AMRITA VISHWA VIDYAPEETHAM

Program
Five-Year Integrated Master of Science Chemistry
Faculty of Sciences

(Revised with effect from 2018-19 AY onwards)

Table of Contents

1. **Scientific Knowledge and Pursuit**: Gain and apply knowledge of basic scientific and mathematical fundamentals, to develop deeper understanding Nature and apply it to develop new theories and models.

2. **Theoretical Methods & Problem Analysis**: Develop analytical skills to analyse complex phenomena using first principles enabling one to identify underlying structure.

3. **Experimental Skills and Development of solutions**: Use of research-based knowledge and research methods including design of physical/computational experiments, Design of solutions for complex chemistry/physics/ mathematics problems and evolve procedures appropriate to a given problem.

4. **Computational, Numerical and Data Analysis**: Numerical analysis and simulation modelling and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Analytical Tool Usage:** Select, and apply appropriate techniques, resources, and modern analytical tools.

6. **Scientific Communication**: Communicate orally and in writing on complex scientific activities with peers, educators, science community, and with society at large, such as being able to comprehend and write effective scientific articles, make effective presentations, and give and receive clear instructions.

7. **Individual and team work**: Think critically and work independently, and as a member or leader in diverse teams, and in multidisciplinary settings.

8. **Project management and finance**: Demonstrate knowledge and understanding of the scientific and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

9**. Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of scientific practice.

10. **The scientist and society:** Apply reasoning through the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional scientific practice.

11. **Environment and sustainability**: Understand the impact of scientific processes in societal and environmental contexts, and demonstrate the knowledge, and need for sustainable development.

12. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of scientific and technological changes for up-to-date research and teaching methods.

PROGRAMME SPECIFIC OUTCOMES

1. Students will be capable of acquiring proficiency in interdisciplinary topics such as mathematics, and physics and the concepts needed for a proper understanding of physics.
2. Students will demonstrate knowledge of Inorganic, Organic, Physical and Analytical Chemistry topics and be able to apply this knowledge to analyze a variety of chemical processes
3. Students will show that they have learned laboratory skills, enabling them to perform experiments in a chemical laboratory and analyze the measurements to draw valid conclusions. In addition, students will demonstrate skills in solving problems numerically using computer programming, plotting tools, and related software.
4. Students will demonstrate oral and written scientific communication and will demonstrate that they can think critically and work independently as well as in a team and play beneficial role in the society as a person of science combined with value-based education, both in professional and personal lives.

Five-Year Integrated Master of Science

Chemistry

CURRICULUM STRUCTURE

For 2018 admissions onwards

GENERAL INFORMATION

CURRICULUM STRUCTURE

Course Code	Course Title	L T P	Cr	ES	Course Code	Course Title	L T P	Cr	ES
SEMESTER 1					**SEMESTER 2**				
18ENG101	Communicative English	2 0 2	3		18ENG121	Professional Communication	1 0 2	2	
	Language Paper I	1 0 2	2			Language Paper II	1 0 2	2	
18CHY101	General Chemistry I	3 1 0	4		18CHY111	General Chemistry II	3 1 0	4	
18CSA100	Problem Solving and Computer Programming	3 0 0	3		18CSA116	Advanced Computer Programming	3 0 0	3	
18MAT105	Introduction to Calculus and Matrix Theory	3 1 0	4		18MAT114	Ordinary Differential Equations and Vector Calculus	3 1 0	4	
18CHY103	Mechanics	3 1 0	4		18PHY202	Electricity and Magnetism	3 1 0	4	
18CSA180	Problem Solving and Computer Programming Lab.	0 0 2	1		18CHY184	Inorganic Quantitative Lab. – Volumetric Analysis	0 0 2	1	
18PHY181	Physics Lab. I	0 0 2	1		18CSA181	Advanced Computer Programming Lab.	0 0 2	1	
18CUL101	Cultural Education I	2 0 0	2		18PHY182	Physics Lab. II	0 0 2	1	
	TOTAL		**24**		18CUL111	Cultural Education II	2 0 0	2	
						TOTAL		**24**	
SEMESTER 3					**SEMESTER 4**				
18CHY202	Physical Chemistry I	3 1 0	4		18CHY212	Physical Chemistry II	3 1 0	4	
18CHY203	Inorganic Chemistry I	3 1 0	4		18CHY213	Organic Chemistry I	3 1 0	4	
18ENV300	Environmental Science and Sustainability	3 0 0	3		18MAT219	Integral Transforms	3 1 0	4	
18MAT207	Introduction to Probability and Statistics	3 1 0	4		18PHY214	Waves and Optics	3 1 0	4	
18PHY305	Basic Electronics	3 1 0	4			Open Elective A*	3 0 0	3	
18CHY281	Inorganic Qualitative Lab	0 0 3	1		18CHY282	Basic Organic Qualitative Lab.	0 0 3	1	
18SSK201	Life Skills I	1 0 2	2		18SSK211	Life Skills II	1 0 2	2	
18AVP201	Amrita Values Programme I	1 0 0	1		18AVP211	Amrita Values Programme II	1 0 0	1	
	TOTAL		**23**			TOTAL		**23**	
SEMESTER 5					**SEMESTER 6**				
18CHY301	Physical Chemistry III	3 1 0	4		18CHY312	Basics of Analytical Chemistry	3 1 0	4	
18CHY302	Inorganic Chemistry II	3 1 0	4		18CHY313	Organic Chemistry III	3 1 0	4	
18CHY303	Organic Chemistry II	3 1 0	4		18CHY314	Inorganic Chemistry III	3 1 0	4	

	Elective A	3 0 0	3			18CHY315	Basic Spectroscopic Techniques	3 1 0	4		
18CHY383	Basic Physical Chemistry Lab.	0 0 3	1				Elective B	3 0 0	3		
18CHY384	Organic Synthesis and Estimation Lab.	0 0 3	1			18CHY385	Inorganic Quantitative Lab. – Gravimetric Analysis	0 0 5	2		
18CHY390	Live-in-Labs.@ / Open Elective B*	3 0 0	3			18CHY386	Physical Chemistry Lab. – Instrumental Analysis	0 0 5	2		
18SSK301	Life Skills III	1 0 2	2				TOTAL		**23**		
	TOTAL		**22**			**18CHY399**	Project (for Exit-option students)		**6**		
									29		
							TOTAL (for Exit-option students)	**145**			
SEMESTER 7						**SEMESTER 8**					
18CHY501	Quantum Chemistry	3 0 0	3			18CHY511	Chemical Thermodynamics and Equilibria	3 1 0	4		
18CHY505	Group Theory and its Applications	3 0 0	3			18CHY512	Molecular Spectroscopy	3 1 0	4		
18CHY502	Concepts in Inorganic Chemistry	3 1 0	4			18CHY513	Organic Reaction Mechanism	3 1 0	4		
18CHY503	Principles in Organic Chemistry	3 0 0	3			18CHY514	Heterocyclic and Natural Products Chemistry	3 0 0	3		
18CHY504	Coordination Chemistry	3 0 0	3			18CHY515	Organometallic Chemistry	3 0 0	3		
18CHY581	Inorganic Semi-micro Qualitative Analysis Lab.	0 0 5	2			18CHY583	Advanced Physical Chemistry Lab.	0 0 5	2		
18CHY582	Organic Quantitative Analysis Lab.	0 0 5	2			18CHY584	Inorganic Quantitative Analysis Lab.	0 0 5	2		
	TOTAL		**20**				TOTAL		**22**		
SEMESTER 9						**SEMESTER 10**					
18CHY601	Electrochemistry, Kinetics and surface Chemistry	3 1 0	4								
18CHY602	Synthetic Strategies and Reagents	3 1 0	4			18CHY696	Dissertation		14		
18CHY603	Solid State Chemistry and Materials Science	3 0 0	3				TOTA		**14**		
18CHY604	Bioinorganic Chemistry	3 0 0	3								
	Elective	3 0 0	3								
18CHY681	Organic Qualitative Analysis Lab.	0 0 5	2								
18CHY682	Instrumental and Analytical Methods Lab.	0 0 5	2								
	TOTAL		**21**				**TOTAL**	**216**			
ELECTIVES											
	Electives A & B (any two)						**Electives I & II (any two)**				
18CHY331	Batteries and Fuel Cells	3 0 0	3	E		18CHY631	Applied Electrochemistry	3 0 0	3	E	
18CHY332	Corrosion Science	3 0 0	3	E		18CHY632	Bioanalytical Chemistry	3 0 0	3	E	
18CHY333	Green Chemistry	3 0 0	3	E		18CHY633	Chemistry of Biomolecules	3 0 0	3	E	
18CHY334	Industrial Catalysis	3 0 0	3	E		18CHY634	Industrial Chemistry	3 0 0	3	E	
18CHY335	Introduction to Food Chemistry	3 0 0	3	E		18CHY635	Industrial Stoichiometry	3 0 0	3	E	
18CHY336	Polymer Chemistry	3 0 0	3	E		18CHY636	Material Science and Nanochemistry	3 0 0	3	E	
18CHY337	Surface Science and Coating Technology	3 0 0	3	E		18CHY637	Medicinal Chemistry	3 0 0	3	E	
18CHY353	Forensic Science	3 0 0	**3**	E		18CHY638	Supramolecular Chemistry	3 0 0	3	E	
						18CHY639	Nanomaterials for Biomedical Application	3 0 0	3	E	
						18CHY640	Industrial Metal Finishing Processes	3 0 0	3	E	
						18CHY641	Biosensors: Fundamentals and Application	3 0 0	3	E	
						18CHY642	Computational Chemistry	3 0 0	3	E	
						18CHY643	Sustainable Chemical Science	3 0 0	3	E	
						18CHY644	Sustainable techniques in Chemical Sciences	3 0 0	3	E	
LANGUAGES											
	Paper I						**Paper II**				
18HIN101	Hindi I	1 0 2	2	B		18HIN111	Hindi II	1 0 2	2	B	
18KAN101	Kannada I	1 0 2	2	B		18KAN111	Kannada II	1 0 2	2	B	
18MAL101	Malayalam I	1 0 2	2	B		18MAL111	Malayalam II	1 0 2	2	B	
18SAN101	Sanskrit I	1 0 2	2	B		18SAN111	Sanskrit II	1 0 2	2	B	

