriate semester.

18.0 COURSE REPETITION AND ARREARS EXAMINATION

18.1 A student should register to re-do a core course wherein "I" or "W" grade is awarded. If the student is awarded "I", or "W" grade in an elective course either the same elective course may be repeated or a new elective course may be taken.

18.2 A student who is awarded "U" grade in a course shall write the end-semester examination as arrear examination , at the end of the next semester, along with the regular examinations of next semester courses The marks earned earlier in the continuous assessment tests for the course, will be used for grading along with the marks earned in the end-semester arrear examination for the course.

19.0 GRADE SHEET

19.1 The grade sheet issued at the end of the semester to each student will contain the following:

(i) the credits for each course registered for that semester.

(ii) the performance in each course by the letter grade obtained.

(iii) the total credits earned in that semester.

(iv) the Grade Point Average (GPA) of all the courses registered for that semester and the Cumulative Grade Point Average (CGPA) of all the courses taken up to that semester.

19.2 The GPA will be calculated according to the formula

$$GPA = \frac{\sum_i (C_i)(GP_i)}{\sum_i C_i}$$

where C_i is the number of credits assigned for i^{th} course
GP_i - Grade point obtained in the i^{th} course
For the cumulative grade point average (CGPA) a similar formula is used except that the sum is over all the courses taken in all the semesters completed up to the point in time.

I and W grades will be excluded for GPA calculations.

U, I and W grades will be excluded for CGPA calculations.

19.3 Classification of the award of degree will be as follows:

CGPA	Classification
8.50 and above, having completed in first appearance in all courses	First class with Distinction
6.50 and above, having completed within a period of 2 semesters beyond the programme period.	First Class
All others	Second Class

However, to be eligible for **First Class with Distinction,** a candidate should not have obtained U or I grade in any course during his/her study and should have completed the P.G. Programme within a minimum period covered by the minimum duration (clause 3.1) plus authorized break of study, if any (clause 8). **To be eligible for First Class,** a candidate should have passed the examination in all courses within the specified minimum number. of semesters

reckoned from his/her commencement of study plus two semesters. For this purpose, the authorized break of study will not be counted. The candidates who do not satisfy the above two conditions will be classified as **second class.** For the purpose of classification, the CGPA will be rounded to first decimal place. For the purpose of comparison of performance of candidates and ranking, CGPA will be considered up to three decimal places.

20 ELIGIBILITY FOR THE AWARD OF THE MASTERS DEGREE

20.1 A student shall be declared to be eligible for the award of the Masters Degree, if he/she has:

i) registered for and undergone all the core courses and completed the Project Work,

ii) successfully acquired the required credits as specified in the Curriculum corresponding to his/her programme within the stipulated time,

iii) successfully completed the field visit/industrial training, if any, as prescribed in the curriculum.

iv) has no dues to the Institution, Hostels and Library.

v) no disciplinary action is pending against him/her

20.2 The award of the degree must be approved by the University.

21.0 POWER TO MODIFY:

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

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M.Sc. CHEMISTRY CURRICULUM

SEMESTER I

Code	Course Title	L	T	P	C
CH 611	Organic Chemistry - I	3	0	0	3
CH 612	Physical Chemistry - I	3	0	0	3
CH 613	Inorganic Chemistry	3	0	0	3
CH 614	Analytical Chemistry	3	0	0	3
CH 615	Unit Operations and Unit Processes	3	0	0	3
CH 616	Organic Chemistry Practical - II	0	0	12	4
	Total Credits				**19**

SEMESTER II

Code	Course Title	L	T	P	C
CH 621	Organic Chemistry-II	3	0	0	3
CH 622	Physical Chemistry-II	3	0	0	3
CH 623	Coordination Chemistry	3	0	0	3
CH 624	Nanotechnology	3	0	0	3
CH 625	Molecular Spectroscopy	3	0	0	3
CH 626	Inorganic Chemistry Practical	0	0	12	4
CH 627	Organic Chemistry Practical - II	0	0	6	2
CH 628	Seminar	0	0	2	1
	Total Credits				**22**

SEMESTER III

Code	Course Title	L	T	P	C
CH 631	Organic Chemistry-III	3	0	0	3
CH 632	Physical Chemistry-III	3	0	0	3
CH 633	Advanced Inorganic Chemistry	3	0	0	3
	Elective-I	3	0	0	3
	Elective-II	3	0	0	3
CH 634	Physical Chemistry Practical	0	0	12	4
	Total Credits				**19**

SEMESTER IV

Code	Course Title	L	T	P	C
	Elective-III				3
	Elective-IV	3	0	0	3
CH 641	Project Work	0	0	20	10
	Total Credits				**16**