EVALUATION SCHEME AND GRADING SYSTEM

R.13 Assessment Procedure

R.13.1The academic performance of each student in each course will be assessed on the basis of Internal Assessment (including Continuous Assessment) and an end-semester examination.

Normally, the teachers offering the course will evaluate the performance of the students at regular intervals and in the end-semester examination.

R.13.2 In theory courses (that are taught primarily in the lecture mode), the weight for the Internal Assessment and End-semester examination will be 50:50. The Internal assessment in theory courses shall consist of at least two periodical tests, weekly quizzes, assignments, tutorials, viva-voce etc. The weight for these components, for theory-based courses shall be 20 marks for the Continuous assessment, comprising of Quizzes, assignments, tutorials, viva-voce, etc. and 15 marks each for both the Periodical Tests.

At the end of the semester, there will be an end-semester examination of three hours duration, with a weight of 50 marks, in each lecture-based subject.

R.13.3 In the case of laboratory courses and practical, the relative weight for internal assessment and End-semester examination will be 80:20.The weight for the components of internal assessment will be decided by the course committee/class committee at the beginning of the course.

Evaluation pattern for course having both Theory and Lab components:

Courses having only one hour per week for lecture/tutorial, be treated as a Lab. course, for evaluation purposes; and evaluation pattern will be 80 marks for continuous assessment of lab work and 20 marks for end-semester lab examination.

Courses having two hours per week for theory and/or tutorials, be given a weight of 60 marks and 40 marks for the Theory and Lab components, respectively; The Lab. component evaluation will be based on continuous evaluation, without any end-semester practical evaluation. 10 marks will be for continuous assessment of the theory portion, 10 marks for each of the two periodical tests, 30 marks for the theory end-semester examination and 40 marks for continuous assessment of lab work and

Courses having three hours per week for theory and/or tutorials, be given a weight of 70 marks and 30 marks for the Theory and Lab components, respectively; The Lab component evaluation will be based on continuous evaluation, without any end-semester practical evaluation. 15 marks will be for continuous assessment of the theory portion, 10 marks for each of the two periodical tests, 35 marks for the theory end-semester examination and 30 marks for continuous assessment of lab work.

R.13.4 It is mandatory that the students shall appear for the end-semester examinations in all theory and weight courses, for completion of the requirements of the course. Those who do not appear in the end-semester examinations will be awarded ‘F’ grade, subject to meeting the attendance requirement.

At the end of a semester, examinations shall be held for all the subjects that were taught during that semester and those subjects of the previous semester s for which the student s shall apply for supplementary examination, with a prescribed fee.

R.13.5 PROJECT WORK: The continuous assessment of project work will be carried out as decided by the course committee. At the completion of the project work, the student will submit a bound volume of the project report in the prescribed format. The project work will be evaluated by a team of duly appointed examiners.

The final evaluation will be based on the content of the report presentation by student and a

viva-voce examination on the project. There will be 40% weight for continuous assessment and the remaining60% for final evaluation.

If the project work is not satisfactory he/she will be asked to continue the project work and appear for assessment later.

R.14 PUBLICATION / INTERNSHIP

R.14.1All students, if they are to be considered for award of the Degree at the time of graduation, are required to have published ONE paper in Scopus-indexed Journal/Conference.

R.14.2Additional 5-10 marks will be awarded for each Publication, subject to a maximum of ONE paper per semester.

The additional marks shall be awarded in the semester in which the paper is published or accepted for publication, if applied for, within10 days of the publication of results of the concerned semester. The additional marks can be awarded to any course(s) where the student has to improve his/her grade.

R.14.3All publications shall be in Scopus-indexed Journals/Conferences and shall be as per the guidelines prescribed by the University.

R.14.4Students who have undergone Internship at reputed organizations or National / International Institutions, with the prior approval of the concerned Departmental Chairperson and the Head of the School, may be considered for waiver of the requirement of publication, for the award of Distinction. However, the decision of the Departmental Chairperson and the Head of the School, in this regard, shall be final.

R.16 Grading

R.16.1 Based on the performance in each course, a student is awarded at the end of the semester, a letter grade in each of the courses registered.

Letter grades will be awarded by the Class Committee in its final sitting, without the student representatives.

The letter grades, the corresponding grade points and the ratings are as follows:

Letter Grade	Grade Points	Ratings
0	10.00	Outstanding
A+	9.50	Excellent
A	9.00	Very Good
B+	8.00	Good
B	7.00	Above Average
C	6.00	Average
P	5.00	Pass
F	0. 00	Fail
FA	0. 00	Failed due to insufficient attendance
I	0. 00	Incomplete (awarded only for Lab courses/ Project / Seminar)
W		Withheld

R.16.2 ‘FA‘grade once awarded stays in the record of the student and is replaced with the appropriate grade when he/she completes the course successfully later.

Students who have secured an ‘FA’ in a course must re-register for the course or register for the course, if offered, under run-time re-do mode.

R.16.3 A student who has been awarded ‘I’ Grade in a Lab course, due to reasons of not completing the Lab., shall take up additional Lab. whenever offered next and earn a pass grade, which will be reflected in the next semester’s grade sheet.

The ‘I’ grade, awarded in a Project/Seminar course, will be subsequently changed into appropriate grade, when the student completes the requirement during the subsequent semester. If he/she does not complete it in the next semester, it will be converted to ‘F’ grade.

R.16.4 A student is considered to have successfully completed the course and earned the credit, if he/she scores a letter grade ‘P’ or better in that course.

R.21 Semester Grade Point Average (SGPA)

On completion of a semester, each student is assigned Semester Grade Point Average (SGPA) which is computed as below for all courses registered by the student during that semester.

Semester Grade Point Average = Σ (Ci x Gpi) / Σ Ci

where Ci is the credit for ith course in that semester and Gpi is the grade point for that course.

The summation is over all the courses registered by the student during the semester, including the failed courses. The SGPA is rounded off to two decimals.

R.22 Cumulative Grade Point Average (CGPA)

The overall performance of a student at any stage of the Degree programme is evaluated by the Cumulative Grade Point Average (CGPA) up to that point of time.

Cumulative Grade Point Average =Σ (Ci x Gpi) / Σ Ci

where Ci is the credit for ith course in any semester and Gpi is the grade point for that course.

The summation is over all the courses registered by the student during all the semesters up to that point of time, including the failed courses. The CGPA is also rounded off to two decimals.

R.23 Ranking

The ranking of the students in a batch at any intermediate or final stage is based on CGPA. Only those students who have passed all courses up to that stage in the first attempt are considered for ranking. Students are eligible for final ranking, only if the programme is completed within the normal duration, i.e., within two years from joining the programme.

R.24 Classification of successful candidates:

R.24.1 A student shall be considered to have successfully completed the programme, if he/she has:

i) registered and successfully completed all the core courses, electives and projects as mentioned in the curriculum;
ii) earned the required minimum number of credits as specified in the curriculum corresponding to the programme, within the stipulated time;
iii) published a paper at a Scopus-indexed Journal/Conference.

R.24.2 Candidates who have successfully completed the programme, within a period of four semesters from entering the programme, shall be classified as follows:
Candidates securing a CGPA of 8.00 and above – FIRST CLASS WITH DISTINCTION *
Candidates securing a CGPA between 6.50 and 7.99 – FIRST CLASS
and the same be mentioned in the Degree certificate;
(*subject to satisfying the condition mentioned at R.14.1 and having passed all the courses, in the first attempt, in four semesters, from the date of joining the programme)
If the programme is completed after four semesters of study, the candidates securing even a CGPA of 8.00 and above, shall be classified to have completed the programme, only with FIRST CLASS.

COURSE OBJECTIVES, COURSE OUTCOMES, SYLLABUS

18AVP201/	**Amrita Values Programme I/**	**1 0 0 1**
18AVP211	**Amrita Values Programme II**	**1 0 0 1**

Objectives
The student will gain understanding of the glory of Indian Itihasa (Epics) in general, wherefrom the student get inspired to follow the lifestyle of inspiring characters depicted in Ramayana.

Course Outcomes
After the completion of the course the student will be able to:

CO 1: Appreciate the relevance of Ramayana in modern times.

CO 2: Understand the family values and ideal human relationships portrayed in the Ramayana.

CO 3: Understand Dharma and its universality, emphasizing its applicability in an individual's life.

CO 4: Evaluate one's own personal ethics based on benchmarks from the Ramayana

CO 5: Apply the spiritual values from Ramayana in resolving personal and social conflicts.

CO 6: Understand the impact of itihasas on Indian civilization with reference to Mahabharata.

CO 7: Appreciate the relevance of Mahabharata and Bhagavad-Gita in the modern world.

CO 8: Understand the four goals of life (Purusharthas) as presented in the Mahabharata.

CO 9: Assimilate the positive qualities of the characters depicted in the itihasa.

CO 10: Analyse critical events and turning points in the Mahabharata with emphasis on the

underlying values and principles.

Course Content

Courses offered under the framework of Amrita Values Programmes I and II

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability

Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading

consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirties, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhīma and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the Vasthupurusha.

Organic Farming in Practice

Organic agriculture is the application of a set of cultural, biological, and mechanical practices that support the cycling of farm resources, promote ecological balance, and conserve biodiversity. These include maintaining and enhancing soil and water quality; conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering. This factsheet provides an overview of some common farming practices that ensure organic integrity and operation sustainability.

Ayurveda for Lifestyle Modification:

Ayurveda aims to integrate and balance the body, mind, and spirit which will ultimately leads to human happiness and health. Ayurveda offers methods for finding out early stages of diseases that are still undetectable by modern medical investigation. Ayurveda understands that health is a reflection of when a person is living in harmony with nature and disease arises when a person is out of harmony with the cycles of nature. All things in the universe (both living and nonliving) are joined together in Ayurveda. This leaflet endow with some practical knowledge to rediscover our pre- industrial herbal heritage.

Life Style and Therapy using Yoga

Yoga therapy is the adaptation of yogic principles, methods, and techniques to specific human ailments. In its ideal application, Yoga therapy is preventive in nature, as is Yoga itself, but it is also restorative in many instances, palliative in others, and curative in many others. The therapeutic effect comes to force when we practice daily and the body starts removing toxins and the rest is done by nature.

Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala,- Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Sixs limbs of Indian paintings) and the contextual stories

from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyan, Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

Indian Martial Arts and Self Defense

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala's traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

Social Awareness Campaign

The course introduces the students into the concept of public social awareness and how to transmit the messages of social awareness through various media, both traditional and modern. The course goes through the theoretical aspects of campaign planning and execution.

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Organic agriculture is the application of a set of cultural, biological, and mechanical practices that support the cycling of farm resources, promote ecological balance, and conserve biodiversity. These include maintaining and enhancing soil and water quality; conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering. This factsheet provides an overview of some common farming practices that ensure organic integrity and operation sustainability.

Ayurveda for Lifestyle Modification:

Ayurveda aims to integrate and balance the body, mind, and spirit which will ultimately leads to human happiness and health. Ayurveda offers methods for finding out early stages of diseases that are still undetectable by modern medical investigation. Ayurveda understands that health is a reflection of when a person is living in harmony with nature and disease arises when a person is out of harmony with the cycles of nature. All things in the universe (both living and non-living) are joined together in Ayurveda. This leaflet endow with some

practical knowledge to rediscover our pre- industrial herbal heritage.

Life Style and Therapy using Yoga

Yoga therapy is the adaptation of yogic principles, methods, and techniques to specific human ailments. In its ideal application, Yoga therapy is preventive in nature, as is Yoga itself, but it is also restorative in many instances, palliative in others, and curative in many others. The therapeutic effect comes to force when we practice daily and the body starts removing toxins and the rest is done by nature.

Learning Outcomes: Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world. Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Evaluation Pattern – R.13 & R.16

18CHY101 GENERAL CHEMISTRY I 3 1 0 4

Course Outcomes

After completion of the course a student will have

CO 1: Understanding of the atomic structure (various theories)

CO 2: Understanding of the basics required for Quantum Chemistry

CO 3: In-depth knowledge of the different types of bonds and their properties.

CO 4: Ability to solve problems related to chemical reactions.

Course Contents

Unit 1 Atomic Structure I

Dalton's atomic theory and its failure, Thomson's experiment charge on electron - Millikan's Oil Drop Technique,e/m ratio of an electron- Chadwick's experiment atomic number,Rutherford's and - limitations of Rutherford's model - Maxwell's electromagnetic theory of radiation and s model, Bohr's model of hydrogen atom - Bohr's theory and Ritz combination principle, spectra – emission and absorption - Hydrogen spectrum, Bohr-Sommerfeld theory.

Unit 2 Atomic Structure II

Planck's quantum theory of radiation, dual character of electrons - de Broglie's equation and experiment-Heisenberg's uncertainty principle - photoelectric effect, Compton, Zeeman and Stark effects, Schrodinger wave equation, eigen values, significance of wave function (ψ and ψ^2) and quantum numbers, Schrodinger wave equation for hydrogen and hydrogen-like systems (no derivations, only the final equation), probability distribution of electrons around the nucleus - distribution of 1s, 2s & 2p electrons or orbitals, shapes of atomic orbitals - s, p, d and f, aufbau principle, Hund's rule, Pauli's exclusion principle, electronic configuration of elements.

Unit 3 Chemical Bonding I

Electrovalency and ionic bond formation, ionic compounds and their properties, lattice energy, Born-Lande equation and its application, Born-Haber cycle and its application, solvation enthalpy and solubility of ionic compounds, covalent bond, covalency, formation of H_2 in terms of decrease of energy, orbital theory of covalency - sigma and pi bonds - formation of covalent compounds and their properties.

Unit 4 Chemical Bonding II

Hybridization and geometry of covalent molecules - VSEPR theory - polar and non-polar covalent bonds, polarization of covalent bond - polarizing power, polarisability of ions and Fajan's rule, dipole moment, percentage ionic character from dipole moment, dipole moment and structure of molecules, co-ordinate covalent compounds and their characteristics, metallic bond - free electron, valence bond and band theories, weak chemical bonds – inter and intra molecular hydrogen bond - van der Waals forces.

Unit 5 Chemical analysis and stoichiometric calculation

Titrimetry - Fundamental concepts – Theory behind acid base, redox, precipitation and complexometric titrations – problems based on stoichiometry - gravimetry principle and model calculations involving estimation of barium, calcium and nickel - data analysis, significant figures, precision and accuracy – types of errors - mean and standard deviation.

TEXTBOOKS:

1. *F. A. Cotton, G. Wilkinson and P. L. Gaus, 'Basic Inorganic Chemistry', 5th edition, John Wiley, 1987.*
2. *C. N. R. Rao, 'University General Chemistry', Macmillan, India, 2000.*

REFERENCES:

1. *B. R. Puri, L. R. Sharma, M. S. Pathania, 'Principles of Physical Chemistry', Vishal Publishing Co., 2008*
2. *Manas Chanda, 'Atomic Structure and Chemical Bond', 4th edition, Tata McGraw-Hill, New Delhi, 2000.*
3. *Peter Atkins and Julio de Paula, 'Elements of Physical Chemistry', 5th edition, Oxford University Press. 2009.*

Learning Outcomes: Students will get the thorough understanding of the basic concepts of atoms, molecules, molecular bonding and stoichiometry.

Evaluation Pattern – R.13 & R.16

18CHY111 GENERAL CHEMISTRY II 3 1 0 4

Course Outcomes

After the completion of the course a student will have

CO 1: Indispensable knowledge of structure of nucleus, stable and unstable atomic nuclei, nuclear reactions and different modes of radioactive decay, kinetics of nuclear reactions.

CO 2: understanding of the qualitative description of bonding in solid materials, crystal classes and symmetries.

CO 3: Understanding to predict and identify acids and bases and the property of solvents

CO 4: Knowledge of fundamental physical scaling laws applied to understanding the properties of materials at the nanometre scale.