Overall Credits 76

ELECTIVES

Code	Course Title	L	T	P	C
CHZ 651	Pharmaceutical Chemistry	3	0	0	3
CHZ 652	Pharmaceutical Technology	3	0	0	3
CHZ 653	Medicinal Chemist ry	2	0	3	3
CHZ 654	Pharmaceutical Industrial Management	3	0	0	3
CHZ 655	GMP, Quality Assurance and Validation	3	0	0	3
CHZ 656	Polymer Chemistry	3	0	0	3
CHZ 657	Polymer Technology	3	0	0	3
CHZ 658	Electrical Properties of Polymeric Materials	3	0	0	3
CHZ 659	Polymer Structure and Property Relationship	3	0	0	3
CHZ 660	Physical Chemistry of Polymers	3	0	0	3
CHZ 661	Industrial Catalysis	3	0	0	3
CHZ 662	Concepts and Techniques in Catalysis	3	0	0	3
CHZ 663	Environmental Chemistry	3	0	0	3
CHZ 664	Water and Waste Water Treatment	3	0	0	3
CHZ 665	Solid Waste Management and Air Pollution	3	0	0	3
CHZ 666	Industrial Electrochemistry	3	0	0	3
CHZ 667	Corrosion and Corrosion Control	3	0	0	3
CHZ 668	Electrochemical Protection Systems	3	0	0	3
CHZ 669	Metal Coating Technology	3	0	0	3
CHZ 670	Protective Coatings	3	0	0	3
CHZ 671	Fuel Cells and Applications	3	0	0	3
CHZ 672	Advanced Batteries and Systems	3	0	0	3
CHZ 673	Electrochemical Material Science	3	0	0	3
CHZ 674	Electrochemical Energy Conversion and Stor age	3	0	0	3
CHZ 675	Inorganic Chemical Technology	3	0	0	3
CHZ 676	Organic Chemical Technology	3	0	0	3
CHZ 677	Textile Chemistry	3	0	0	3
CHZ 678	Biochemistry	2	0	3	3
CHZ 679	Chlor-alkali Technology	3	0	0	3

M.Sc. CHEMISTRY SYLLABUS

CH 611 ORGANIC CHEMISTRY-I

L	T	P	C
3	0	0	3

Unit I STEREOCHEMISTRY 9

Introduction to molecular symmetry and point groups - optical isomerism - conditions for optical activity - Newmann, Sawhorse and Fisher projection formulae - Interconversion - concept of chirality - R,S nomenclature - diastereoisomerism in acyclic and cyclic systems - enantiotopic and diastereotopic atoms, groups and faces - optical activity of biphenyls, allenes and spiranes - stereo specific and stereoselective syntheses - asymmetric synthesis - Cram's rule - Prelog's rule - conformational analysis of cyclic and acyclic systems - Curtin-Hammett principle - conformation and reactivity - geometrical isomerism - E, Z-nomenclature - determination of configuration of geometrical isomers using physical and chemical methods.

Unit II SUBSTITUTION REACTIONS - I 9

Reactive intermediates - formation and stability of carbonium ions, carbanions, carbenes and carbenoids, nitrenes, free radicals and arynes, ylides - Aliphatic nucleophilic substitutions - S_N1, S_N2 and S_Ni mechanisms - effects of substrate, attacking nucleophile, leaving group and solvent - stereochemistry of nucleophilic substitution reactions - substitutions at carbonyl, bridgehead, vinylic and allylic carbons.

Unit III SUBSTITUTION REACTIONS - II 9

Neighbouring group participation,- norbornyl cation and other non-classical carbocations, ambident nucleophiles - O versus C alkylation - Aromatic nucleophilic substitutions - mechanisms - effects of substrate, structure, leaving group and attacking nucleophile - various methods of benzyne generation and reactions of benzynes - reactions of aryl diazonium salts - aromatic electrophilic substitution reactions and mechanisms - vicarious nucleophilic substitution (VNS), Chichibabin and Schiermann reactions - aromatic electrophilic substitution reactions and mechanisms.

Unit IV ELIMINATION AND ADDITION REACTIONS 9

Addition to carbon-carbon and carbon-hetero multiple bonds - electrophilic, nucleophilic and free radical additions - stereochemistry of addition to carbon-carbon multiple bonds - orientation and reactivity, addition to conjugated systems and orientation - addition to α, β - unsaturated carbonyl groups - E_1,

E_2 and E_1CB mechanisms - stereochemistry of E_2 elimination - competition between elimination and substitution reactions - orientation effects in elimination reactions - effects of substrate structures, attacking base, leaving group and medium on E_1 and E_2 reactions - pyrolytic eliminations - Bredt's rule - Chugaev and Cope eliminations - Peterson's synthesis.