CO 5: A perfect understanding of the fundamentals of water and wastewater treatment

Course Contents

Unit 1 Nuclear Chemistry

Size, structure and stability of the nucleus - n/p ratio, packing fraction, mass defect and binding energy - nuclear fission and fusion, atom bombs -hydrogen bomb – radioactivity, alpha, beta particles and gamma radiation - Soddy-Fajan displacement law, half and average life period - Geiger-Muller Counter and Wilson Cloud Chamber. applications of radioactivity - in medicine, agriculture, carbon and fossil dating - isotopes, isobars, isotones, isodiapheres and nuclear isomers - natural and artificial radioactivity, artificial transmutation of elements, induced radioactivity, preparation of transuranic elements, Q values, nuclear coulombic barrier**.**

Unit 2 Solid State

Crystalline and amorphous solids, isotropy and anisotropy, elements of symmetry in crystal systems indices - Miller indices, space lattice and unit cell, Bravais lattices, the seven crystal systems and their Bravais lattices, X-ray diffraction - Bragg's equation and experimental methods (powder method and rotating crystal technique), types of crystals - molecular, covalent, metallic and ionic crystals - close packing of spheres – hexagonal, cubic and body centered cubic packing, interstices in packing - types of crystals – molecular, covalent, metallic crystals - defects in crystals – stoichiometric, non-stoichiometric, extrinsic and intrinsic defects.

Unit 3 Liquid state

Properties of liquids-viscosity, surface tension, capillary action, evaporation, vapour pressure, boiling point and distillation, heat transfer involving liquids

Unit 4 Acids, Bases and Non-aqueous solvents

Concepts of acids and bases – hard and soft acids and bases - Pearson's concept, HSAB principle and its application - basis for hard - hard and soft - soft interactions - non-aqueous solvents - general characteristics of non-aqueous solvent - melting point, boiling point, latent heat of fusion and vaporization, and dielectric constant - reactions such as complex formation, redox, precipitation and acid base type in non-aqueous solvents like liquid ammonia, liquid SO_2 and liquid HF.

Unit 5 Water Technology

Soft and hard water – Hardness – units of hardness – alkalinity - dissolved oxygen – water for various types of industries – treatment of water by ion exchange process - boiler feed water – boiler compounds – internal and external conditioning - water for drinking - municipal water treatment – desalination by RO and electro dialysis.

TEXTBOOKS:

1. Marion Clyde Day Jr, Joel Selbin, Harry H Sisler, '*Theoretical Inorganic Chemistry'*, LLC, 2012
2. F. A. Cotton and G. Wilkinson*, 'Advanced Inorganic Chemistry', 5th edition, John Wiley and Sons, New York, 1987*
3. *B. R. Puri, L. R. Sharma, Kalia, 'Principles of Inorganic Chemistry', Vishal Publishing Co., 2008*

REFERENCES:

1. *H. S. Arnicker, 'Essentials of Nuclear Chemistry', 4th edition, New Age International Publishers, 2005.*
2. *L. V. Azaroff, "Introduction to Solids", Mc Graw Hill, New York, 2009*
3. *B. R. Puri, L. R. Sharma, M. S. Pathania, Principles of Physical Chemistry', Vishal Publishing Co., 2008*
4. *Gurdeep Raj, 'Advanced Inorganic Chemistry', 31st edition, Goel Publishing House, 2008.*

Learning Outcomes: Students will get the thorough understanding of the basic concepts of nuclear chemistry, solid state chemistry, acids and bases and water technology, which will be used in industrial and engineering applications.

Evaluation Pattern – R.13 & R.16

18CHY184 Inorganic Quantitative lab. –Volumetric Analysis 0 0 2 1

Course Outcomes

After completion of the course a student will be conversant with

CO 1: Various methods of titrations to determine the amounts of acids and bases in a given solution

CO 2: Different methods of redox titrations in Quantitative analysis of inorganic compounds

CO 3: Different types of titrations involving Inorganic Complexes.

Course Contents:

Acid base titrations

1. Preparation of standard sodium carbonate solution, and standardization of hydrochloric acid (methyl orange indicator). Estimation of sodium hydroxide in solution using phenolphthalein indicator.
2. Preparation of standard oxalic acid solution and standardization of sodium hydroxide solution. Estimation of sulphuric acid in solution.
3. Estimation of sodium hydroxide and sodium carbonate in a mixture (analysis of commercial caustic soda) by double indicator method.

Redox titrations

Permanganometry

4. Preparation of standard oxalic acid solution and standardization of potassium permanganate solution. Estimation of ammoniumIron (11) sulphate in solution.
5. Preparation of standard oxalic acid solution and standardization of potassium

permanganate solution. Estimation of hydrogen peroxide solution.

6. Estimation of calcium.
7. Estimation of Ferrous iron.

Dichrometry

8. Estimation of ferrous iron using external and internal indicators.
9. Estimation of ferric iron using external and internal indicators.

Iodimetry and Iodometry

10. Standardisation of sodium thiosulphate using potassium iodate, Electrolytic copper and potassium dichromate.
11. Estimation of As2O3 and arsenite
12. Estimation of copper sulphate.
13. Estimation of iron in the given sample of haematite by dichromate method.
14. Estimation of copper in bronze by iodometric method.
15. Estimation of tin in solder using EDTA.

TEXTBOOKS:

1. *A. I.Vogel, 'A text book of Qualitative Analyses', 4th edition, Longmans publications, 1985.*
2. *G. Pass & H. Sutcliffe, 'Practical Inorganic Chemistry', 2nd edition, Chapman & Hill, 1974.*

REFERENCES:

1. *G. S.Turpin, 'Practical Inorganic chemistry', MacMillan, 1895.*
2. *G. W. Parshall, 'Inorganic Synthesis', Vol. 15, Tata McGraw-Hill Education, 1974.*

Learning Outcomes: This lab course trains the students in volumetric analyses. The knowledge of different type of the titrations and analyses they get is helpful in understading and applying the analytical chemistry in industrial applications.

Evaluation Pattern – R.13 & R.16

18CHY202 PHYSICAL CHEMISTRY I 3 1 0 4

Course Outcomes

After completion of the course, a student will

CO 1: Have the ability to solve problem and critically think about thermodynamic and kinetic problems and extrapolate solutions based on learned theory.

CO 2: Be able to predict reaction spontaneity using relevant thermodynamic parameters.

CO 3: Understand the different thermodynamic properties and know how they are inter related at different conditions.

CO 4: Know how to apply Le-Chateliers principle to chemical and physical equilibrium conditions.

CO 5: Be able to calculate solution concentration in various units and perform stoichiometric calculations.

CO 6: Students will be able to understand the relevance of colligative properties and its applications

CO 7: Have the ability to demonstrate the variation of free energy functions with temperature, pressure and volume.

CO 8: Have a perfect knowledge of real gases and van der Waal gases.

CO 9: Understand thoroughly the three laws of thermodynamics and their importance in day to day life.

Course Contents:

Unit 1 Kinetic Theory of Gases

Kinetic molecular model of gases – Maxwell distribution of velocities and its use in calculating molecular velocities (average rms and most probable velocity and average kinetic energy) - Collision diameter, mean free path and viscosity of gases including their pressure and temperature dependence – Relation between mean free path and coefficient of viscosity – behaviour of real gases – deviation of gases from ideal behaviour – compressibility factor – van der Waal's equation of state - its derivation and application in explaining ideal gas behaviour – virial equation of state – van der Waals equation expressed in virial form and calculation of Boyle temperature – Isotherms of real gases and their comparison with van der Waal's isotherms – Determination of molecular mass by limiting density method – critical phenomena – critical constants and determination.

Unit 2 First law of thermodynamics and Thermo chemistry

System and surrounding – isolated, closed and open systems - state of the system - Intensive and extensive variables. Thermodynamic processes - reversible and irreversible, isothermal and adiabatic processes - state and path functions - exact and inexact differentials, concept of heat and work. First law of thermodynamics – statement. Relation between Cp and Cv, calculation of w, q, dE and dH for expansion of ideal and real gases under isothermal and adiabatic conditions of reversible and irreversible processes. Thermochemistry Enthalpy change of a reaction and different enthalpy changes - relation between enthalpy of reaction at constant volume (qv) and at constant pressure(qp) - temperature dependence of heat of reaction - Kirchoffs equation - of solution and dilution bond energy and its calculation from thermo chemical data - Integral and differential heats.

Unit 3 Second and Third laws of Thermodynamics

Second law of thermo dynamics - different statements of the law - Carnot’s cycle and efficiency of heat engine - Carnot’s theorem - thermodynamic scale of temperature - concept of entropy - definition and physical significance of entropy - entropy as a function of P, V and T - entropy changes during phase changes - entropy of mixing - entropy criterion for spontaneous and equilibrium processes in isolated system - Gibb’s free energy (G) and Helmholtz free energy (A) - variation of A and G with P, V and T - Gibb’s - Helmholtz equation and its applications - thermodynamic equation of state - Maxwell’s relations..

Unit 4 Chemical equilibria

Law of mass action - equilibrium constant – Relation between Kp, Kc and Kx – Thermodynamic treatment of the law of mass action – vant Hoff reaction isotherm – Temperature dependence of the equilibrium constant – The van'tHoffs equation – Pressure dependence of the equilibrium constant Kp and K_c– Factors that change the state of equilibrium - Le-chatelier's principle and its application to chemical and physical equilibria.

Unit 5 Solutions

Mixture, homogeneous and heterogeneous mixtures, solution, solvent, solute - concentration of a solution, methods for expressing concentration - concept of activity and activity coefficients - completely miscible liquid systems - benzene and toluene. Duhem - Margules equation, azeotropes - HCl – water and ethanol - water systems - partially miscible liquid systems - phenol - water, triethanolamine - water and nicotine - water systems. Lower and upper CSTs - effect of impunities on CST - completely immiscible liquids - Nernst distribution law – derivation. Applications - determination of formula of a complex ($KI + I_2 = KI_3$). Solvent extraction principle and derivation of a general formula of the amount unextracted - colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression in freezing point and osmotic pressure (quantitative treatment), molecular weights from colligative properties.

TEXTBOOKS:

1. *Gurdeep Raj, 'Advanced Physical Chemistry', 35th edition, Goel Publishing House, 2009.*
2. *Puri, Sharma &Pathania, 'Principles of Physical Chemistry', 42nd edition, Vishal Publishing & Co, 2007.*

REFERENCES:

1. *R. Stephen Berry, Stuart A. Rice & John Ross, 'Physical Chemistry', 2nd edition, Oxford University press, 2000.*
2. *Levin, 'Physical Chemistry', 6th edition, Tata Mcgraw-Hill Education, 2011.*

Learning Outcomes: This course familiarises students with principles kinetics, thermodynamics and chemical equ librium whuch are valuable in understanding and analysing all kinds of chemical, natural, engineering and other processes.

Evaluation Pattern – R.13 & R.16

18CHY203 INORGANIC CHEMISTRY I 3 1 0 4

Course Outcomes

After completion of the course a student will gain

CO 1: Perfect knowledge of periodic table.

CO 2: An understanding of the properties of elements in the periodic table

CO 3: Knowledge of extraction of metals from their ores.

CO4: Knowledge in identifying the cations and anions in inorganic mixture.

CO5: Comprehensive understanding in extraction of metals using Ellingham diagram.

Course Contents:

Unit 1 s block elements

Long form of periodic table and classification based on electronic configuration - periodicity in properties – atomic, ionic, covalent radii – ionization potential, electron affinity – electronegativity - effective nuclear change and their trends in periodic table. Anomalous behavior of 1st element of a group – diagonal relationship.

S Block elements: General characteristics – atomic and ionic radii – ionization energies – electropositive character – reducing properties – hydration of ions – flame coloration – lattice energies – chemical properties – extraction of alkali and alkaline earth metals – uses of alkali and alkaline earth metals – complexes of alkali and alkaline earth metals – compounds of alkali and alkaline earth metals and their applications.

Unit 2 p block elements

General characteristics – metallic and non-metallic character – diagonal relationship – extraction – Lewis acids – back bonding – boron compounds. Catenation – structure of graphite – intercalation compounds – metal carbonyls – carbides – silica, silicates, glass manufacturing – zeolites. Allotropy in P and S. compounds of N and P - hydrazine – hydrazoic acid – hydroxyl amine – phosphazines. Anomalous behavior of oxygen, structure of ozone.Hydrides, halides, oxides, oxoacids, persulfuric acids, nitrides of group VI and VII elements. Inter halogen compounds and their structure. Isolation of noble gases – preparation, properties, structure and uses of noble gas compounds.

Unit 3 d block elements

Transition metals: Transition metals – general characteristics – metallic character – oxidation states – size – density – melting and boiling points – ionization energy – color – magnetic properties – reducing properties – catalytic properties – Non stoichiometric compounds – complex formation – alloy formation – difference between first row and other two rows. Chemistry of Zr, Ti, V and Mo compounds.

Unit 4 f block elements

Position in the Periodic Table - General characteristics of Lanthanides and Actinides - Lanthanide contraction and its consequences. Isolation of Lanthanides from Monazite including the Ion exchange resin method. Actinides - occurrence and preparation, comparison with lanthanides. Chemistry of Thorium and Uranium - Important compounds - preparation, properties and uses of Uranyl nitrate, Uranium hexafluoride, Thorium dioxide.

Unit 5 Metallurgy

Occurrence of metals based on standard electrode potential – concentration of ores – calcination, roasting and smelting – reduction using carbon and other reducing agents – electrolytic reduction – hydrometallurgy – Ellingham diagram. Refining of metals – electrolytic refining – oxidative refining – zone refining – Van Arkel method. Extractive metallurgy of Li, Ni – Ferrous metallurgy – manufacture of steel by open hearth process –

Alloys – composition and uses of German silver, Brass, Bronze, Gunmetal, Alnico.

TEXTBOOKS:

1. *Puri B R, Sharma L R, Kalia K K, 'Principles of Inorganic Chemistry', 23rd edition, ShobanLalNagin Chand & Co, New Delhi, 1993.*
2. *Lee J. D., 'Concise Inorganic Chemistry', Black Well Science, UK. 2006*
3. *Soni P. L., 'Text Book of Inorganic Chemistry', S, Chand & Co, New Delhi, 2006.*

REFERENCE BOOKS:

1. *Madan R. D., Tuli G. D and Malik S. M., 'Selected Topics in Inorganic chemistry', S. Chand & Co, New Delhi, 2006.*
2. *S. F. A. Kettle, 'Physical Inorganic Chemistry', Spectrum, 1996.*
3. *B. E. Dogulas DH McDaniel's and Alexander, 'Concepts and Models of Inorganic Chemistry', Oxford IBH, 1983.*

Learning Outcomes: This course is helpful in understanding the general nature of elements, their classification, their extraction using metallurgical processes and applications.

Evaluation Pattern – R.13 & R.16

18CHY212 PHYSICAL CHEMISTRY II 3 1 0 4

Course Outcomes

After completion of the course, a student will

CO 1: Understand the basics of heterogeneous systems

CO 2: Master the ability to apply phase rule to different systems

CO 3: Acquire a thorough understanding of the basics of rates of reactions

CO 4: Apply the principles of kinetics to different types of reactions

CO 5: Understand the theory of rates of reactions and their application

CO 6: learn about the different types of catalysis.

CO 7: Understand the concept of adsorption and its wide range of applications

CO 8: Master the concepts of electrochemistry applied to electrolytes in solution

CO 9: Learn the theory of strong and weak electrolytes, pH and its calculations in different types of solutions

CO 10: Understand the theory behind the electrochemical cells & cell potential and their applications.

Course Contents

Unit 1 Phase Equilibria

Definition of terms: Phase, components and degrees of freedom – Derivation of Gibbs phase rule - application of phase rule to one component system: Water, carbondioxide and sulphur system – Reduced phase rule - Two component system: Simple eutectic system: Pb-Ag system, Pattinson's process. Thermal analysis and cooling curves, Compound formation with congruent melting point Zn – Mg, and incongruent melting point Na – K system. Metal systems forming continuous solid solutions and solid solutions with minimum and maximum melting points.

Unit 2 Chemical Kinetics

Molecularity and order of a reaction, rate law expression and rate constant - first, second, third and zero order reactions, pseudo-first order reactions (pseudo-unimolecular reactions), complex reactions - equilibrium and steady state approximations - mechanism of these reactions - effect of temperature on reaction rates - Arrhenius equation and its derivation, activation energy, characteristics of activated complex Theories of reaction rates – collision theory – derivation of rate constant of bimolecular gases reaction – failure of collision theory – Lindemann's theory of unimolecular reaction. Theory of absolete reaction rates – derivation of rate for a bimolecular reaction – significance of entropy and free energy of activation.

Unit 3 Catalysis

Catalysis – homogeneous and heterogeneous – homogeneous catalysis – kinetic of acid – ase reaction and mechanism - theory of homogeneous and heterogeneous catalysis. Heterogeneous catalysis – adsorption – types – chemical and physical, characteristics of adsorption. Different types of adsorption isotherms – Freundlich and Langmuir - enzyme catalysis, difference between enzyme catalysis and general heterogeneous catalysis, factors affecting the rate of enzyme catalyzed reactions.

Unit 4 Electrochemistry I

Electrolysis, Faraday's laws of electrolysis, strong and weak electrolytes specific, equivalent and molar conductance, equivalent conductance at infinite dilution and their measurement - Kohlrausch's law and its applications - calculation of equivalent conductance at infinite dilution for weak electrolytes, degree of dissociation of weak electrolytes - solubility of sparingly soluble salts - applications of conductivity measurement - conductometric titrations - acid-base precipitation and complexometric titrations, Ostwald's dilution law and its limitations, common ion effect and its application, concept of pH, indicators, theories of indicators – buffers and their pH - Henderson equation, hydrolysis and example of hydrolysis - relation between K_h, K_b and K_w, transport number (Hittorf number) and its experimental determination - Hittorf's method and moving boundary method.