Unit V NAMED REACTIONS **9**

Hell-volhard-Zelinskii, Japp-Klingemann, Stork enamine, Ziegler alkylation, Birch reduction, Clemmensen reduction, Wolff-Kishner reduction, Meerwein-Pondorf-Verley reduction, Oppenauer oxidation - Aldol, Claisen, Benzoin, Wittig and Stobbe condensations - Michael addition, Mannich reaction, Robinson annulation, Dieckmann, Hundsdiecker, Heck, Shapiro, Koenigs-Knorr, Polonowski, Hofmann-Loffler, Reformatsky, Darzen's, Simmons-Smith, Gattermann-Koch, Mitsunobu reaction, Kolbe-Schmitt carboxylation and Sharpless asymmetric epoxidation.

L: 45

REFERENCES:

1. Michael Smith, Michael B. Smith and Jerry March, Advanced Organic Chemistry, Reactions, Mechanisms and Structure 7th Edition, Wiley Intersciences, New York, Wiley Interscience, 2009.
2. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry, Part A - Structure and Mechanisms, 5th Edition, Springer, 2007.
3. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry, Part B: Reactions and Synthesis, 5th Edition, Springer, 2007.
4. Graham Solomons T.W., Craig Fryhle, Organic Chemistry, 9th Edition, John Wiley and Sons, New York, 2007.
5. Morrison R.T., Boyd R.N. and S. K. Battacharjee Organic Chemistry, 7th Edition, Pearsons, 2007.
6. Eliel E.L. and Wilen S.H., Stereochemistry of Organic Compounds, John Wiley India, 2009.
7. Nasipuri D., Stereochemistry of Organic Compounds, 2nd Edition, Wiley Eastern Ltd., 1991.
8. Kalsi P.S., Stereochemistry of Organic Compounds, Wiley Eastern Ltd., New Delhi, 1992.
9. Peter Sykes, Guidebook to Mechanism in Organic Chemistry, Orient Longman, 2005.

CH 612 PHYSICAL CHEMISTRY-I

L	T	P	C
3	0	0	3

Unit I CHEMICAL THERMODYNAMICS 9

First law of thermodynamics - Joule Thomson effect - thermochemistry - standard enthalpy changes - standard enthalpies of formation - second law of thermodynamics - free energy and work function - Maxwell relations - Ellingham diagram - third law of thermodynamics - evaluation of absolute entropies of solids, liquids and gases - partial molar properties - chemical potential - vant Hoff's equation - Gibbs - Duhem equation.

Unit II PHASE EQUILBRIA 9

Two component systems - classification - solid-gas (dehydration and rehydration of $CuSO_4$, $5H_2O$), solid-liquid systems - benzene-picric acid system, salt-water system fractional distillation - three component systems involving liquid - liquid equilibria.

Unit III MOLECULAR SYMMETRY AND GROUP THEORY 9

Symmetry elements and symmetry operations - group postulates - types of groups - point groups - representation of molecular point groups - great orthogonality theorem - character tables for point groups - point groups and geometry of H_2O, NH_3, CH_4, CO_2, $[Ni(CN)_4]^{2-}$, C_6H_6 and $[Co(NH_3)_6]^{3+}$ molecules - applications of group theory.

Unit IV ELECTROCHEMISTRY 9

Ion-solvent and ion-ion interactions, ion transport in solutions - electrochemical cells electrical double layer - various models - electrocapillary phenomena - electrokinetic phenomena - electro - osmosis - streaming potential and electrophoresis - Tiselius apparatus - kinetics of electrode processes - Butler-Volumemer equation - Tafel equation.

Unit V APPLIED ELECTROCHEMISTRY 9

Electrochemical energy conversion - nickel-cadmium battery, lithium battery - silver-zinc cells - dry cells - fuel cells (Hydrogen-Oxygen) - galvanic corrosion - methods of corrosion control - electroplating - electroforming and electrochemical machining - electrorefining - electrolytic oxidation and reduction - manufacture of organic and inorganic compounds.

L: 45

REFERENCES:

1. Atkins P., and Paula J.D., Physical Chemistry, 7th Edition, Oxford University Press, London, 2002.
2. Alberty P.A. and Silbey R.U., Physical Chemistry, 1st Edition, John Wiley and Sons Inc., 1995.
3. Castellan G.W., Physical Chemistry, 3rd Edition, Narosa Publishing House, 2004.
4. Philip H. Reiger, Electrochemistry, Prentice Hall Inc., New Delhi, 1987.
5. Kuriacose J.C. and Rajaram J., Thermodynamics for Students of Chemistry, 3rd Edition, S. Chand and Co., New Delhi, 2001.
6. Crow D.R., Principles and Application of Electrochemistry, Chapman and Hall, 1988.
7. Cotton F.A., Chemical Application of Group Theory, 3rd Edition, Wiley, New York, 2003.

CH 613 INORGANIC CHEMISTRY

L	T	P	C
3	0	0	3

Unit I ATOMIC STRUCTURE **9**

Modern views on atomic structure - Wave equation - hydrogen atom and polyelectron atoms, electronic configuration and term symbols, periodic properties of elements - atomic size, ionization energy, electron affinity, electro negativity, covalent and ionic radii and magnetic properties.

Unit II NON-VALENCE FORCES **9**

van der Waals' forces - hydrogen bond - clathrates, metallic bond - free electron theory of metals, ionic solids - lattice energy - Born-Haber cycle.

Unit III CRYSTAL STRUCUTRE **9**

Radius ratio - structures of AX, AX_2, A_2X_3, ABX_3 and A_2BX_4 type solids - layer structure - cadmium iodide - covalent solids - diamond and graphite - Polymorphism and XRD principle.

Unit IV COVALENT BOND **9**

Valence bond theory - hybridization and resonance - diatomic and polyatomic systems - VSEPR theory - molecular orbital theory - LCAO approximation for diatomic and polyatomic systems.

Unit V AQUEOUS AND NON-AQUEOUS CHEMISTRY **9**

Acid-base concepts, HSAB theory, super acids, non-aqueous solvents - reactions in liquid ammonia, sulphuric acid, aprotic solvents - molten salts - electrode potentials and applications in inorganic systems.

L: 45

REFERENCES:

1. Cotton F.A., Wilkinson G. and Gaus P.L., Basic Inorganic Chemistry, 3rd Edition, John Wiley and New York, 2003.
2. Atkins P.W., Overton T., Rourke, J., Weller, M. and Armstrong, F. Shriver and Atkins inorganic chemistry, 4th edition, Oxford University Press, 2006.
3. Huheey J.E., Keiter E.A. and Keiter R.L., Inorganic Chemistry, 4th Edition, Addision Wesley Publication, London, 1993.
4. Jolly W.L., Modern Inorganic Chemistry, 2nd Edition, McGraw - Hill, Inc., 1991.
5. Lee J.D., Concise Inorganic Chemistry, 5th Edition, Blackwell Science, 2003.

CH 614 ANALYTICAL CHEMISTRY **L T P C**
3 0 0 3

Unit I WET CHEMICAL METHODS OF ANALYSIS **9**

Volumetric analysis - neutralization, precipitation, complexometric and redox titrations - Gravimetric analysis - volatilization and precipitation methods - Types of error - evaluation of analytical data - Colorimetric analysis - principle and applications.

Unit II SPECIAL METHODS **9**

Molecular spectroscopy: UV, Visible, IR absorption - Fluorescence, phosphorescence and chemiluminescence methods - Atomic absorption and atomic fluorescence spectroscopy - Emission spectroscopy, flame photometry and ICP-AES, X-ray Diffraction -principle, instrumentation and analytical applications.

Unit III ELECTROANALYTICAL TECHNIQUES **9**

Conductometry and high frequency titrations - Potentiometry, pH-metry and ion-selective electrodes - Electrogravimetry and coulometry - Voltametry - polargraphy, amperometric titrations and anodic stripping Voltametry - principle, practice and applications.

Unit IV SEPARATION TECHNIQUES **9**

Chromatography - Column, TLC, GC, HPLC and GPC techniques - Solvent extraction and ion exchange techniques - Supercritical fluid chromatography - Capillary electrophoresis - principle, instrumentation and applications.

Unit V THERMAL METHODS OF ANALYSIS **9**

Thermal analytical techniques - TGA, DTA, DSC - principle, instrumentation and applications.

L: 45

REFERENCES:

1. Skoog D.A., West D.M., Hollder F.J. and Courch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.

3. Skoog D.A., Holler F.J. and Nieman T.A., Principles of Instrumental Analysis, 5th Edition, Harcourt College Publication., Singapore, 1998.

4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.

5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.

6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

CH 615 UNIT OPERATIONS AND UNIT PROCESSES **L T P C**

3 0 0 3

Unit I BASIC CONCEPTS **9**

Stoichiometric principles - material and energy balances - Combustion, Theoretical air for combustion, Flue gas analysis - water treatment - environmental protection.

Unit II HEAT AND MASS TRANSFER **9**

Modes of Heat Transfer - Fourier's law - simple numerical problems on conduction - natural and forced convection - heat transfer equipment - Drying, Distillation - vapour liquid equilibria - distillation methods - continuous rectification of binary systems.

Unit III MASS TRANSFER OPERATIONS **9**

Adsorption and adsorption principles - equilibrium relationships - methods of calculation - various types of equipment - Extraction and Leaching - liquid extraction - ternary diagram - selection of solvent and equipment - method of calculation of co-current and counter-current extraction operations - Crystallization - types of crystallization equipment - material and energy balances.

Unit IV MECHANICAL OPERATIONS **9**

Laws of crushing - closed and open circuit grinding - various types of crushers and grinders - settling, floatation and filtration concepts.