Unit 5 Electrochemistry II

Potential and its origin – electrical double layer and equilibrium – single electrode potential, standard hydrogen electrode - EMF series and its significance – Galvanic cells, IUPAC notation - reversible and irreversible cells, electrodes, calomel and Ag/AgCl reference electrodes - indicator and ion selective (pungor) electrodes and their applications, Computation of cell EMF, Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K) Concentration cells -variation of potential with concentration, Nernst equation and its

applications, potentiometric titrations - acid-base, redox and precipitation titrations. Corrosion –basic concept - electrochemical corrosion and its mechanism - Cathodic and anocic protection-Inhibitors.

TEXTBOOKS:

1. *Puri, Sharma &Pathania, 'Priniciples of Physical Chemistry', 42nd edition, Vishal Publishing Co, 2007.*
2. *Gurdeep Raj, 'Advanced Physical Chemistry', 35th edition, Goel Publishing House, 2009.*

REFERENCES:

1. *Glasstone and Lewis, 'Elements of Physical Chemistry', 2nd edition, Macmillan, 1982.*
2. *P. C. Rakhit, 'Physical Chemistry', 7th edition, Sarat Book House, 2001.*
3. *R. Stephen Berry, Stuart A. Rice & John Ross, 'Physical Chemistry', 2nd edition, Oxford University press, 2000.*

Learning Outcomes: This course enable students to understand the basic principles involved in chemical kinetics, catalyses and electrochemistry and enable them to look into their industrial applications.

Evaluation Pattern – R.13 & R.16

18CHY213 ORGANIC CHEMISTRY I 3 1 0 4

Course Outcomes

After completion of the course a student will

CO1: Gain knowledge about classification and nomenclature of organic compounds, detection and estimation of elements present in organic compounds, physical and chemical methods of determination of molecular weights

CO2: Familiarise with various electronic effects, reactive intermediates in organic reactions.

CO3: Learn about various types of isomerism in organic compounds, stereochemistry of organic compounds

CO4: Learn about general methods of preparation of alkanes, alkenes, alkynes, conformations of acyclic and cyclic compounds

CO5: Have in-depth knowledge on aromaticity, various types of reactions like electrophilic and nucleophilic substitution reactions, disubstitution reactions of aromatic compounds

Course Contents:

Unit 1 Basic concepts in Organic Chemistry
Composition of organic compounds – detection and estimation of elements – carbon, hydrogen, nitrogen, oxygen, sulphur, phosphorous, halogens – Calculation of empirical and molecular formula - determination of molecular weights – physical and chemical methods -

empirical formula and molecular formula – Classification and Nomenclature of organic compounds.

Unit 2 Organic reactions and their mechanisms

Electron displacement effects – inductive, electromeric, mesomeric and hyperconjugative. Reactive intermediates – carbocations, carbanions, free radicals and carbenes – electrophiles and nucleophiles – hemolytic and heterolytic reactions – Substitution reactions (SN1 and SN2) – addition reaction – electrophilic and nucleophilic, elimination – E1 and E2 and rearrangement reactions – inter and intramolecular - condensation reactions – reduction and oxidation reactions.

Unit 3 Isomerism and Stereochemistry

Structural isomerism - chain, position, functional and metamerism, geometrical isomerism – determination of configuration, optical isomerism, Asymmetry, dissymmetry and chirality, enantiomers – Fischer projections – absolute and relative configurations – R and S systems – resolution of racemic mixtures – asymmetric synthesis.

Unit 4 Alkanes, cycloalkanes, alkenes and alkynes

Structure, nomenclature, isomerism in alkanes, alkenes and alkynes. General methods of preparation of alkanes, cycloalkanes, alkenes and alkynes. Physical and chemical properties alkanes, cycloalkanes, alkenes and alkynes. Conformation of alkanes.

Unit 5 Homocyclic Aromatic compounds and Aromaticity

Structure of benzene – nomenclature of aromatic compounds – general methods of preparation – physical chemical properties – Electrophilic and nucleophilic substitution reactions – orientation in aromatic disubstitution - Aromaticity – Huckel's rule – anisotropic ring current – aromatic – nonaromatic and antiaromatic compounds.

TEXTBOOKS:

1. Organic Chemistry, T. W. Graham Solomons, Craig B. Fryhle, John Wiley & Sons; 10th edition (December, 2009)

2. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition, Prentice Hall, 1992.

3. D. Nasipuri 'Stereochemistry of Organic Compounds', 2nd Edition, New Age International (P) Ltd., Publishers, 1994.

REFERENCES:

1. Peter Sykes, 'A Guide book to Mechanism in Organic Chemistry', 6th Edition, Pearson Education, 2009.

2. P. S. Kalsi' 'Organic Reactions and their Mechanisms", New Age International Publishers, 2009.

4. J. Clayden, N. Greeves, S. Warren and P. Wothers, 'Organic Chemistry', 2nd edition, Oxford University Press, 2012.

5. K. S. Tewari and N. K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House, 2005.

Learning Outcomes: The information students get in this course about the carbon compounds, types, bonding, structures and reactions will enable them to advance into various applications of organic chemistry (in drugs, plastics, dyes and other everyday life products).

Evaluation Pattern – R.13 & R.16

18CHY281 Inorganic Qualitative Lab. 0 0 3 1

Course Outcomes

After completion of the course, a student will be able to

CO 1: Gain a thorough knowledge of Systematic qualitative analysis of mixtures containing two acidic and two basic radicals with an interfering radical.

CO 2: Actively engage in safe laboratory practices: handling laboratory glassware, equipment, and chemical reagents including how to perform common laboratory techniques.

CO 3: Prepare Inorganic Complexes with ease

Course Contents:

I. Qualitative Analysis:

Analysis of mixtures containing two anions (one simple and one interfering) and two cations (of different groups) from the following:

Anions - HCO_3^-, CO_3^{2-}, Cl^-, F^-, Br^-, I^-, NO_3^-, BO_3^{3-}, SO_4^{2-} and PO_4^{3-}

Cations - Pb^{2+} Bi^{3+}, Cd^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Mn^{2+}, Zn^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, K^+, Na^+ and NH_4^+, Cu^{2+}, Mn^{2+}.

Note:

1. Mixtures requiring elimination of phosphate and borate radicals should not be given (avoid cat ions like Ba^{2+}, Sr^{2+}, Ca^{2+} and Mn^{2+} when phosphate and borate are given).
2. Combinations like Cl^- and Br^-, $I^-$and Cl^- and NO_3^- and Br^- shall be avoided.
3. Salts that yield $SrSO_4$, $BaSO_4$, $CaSO_4$, $PbSO_4$ and $FeSO_4$ on double decomposition shall be avoided.
4. The two cations in the mixture should belong to different groups. However, combinations like Mg^{2+} and NH_4^+, K^+ and NH_4^+ can be given.

II. Preparations: *(Any six from the following)*

1. Ferrous ammonium sulphate
2. Tetrammine copper (II) sulphate
3. Potassium trisoxalato chromate
4. Prussian Blue
5. Hexammine Cobalt (II) chloride
6. Nickel dimethyl glyoximate
7. Potassium trisoxalato ferrate (III)
8. Tristhioureacopper (I) sulphate
9. Ferric alum
10. Potash alum
11. Mohr Salt from Kipp's waste.

TEXTBOOKS:

1. A. I. Vogel, 'A text book of Qualitative Analyses', 4th edition, Longmans publications, 1985.

2. V. V. Ramanujam, 'Inorganic Semi Micro Qualitative Analysis', 3rd edition, The National Publishing Company, 1974.

REFERENCES:

1. G. Pass & H. Sutcliffe, 'Practical Inorganic Chemistry', 2nd edition, Chapman & Hill, 1974.

2. D. A.Skoog and D. M.West, 'Analytical Chemistry - An Introduction', 4th Edition, CBS Publishing Japan Ltd., 1986.

Learning Outcomes: The methods used in analysing the different inorganic cations and the chemistry behind it is very useful in the various applications like food safety and pharmaceuticals.

Evaluation Pattern – R.13 & R.16

18CHY282 Basic Organic Qualitative Lab. 0 0 2 1

Course Outcomes

After completion of the course, a student will gain practical experience in

CO 1: Preparation of reagents used in Organic analysis.

CO 2: Determination of melting and Boiling points of organic compounds

CO 3: Recrystallisation of organic compounds to get maximum purity of the compounds prepared.

CO 4: Identifying the elements present in the compound, the type of functional groups present in the compound and prepare derivatives to confirm the compound.