Unit V UNIT PROCESSES **9**

Nitration, sulphonation, halogenation, esterification, amination, saponification and hydrogenation - role of the above unit processes in such industries as petroleum, drugs, pharmaceuticals and organic synthesis.

L: 45

REFERENCES:

1. Groggins P.H., Unit Processes in Organic Synthesis, McGraw Hill Book Co., Kogakusha, 5th Edition, 2007.
2. McCabe W.L., Smith J.C. and Harriot P., Unit Operations of Chemical Engineering, 6th Edition, McGraw Hill Book Co. 2001.
3. Perry J.H., Handbook of Chemical Engineers, McGraw Hill Book Co., 2006.
4. Badger W.I. and Banchero I.T., Introduction to Chemical Engineering, McGraw Hill Book Co. Inc., Kogakusha, 1988.

CH 616 ORGANIC CHEMISTRY PRACTICALS - I L T P C

0 0 12 4

1. Qualitative analysis of simple organic compounds and two component mixtures.
2. Purification of organic solvents and reagents - Purification of liquids by distillation - Purification of solids by recrystallization - Determination of melting point - Determination of boiling point by capillary method.
3. Preparation of simple organic compounds (based on conventional, green, microwave, sono-chemistry and photo-Chemical synthesis) and their identification by physical and chemical methods.

L: 180

REFERENCES:

1. A. I. Vogel, Vogel's Textbook of Practical Organic Chemistry, 5th Edition, Prentice Hall, 2008.
2. N. S. Gnanapragasam, G. Ramamurthy, Organic Chemistry - Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.
3. V K Ahluwalia, R. Agarwal Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press, 2000.

CH 621 ORGANIC CHEMISTRY-II **L T P C**

3 0 0 3

Unit I REARRANGEMENTS **9**

General mechanistic considerations, nature of migration, migratory aptitude - nucleophilic, electrophilic and free radical rearrangements - Wagner-Meerwein, McLafferty, Demyanov, Favorskii, Fritsch-Butternberg-Wiechell, Neber, Hofmann, Curtius, Beckmann, Schmidt, Lossen, Wolff, Baeyer - Villiger, Stevens, Wittig, Chapman, Wallach, Orton, Bamberger, Pummerer and Von Ritchter rearrangements.

Unit II REAGENTS IN ORGANIC SYNTHESIS **9**

Synthesis and application of - Diborane, $LiAlH_4$, $NaBH_4$, DIBAH, Bu_3SnH, SeO_2, OsO_4, NBS, DCC, $Pb(OAc)_4$, $KMnO_4$, PCC, Swern, Dess Martin, DDQ, LDA, crown ethers, Gilman's reagent, phase transfer catalysts, Wittig, Tebbe, Wilkinson's catalysts, Palladium and copper catalysts in coupling, Low valent titanium(Mcmurry), Co(Salen) complex (Jacobsen), BINAL(H), BINAP, Chemzyme, Grubb and Schrock catalyst (Olefin Metathesis).

Unit III MULTISTEP SYNTHESIS **9**

Strategies for synthetic analysis and planning - functional group introduction, removal and interconversion - activating groups - protection and deprotection of hydroxyl, amino, carbonyl and carboxylic acid groups - retrosynthetic analysis, synthons and synthetic equivalent groups - C-C, C=C, C-O bond forming reactions - linear and convergent synthesis - control of stereochemistry - reactive umpolung - analysis and synthesis of a few target molecules.

Unit IV HETEROCYCLICS AND ALKALOIDS **9**

Synthesis and reactivity of Indoles, quinoline, isoquinoline, pyrimidine, purines, coumarins, chromones, benzopyrans - Alkaloids - synthesis of quinine, papaverine, nicotine, cocaine and atropine.

Unit V AMINO ACIDS, β-LACTAMS, PROTEINS AND NUCLEIC ACIDS **9**

Classification, properties and synthesis of amino acids - β-Lactams - antibiotic action - structure of penicillin, cephalosporin, carbapenems - classification of proteins - peptide linkage - synthesis of peptides - primary, secondary, tertiary and quaternary structures of proteins - Nucleic acids: structure of DNA and RNA.

L: 45

REFERENCES:

1. Jerry March, Advanced Organic Chemistry, 4th Edition, Wiley-Interscience, New York, 2007.
2. Morrison R.T., Boyd R.N. and S. K. Battacharjee Organic Chemistry, 7th Edition, Pearsons, 2007.
3. Lowry T.H. and Richardson K.S., Mechanism and Theory in Organic Chemistry, 2nd Edition, Harper and Row Publishers, 1981.
4. Michael B. Smith and Jerry March, Advanced Organic Chemistry, Reactions, Mechanisms and Structure 7th Edition, Wiley Intersciences, New York, 2009.
5. Finar I.L., Organic Chemistry, Volume II, 5th Edition, ELBS Longmann Group Ltd., London, 1980.
6. Stuart G. Warren, Organic Synthesis: The Disconnection Approach Wiley India, 2009.
7. Achesen R.M., Chemistry of Heterocyclic Compounds, Wiley Eastern, 1973.
8. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry, Part A - Structure and Mechanisms, 5th Edition, Springer, 2007.
9. Francis A. Carey and Richard J. Sundberg, Advanced Organic Chemistry, Part B: Reactions and Synthesis, 5th Edition, Springer, 2007.

CH 622 PHYSICAL CHEMISTRY-II

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3	0	0	3

Unit I INTRODUCTION TO QUANTUM CHEMISTRY 9

Inadequacy of classical mechanics - black body radiation, photo electric effect, heat capacity of solids - Planck's quantum theory - quantum mechanical operators - Hamiltonian operators - momentum operators, permutation operators - eigen value - eigen function equations.

Unit II QUANTUM CHEMISTRY OF ATOMS 9

Postulates of quantum mechanics, Schrodinger wave equation and its solution to a particle in a box, rigid rotor and harmonic oscillators - H atom solutions - variation method - perturbation method - He atom - SCF and Hartree-Fock methods.

Unit III QUANTUM CHEMISTRY OF MOLECULES 9

Born Oppenheimer approximation LCAO - MO method of H_2^+ and H_2^- - electronic configuration and properties of homo and hetero nuclear diatomic molecules - valence bond - covalent - resonance - polarity of bonds - 3 electron bonds - Localized and delocalized bonds - hybridization - Huckel theory of conjugated molecules - cyclic systems - Woodward Hoffman rules.

Unit IV CATALYSIS 9

Acid-base catalysis - general scheme - Arrhenius complex - Vant Hoff's complex - specific and general catalysis - catalytic constants - Bronsted relationship - Hammett acidity functions - mechanism of acid-base catalysed reaction - catalysis by transition metal ions and their complexes - supported transition metal complexes as catalysts - enzyme catalysis - theory and applications.

Unit V SURFACE PHENOMENA AND HETEROGENEOUS CATALYSIS 9

Diffusion - adsorption - surface reaction - various adsorption isotherms - determination of surface area - pore volume and pore size - thermodynamics of interfaces - solid catalysts - metal-metal oxides - geometric factor - electronic factor - zeolites - phase transfer catalysis - colloidal electrolytes - reactions on surfaces - surface characterization techniques - ESCA, AES and SIMS.

L: 45

REFERENCES:

1. Atkins P. and Paula J.D., Physical Chemistry, 7th Edition, Oxford University Press, London, 2002.
2. Castellan G.W., Physical Chemistry, 3rd Edition, Narosa Publishing House, 2004.
3. Laidler K., Chemical Kinetics, 2nd Edition, Harper and Row, New Delhi, 1997.
4. McQuarrie D.A., Quantum Chemistry, 1st Edition, University Science Books, Mill Valley, California, 2003.
5. Hanna M.W., Quantum Mechanics in Chemistry, 3rd Edition, Addition Wesley, London, 1981.
6. Rajaram J. and Kuriacose J.C., Kinetics and Mechanism of Chemical Transformation, Mc Millan India Ltd., New Delhi, 1993.
7. Adamson W., Physical Chemistry of Surfaces, 5th Edition, Wiley, 1990.
8. Levine I.N., Quantum Chemistry, 5th Edition, Pearson Education, 2000.

CH 623 CO-ORDINATION CHEMISTRY L T P C

3 0 0 3

Unit I COORDINATION COMPOUNDS 9

Nomenclature, structure and stability - geometry and isomerism - absolute configuration - ORD and CD spectra - stability of complexes - thermodynamic aspects, successive and overall formation constants - experimental methods.

Unit II THEORIES OF METAL- LIGAND BOND 9

Valence bond theory - hybridization - crystal field theory - crystal field splitting, crystal field stabilization energy - thermodynamic and structural implications, Jahn Teller effects, ligand field theory - molecular orbital theory - pi bonding.

Unit III SPECTRA OF CO-ORDINATION COMPOUNDS 9

Free ion terms, transformation in crystal field, energy diagrams in weak and strong field cases - Tanabe - Sugano diagrams, selection rules - magnetic properties - Van Vleck equation, magnetic susceptibility - experimental methods - ESR spectra of transition metal ions.

Unit IV REACTIONS OF CO-ORDINATION COMPOUNDS 9

Inert and labile complexes - substitution reactions in square-planar and octahedral complexes - electron transfer reactions - photochemical reactions.