Course Contents:

1. Basic idea on the preparation of reagents used in organic analysis. (Borshes reagent, Schiff's reagent, phenolphthalein, Neutral FeCl3, Tollens reagent, Fehlings solution),
2. Determination of boiling point and melting point – capillary method,
3. Methods of re-crystallisation,
4. Tests for elements: Nitrogen, Halogens and Sulphur
5. Tests for unsaturation. Tests for aromatic character.
6. Study of the reactions of the following functional groups: alcohol, aldehyde, ketone, carboxylic acid, 1,2 dicarboxylic acid, ester, primary and secondary amines,
7. Systematic analysis of the following organic compounds containing one functional group and characterization with a derivative - alcohol, aldehyde, ketone, carboxylic acid, 1,2 dicarboxylic acid, ester, primary and secondary amines.

REFERENCES:

1. F. G.Mann and B. C.Saunders, 'Practical Organic Chemistry' 4th edition, Pearson

Education, 2009.
2. V. K.Ahluwalia and S. Dhingra 'Comprehensive Practical Organic Chemistry' Universities Press, 2000.
3. B. S.Furnis, A. J.Hannaford, P. W. G. Smith and T. R.Tatchell, 'Vogel's Text book of Practical Organic Chemistry', ELBS/Longman, 1989.
4. S. P. Bhettani & Aruna Chhikara, 'Practical organic chemistry (qualitative analysis)', Ane books (India) Pvt Ltd, 2008.

5. O. P. Pandey, D.N Bajpai, S. Gini, 'Practical Chemistry, for I, II & III BSc. Students', S. Chand & Company Ltd reprint, 2009.

6. V. K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate, 'College Practical Chemistry', Universities Press (India) Pvt Ltd, 2008.

Learning Outcomes: This lab course provides the students with the knowledge of fundamental principles and practicle techniques to identify the nature and reactivity of organic compounds. Which is very useful in the synthesis and analysis of the various highly useful organic compounds.

Evaluation Pattern – R.13 & R.16

18CHY301 PHYSICAL CHEMISTRY III 3 1 0 4

Course Outcomes

After completing the course, a student will have a thorough knowledge of

CO 1: Basics of quantum mechanics.

CO 2: Application of quantum mechanical treatment to simple systems.

CO 3: The basics of group theory – symmetry elements and symmetry operations, and its importance in the molecular spectroscopy and molecular symmetry.

CO 4: Group theory for formation of group multiplication tables.

CO 5: Basics of irreversible thermodynamics

CO6: Different statistical methods to derive the thermodynamic properties.

CO 7: The photophysical, photochemical reactions, photosensitized reaction, chemiluminescence and their applications.

CO 8: The principles for predicting mechanisms of simple photochemical reactions.

CO 9: Adsorption- types and mechanism and derivation of adsorption isotherms.

CO 10: The special properties of colloids, types, preparation, properties and applications.

Course Contents:

Unit 1 Introduction to Quantum Chemistry

Introduction to quantum mechanics, Planck's quantum theory of radiation, photoelectric effect - dual nature of radiation, de Broglie's hypothesis - dual character of matter, uncertainty principle, Schrodinger wave equation - time dependent and time independent (no derivation), wave function ψ and its physical meaning, application of Schrodinger equation - particle in a one-dimensional box with two infinite potential barriers (energy of the particle, quantum number and quantization, momentum of the particle, energy level diagram, zero point energy, forms of the wave, node) and utility of this model, application of quantum mechanics to problems in chemistry - quantum chemistry (mention a few applications).

Unit II – Basics of Group Theory

Symmetry- Elements of symmetry and symmetry operations – identity, proper axis of rotation, plane of symmetry, improper axis of rotation and center of inversion. Group and group theory- brief mathematical introduction, abelian and cyclic groups. Molecular point groups, classification and nomenclature of point groups- conditions and examples of non-axial, axial, dihedral and infinite point groups. Algebra of symmetry operations, matrix representations of symmetry operations, group multiplication table.

Unit 3 Irreversible and Statistical Thermodynamics

Reversible and irreversible thermodynamics, examples for irreversible processes, postulate or assumption of local equilibrium, entropy production - entropy production in heat flow and in matter flow, forces and fluxes, introduction to statistical thermodynamics, system, assembly, ensemble, canonical and micro canonical ensemble, Boltzmann distribution law (no derivation), partition function, qualitative and basic ideas of Maxwell-Boltzmann statistics, Bose-Einstein statistics and Fermi-Dirac statistics, bosons and fermions.

Unit 4 Photochemistry

Photochemistry - Consequences of light absorption - The Jablonski diagram – non-radiative transitions - radiative transitions – laws of photochemistry - Lambert's law, Beer's law and Beer-Lambert law, deviation from Beer's law, Grotthus - Draper law - The Stark Einstein law of photochemical equivalence - Quantum efficiency (quantum yield). Energy transfer in photochemical reactions – photosensitisaiton - Photosynthesis in plants - Chemiluminescence - fluorescence and phosphorescence – lasers - uses of lasers. Photochemical reactions - Kinetics of hydrogen-bromine reaction - decomposition of HI - photoelectric cells, photosensitization and photosensitiser, photosynthesis.

Unit 5 Surface Chemistry and Colloids

Absorption – physical and chemical - adsorption isotherms, Freundlich and Langmuir isotherms, positive, negative and electrostatic adsorption, applications of adsorption, colloidal state, dispersed phase, dispersion medium, types of colloidal systems, sols, gels and foams - lyophobic and lyophilic colloids, preparation by mechanical and electrical dispersion and chemical methods, purification by electrodialysis, and ultrafiltration, properties - colour, optical and electrical properties, qualitative idea of electrical double layer (Helmholtz-Perrin theory, Gouy-Chapman theory, Stern's theory), stability of lyophobic and lyophilic sole,

isoelectric point, protection of colloids - protective colloids, Gold Number, Hofmeister series, coagulation or flocculation - addition of electrolytes, continuous dialysis and salting out, Hardy-Schulze law, coacervation, sensitization, micelle and critical micellisation concentration, application of colloids.

TEXTBOOKS:

1. *R. K. Prasad, 'Quantum Chemistry', 3rd edition, New Age International Publishers, 2006.*
2. *Puri, Sharma &Pathania, 'Principles of Physical Chemistry', 42nd edition, Vishal Publishing Co, Delhi, 2007.*
3. *Gurdeep Raj, 'Advanced Physical Chemistry', 35th edition, Goel Publishing House, 2009.*

REFERENCES:

1. *Donald A McQuarrie, "Quantum Chemistry", Viva Books Private Ltd.*
2. *Glasstone and Lewis, 'Elements of Physical Chemistry', 2nd edition, Macmillan, 1982.*
3. *R. Stephen Berry, Stuart A. Rice & John Ross, 'Physical Chemistry', 2nd edition, Oxford University press, 2000.*

Learning Outcomes: This course provides the basic knowledge of quantum chemistry, group theory, surface chemistry and photochemistry which are all very important branches of chemistry and have versatile applications.

Evaluation Pattern – R.13 & R.16

18CHY302 INORGANIC CHEMISTRY II 3 1 0 4

Course Outcomes

After completing the course, a student gains

CO 1: An understanding of the salient features of coordination compounds, this includes coordination number, oxidation number, electronic configuration, nomenclature, ligands, structure and bonding.

CO 2: Knowledge of spectral and magnetic properties of complexes through CFT and MOT.

CO 3: Knowledge of the stability of metal complexes by the use of formation constants and to calculate the thermodynamic parameters from them.

CO 4: Knowledge of organometallic compounds and learns to apply the concept of isomerisation in the above compounds.

CO 5: Basic knowledge of catalytic cycle of organometallic compounds which is involved in industrial application.

Course Contents:

Unit 1 Coordination Chemistry I

Werner's theory – Electronic interpretation of co-ordination compounds - EAN rule – types of

ligands – Nomenclature, isomerism – stability of complexes – factors influencing stability – Application of coordination compounds in qualitative and quantitative analysis. Theories of bonding in coordination compounds – VBT, CFT and MOT. VBT – merits and demerits – CFT – crystal field splitting in tetrahedral and octahedral complexes – factors affecting crystal field splitting – CFSE of complexes – spectrochemical series – Explanation of geometry, magnetism and colour on the basis of the above theories.

Unit 2 Coordination Chemistry II

Spectral and magnetic properties of metal complexes - Electronic absorption spectrum of [Ti $H_2O)_6]^{3+}$ ion. Types of magnetic behavior, spin-only formula, calculation of magnetic moments. Reactivity of metal complexes - Labile and inert complexes, ligand substitution reactions – SN_1 and SN_2 substitution reactions of square planar complexes – Trans effect and applications of trans effect.