Unit V COMPARATIVE CHEMISTRY OF OXIDATION STATES OF d AND F BLOCK ELEMENTS 9

Lanthanides-occurrence, isolation, lanthanide contraction, oxidation states, spectral and magnetic properties, co-ordination complexes, actinides, comparative chemistry with transition metals and lanthanides.

L: 45

REFERENCES:

1. Cotton F.A., Wikinson G. and Gaus P., Basic Inorganic Chemistry, 3rd Edition, John Wiley and Sons, 2003.
2. Shriver D.F. and Atkins P.W., Inorganic Chemistry, 3rd Edition, (ELBS), Oxford University Press, Oxford, 2004.
3. Huheey J.E., Keiter E.A. and Keiter R.L., Inorganic Chemistry, 4th Edition, Addison Wesley Publication, London, 1993.
4. Cotton F.A., Wikinson G., Murillo C.A. and Bochmann M., Advanced Inorganic Chemistry, 6th Edition, John Wiley and Sons, New York, 2003.
5. Jolly W.L., Modern Inorganic Chemistry, 2nd Edition, McGraw Hill Inc., 1991.
6. Meissler G.L. and Tarr D.A., Inorganic Chemistry, 3rd Edition, Pearson Education, Singapore, 2004.

CH 624 NANOTECHNOLOGY L T P C

3 0 0 3

UNIT I INTRODUCTION 9

Definition of nano - significance of the nanoscale - new materials: nanomaterials - properties of nanomaterials - nanomaterial science - nanoscale in one dimension -thin films, layers and surfaces - nanoscale in two dimensions - carbon nanotubes- inorganic nanotubes, nanowires, biopolymers- nanoscale in three dimensions - nanoparticles, fullerenes, carbon 60, dendrimers, quantum dots- applications of nanomaterials- current applications- sunscreens and cosmetic, composites, clays, coatings and surfaces, tougher and harder cutting tools.

UNIT II PREPARATION OF NANOMATERIALS 9

Methods of preparation of nanomaterials, bottom-up and top-down approach, sol-gel synthesis, inert gas condensation, mechanical alloying or high-energy ball milling, plasma synthesis, and electrodeposition.

UNIT III CHARACTERIZATION TECHNIQUES AND APPLICATION 9

Atomic Force Microscopy (AFM): Contact and Tapping Mode - Scanning Electron microscopy (SEM), Transmission electron microscopy (TEM), Introduction to advanced Scanning Probe Microscopy - Electrostatic Force Microscopy (EFM) - Magnetic Force Microscopy (MFM) - Scanning Thermal Microscopy (SThM), Scanning Tunnelling Mode (STM), Piezoelectric force microscopy (PFM), Scanning Capacitance Microscopy (SCM), X-ray Photoelectron spectroscopy (XPS), Powder XRD - Nanoindentation.

Short-term Applications - Paints, remediation, fuel cells, displays, batteries, fuel additives, catalysts.

Longer-term Applications - Carbon nanotube composites, lubricants, magnetic materials, medical implants machinable ceramics, water purification, military battle suits.

UNIT IV CARBON NANOTUBES 9

History - production methods - arc method, laser method, chemical vapor deposition, ball milling, other methods - purification methods- gas phase, liquid phase, intercalation, - dispersion - fictionalization -chopping, oxidation, and "wrapping" of CNTs.

UNIT V PROPERTIES CARBON NANOTUBES 9

Electrical conductivity, strength and elasticity, thermal conductivity and expansion, field emission, high aspect ratio, highly absorbent. applications - field emission, conductive or reinforced plastics, energy storage, conductive adhesives and connectors, molecular electronics, thermal materials, structural composites, fibers and fabrics, catalyst support, CNT ceramics, biomedical applications, air, water and gas filtration, other applications.

L: 45

REFERENCES:

1. Pradeep T., Nano: The Essentials Understanding Nanoscience and Nanotechnology, Tata McGraw-Hill, New Delhi, 2007.
2. Mark Ratner and Daniel Ratner, Nano Technology, Pearson Education, New Delhi, 2003.
3. Tlusty J, Machining Processes and Equipment, 2nd Edition, Prentice Hall, 2000.
4. Viswanathan B.,Nano Materials, Narosa Publications, New Delhi, 2009.

CH 625 MOLECULAR SPECTROSCOPY **L T P C**
3 0 0 3

UNIT I ELECTROMAGNETIC RADIATION AND ROTATIONAL SPECTROSCOPY **9**

Characterization of electromagnetic radiation - regions of the spectrum - basic elements of practical spectroscopy - enhancement of spectra - Applications of group theory - Microwave spectroscopy - rotational spectra of molecules - applications.

UNIT II INFRA-RED & RAMAN SPECTROSCOPY **9**

Infra-red spectroscopy - harmonic and unharmonic vibrations - dissociation energy of diatomics - vibrating rotator - PQR branches in IR spectra - Fermi resonance - Raman spectroscopy - mutual exclusion principle

UNIT III SPIN RESONANCE SPECTROSCOPY **9**

Proton magnetic resonance spectroscopy - relaxation processes - chemical shift - coupling - simplification of complex NMR spectra - 13C NMR spectra - Electron spin resonance spectroscopy - hyperfine interactions.

UNIT IV MASS SPECTROMETRY **9**

Reactions of ions in gas phase - effect of isotopes - nitrogen rule - determination of molecular formula - fragmentations and rearrangements - metastable ions - fragmentation of organic compounds. Application of Mass spectroscopy with GC.

UNIT V UV-VISIBLE & MOSSBAUER SPECTROSCOPY **9**

UV-Visible spectroscopy - electronic transitions - solvent effects - Woodward's rule - Mossbauer nuclei - Doppler Effect - isomer shift - quadrupole splitting - magnetic hyperfine interactions. **L: 45**

REFERENCES:

1. Banwell C.N. and McCash E.M., Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw Hill, New Delhi, 1995.
2. Kemp W., Organic Spectroscopy, 3rd Edition, ELBS, McMillan, London, 1991.
3. Drago R., Physical Methods for Chemists, Saunders, Philadelphia, 1992.
4. Williams D.H. and Fleming I., Spectroscopic Methods in Organic Chemistry, 4th Edition, McGraw Hill, New York, 1989.
5. Pasto D., Johnson C. and Miller M., Experiments and Techniques in Organic Chemistry Prentice-Hall Inc., New Jersey, 1992.
6. Pavia D.L., Lampman G.M. and Kriz G.S., Introduction to Spectroscopy, 3rd Edition, Brooks/Cole Publication, Singapore, 2001.
7. Robert M. Silverstein, Francis X. Webster, David Kiemle, Spectrometric Identification of Organic Compounds, 7th Edition, Wiley, 2005.

CH 626 INORGANIC CHEMISTRY PRACTICAL

L	T	P	C
0	0	12	4

1. QUANTITATIVE INORGANIC ANALYSIS **36**

(i) Ores: oxides and carbonates.

(I) Alloys: ferrous and nonferrous - brass and solder

(II) Spectrophotometry: estimation of copper, nickel, iron and manganese

2. ESTIMATION OF INDUSTRIAL PRODUCTS **36**

(i) Active CaO in lime

(I) Chlorine in bleaching power

(II) Analysis of cement - silica, mixed oxide - Fe_2O_3, Al_2O_3 and CaO/MgO

(III) Lead in red lead

(IV) $BaSO_4$ in lithopone

3. WATER ANALYSIS **36**

(i) Total dissolved solids

(ii) Carbonate and non-carbonate hardness by EDTA

(iii) Dissolved oxygen, BOD and COD

(iv) Alkalinity

(v) F^-, Cl^-, SO_4^{2-} and Fe^{3+}

(vi) Turbidity

4. PREPARATION OF TYPICAL INROGANIC COMPLEXES **18**

5. TITRIMETRY & GRAVIMETRY **18**

Estimation of Nickel by Gravimetry & Copper by Titrimetry

Estimation of Barium by Gravimetry & Calcium by Complexometry

6. QUALITATIVE INORGANIC SEMI-MICRO ANALYSIS **36**

Detection of at least four cations (2 common and 2 uncommon) in a mixture of salts.

P: 180

REFERENCES:

1. Jeffery G.H., Bassett J., Mendham J. and Denney R.C., Vogel's Text Book of Quantitative Chemical Analysis, ELBS, 5th Edition, Longman, Singapore Publishers, Singapore, 1996.

2. Kolthoff I.M., Sandell E.B. et al., Quantitative Chemical Analysis, Macmillan, Madras, 1980.

CH 627 ORGANIC CHEMISTRY PRACTICALS - II

L	T	P	C
0	0	6	2

1. Identification and purification of organic compounds by Thin layer and Column chromatographic techniques.
2. Multistep synthesis of organic compounds - isolation and characterization of the products by various spectroscopic techniques.
3. Isolation, characterization and identification of Caffeine (from tea leaves), Piperine (from black pepper) and Cumin oil (from cumin seeds).

P: 90

REFERENCES:

1. A.I. Vogel, Vogel's Textbook of Practical Organic Chemistry (4th Edition), Longmann group, 2008.
2. N. S. Gnanapragasam, G. Ramamurthy, Organic Chemistry - Lab manual, S. Viswanathan Co. Pvt. Ltd., 1998.
3. V K Ahluwalia S Dhingra Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press, 2000.
4. Robert M. Silverstein, Francis X. Webster, David Kiemle, Spectrometric Identification of Organic Compounds, 7th Edition, Wiley, 2005.
5. Kemp W., Organic Spectroscopy, 3rd Edition, ELBS, McMillan, London, 1991.