Unit 3 Organometallic compounds

Definition, classification and nomenclature of organometallic compounds, Ylides, classification on the basis of hapticity. Catalytic properties of organometallic compounds - alkene hydrogenation, synthesis of water gas – shift reaction, Zeigler-Natta polymerisation, Wilkinson catalyst - 18 electron rule, metal-alkene complexes, metal-alkyne complexes, carbene and carbyne complexes. Metal nitrosyls and dinitrogen complexes. Metallocenes – ferrocene (preparation and structure only). Dibenzene chromium. Zeise's salt – preparation, properties and structure.

Unit 4 Metal Carbonyls and Metal clusters

Preparation and properties of mononuclear carbonyls. Structures of Mo $(CO)_6$, Fe $(CO)_5$ and $Ni(CO)_4$. Polynuclear carbonyls, bridged carbonyls and bonding in metal carbonyls. Preparation and properties of carbonyls of Fe and Ni. Metal clusters - carbonyl and halide clusters, low nuclearity carbonyl clusters and high nuclearity carbonyl clusters, electron counting schemes for $Rh_6(CO)_{16}$ and $[Os_6(CO)_{18}]^{2-}$ metal only clusters (Zintl ions).

Unit 5 Bioinorganic Chemistry

Essential and trace elements in biological systems, myoglobin and haemoglobin, role of myoglobin and haemoglobin in biological systems, mechanism of oxygen transport, cooperativity, Bohr effect. Vitamin B12 (structure not expected) Metalloenzymes of zinc, inhibition and poisoning of enzymes. Electron carriers – cytochromes. Role of alkali and alkaline earth metals in biological systems, Photosynthesis, Na/K pump. Biological function and toxicity of metals – Fe, Cu, Zn, Cr, Mn, Ni, Co, Cd, Hg and Pb, treatment of metal toxicity. Anti cancer drugs – cisplatin and carboplatin.

TEXTBOOKS:

1. *Puri B R, Sharma L R, Kalia K K, 'Principles of Inorganic Chemistry', 23rd edition, Shoban Lal Nagin Chand & Co, New Delhi, 1993.*
2. *Lee J. D., 'Concise Inorganic Chemistry', Black Well Science, UK. 2006*
3. *Soni P. L., 'Text Book of Inorganic Chemistry', S, Chand & Co, New Delhi, 2006.*

REFERENCES

1. J.E. Huheey, R.A. Keiter, R.L. Keiter, 'Inorganic Chemistry-Principles of Structure and Reactivity', 4th Edn., Prentice Hall, 1997.
2. *F. A. Cotton, G. Wilkinson, C. A. Murillo & M. Bochmann, 'Advanced Inorganic Chemistry', 6th edition, John Wiley, 1999.*

Learning Outcomes: This course gives a basic understanding of the preparation, structure and functions of coordination compounds and organomettalic complexes (including bio-molecules) and their application as drugs, in gas storage etc.

Evaluation Pattern – R.13 & R.16

18CHY303 ORGANIC CHEMISTRY II 3 1 0 4

Course Outcomes

After completing the course, a student will be gaining an insight into

CO 1: Different types of organic compounds with varying functional groups

CO 2: The mechanisms of reactions involved in organic chemistry

CO 3: The methods of preparation, reactions and interconversions in organic chemistry.

CO 4: Types of compounds containing nitrogen, their preperations, reactions and their importance in organic chemistry

Course Contents:

Unit 1 Alkyl Halides, aryl halides and Organometallic compounds

Structure, nomenclature, preparation of alkyl and aryl halides. Chemical and physical properties – SN1 and SN2 reactions – di, tri and tetra halogen derivatives – unsaturated halogen derivatives. Aryl halides – preparation, physical and chemical properties and uses - Addition halogen compounds – Chlorobenzene – DDT. Aralkyl halides – preparation and properties. Grignard reagents – preparation – chemical and physical properties – organolithium compounds.

Unit 2 Alcohols and Phenols

Alcohols: Nomenclature – preparation and properties. Conversion to tosylates – oxidation. Tests for hydroxyl groups. Industrial importance of various alcohols. Synthesis and properties of polyhydric alcohols.

Phenols: Preparation, properties, reactions (oxidation) to quinones, Riemer-Tiemann reaction – Bromination, Nitration, Liebermann’s nitroso reaction, preparation of phenolphthalein, Kolbe's reaction – Pinacol–Pinacolone rearrangement. Industrial importance of picric acid, quinol and nitro phenols.

Ethers: Nomenclature, preparation and reactions - Claisen rearrangement, Zeisel's method – crown ether structure.

Thioalcohols - general physical and chemical characteristics.

Unit 3 Aldehydes and Ketones

Nomenclature, classification and preparation of aldehydes and ketones – reactivity of carbonyl groups – acidity of alpha H. Reactions – Oxidation, reduction, metal hydride reduction, nucleophilic addition, Wittig reaction, Grignard reagent, Michael addition, Cannizaro, Aldol, Perkin, Knoevenagel, Benzoin, Claisen, Reformatsky, Beckmann

rearrangement, stobbe condensation (with mechanism).

Unit 4 Carboxylic acids, Acid derivatives and Active methylene compounds

Nomenclature. Classification of aliphatic and aromatic carboxylic acids. Preparation and reaction – acidity – reduction (mechanisms) substitution in alkyl/aryl group. Fischer esterification reaction. Decarboxylation reactions.

Dicarboxylic acids – preparation of oxalic, malonic, succinic, glutaric, adipic, phthalic acids and unsaturated acids (acrylic, crotonic and cinnamic, maleic and fumaric).

Active methylene compounds: Synthesis and application of ethyl acetoacetate, diethyl malonate and cyano aceto esters.

Acid derivatives: Preparation/reaction of acid chlorides, acid anhydrides, amides, esters, acid/alkaline hydrolysis of esters, trans-esterification.

Derivatives of carbonic acids: Preparation, properties and structure of urea, manufacture of urea and thiourea, preparation and basicity of guanidine.

Unit 5 Organic compounds containing Nitrogen

Nitro compounds – Nomenclature, preparation and properties of aliphatic and aromatic nitro compounds. Reduction of nitro benzene under various conditions. Di and tri substituted aromatic nitro compounds – synthesis of o-, m-, p- dinitrobenzenes and tri nitrobenzene. **Amino compounds** – nomenclature and classification. Carbylamine reaction, diazotization – comparison of aliphatic and aromatic amines. Reductive amination of aldehydic and ketonic compounds.

Diazonium salts – preparation and reactions. Diazoalkanes and azides Cyan compounds.

TEXTBOOKS:

1. Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition, Prentice Hall, 1992.
2. K.S. Tewari and N.K. Vishnoi 'Organic Chemistry', 3rd Edition, Vikas Publishing House, 2005.
3. T.H.Lowry, K.S.Richardson, 'Mechanism and Theory in Organic Chemistry', 3rd edition, Harper Colins, New York, 1987.

REFERENCES:

1. L.G. Wade, J.R., 'Organic Chemistry', 5th edition, Pearson Education, Singapore, 2004.
2. Solomons & Fryhle, 'Organic Chemistry', 7th edition, Wiley India Pvt. Ltd., 2004.
3. John McMurry, 'Fundamental of Organic Chemistry', 7th edition, Brook and Cole, 2011.

Learning Outcomes: This course provides the basic information about the various organic compounds, their structures and functions as well as the chemical and biochemical processes they are involued in.

Evaluation Pattern – R.13 & R.16

18CHY312 BASICS OF ANALYTICAL CHEMISTRY 3 1 0 4

Course Outcomes

After completing the course, a student will be able to

CO 1: Explain the importance of analytical methods in qualitative and quantitative analysis and critically evaluate data from a variety of analytical chemistry techniques and apply knowledge of the statistical analysis of data.

CO 2: Acquire theoretical and practical knowledge on different chromatographic techniques.

CO 3: Understand the principle and instrumentation of thermoanalytical techniques and also to develop skills to analyze the DTA-TG curves.

CO 4: Develop knowledge on current electro analytical techniques and comprehend the factors that must be controlled to obtain reliable and reproducible data from electroanalytical experiments.

CO5: Understand the principle, instrumentation and application of X-RD, SEM, TEM and AFM

Course Contents:

Unit 1 Theoretical principles of qualitative and quantitative analysis

Types of analytical methods - Importance of analytical methods in qualitative and quantitative analysis - chemical and instrumental methods - advantages and limitations of chemical and instrumental methods. **Data Analysis** - Types of errors, minimization of errors, propagation of errors, accuracy and precision, least square analysis, average standard deviation, coefficient of variance, significant figures.

Unit 2 Chromatographic Techniques

Theory of separation, chromatographic separation, chromatographic techniques - Column chromatography, thin layer chromatography, Paper chromatography, Ion-exchange chromatography, gas chromatography - principle, Significance of Rf-values. HPLC, GC-MS, bioseparation - electrophoresis, centrifugation, DNA/protein separation, purification, polymer separation, green separation process, separation using zeolite and polymer membranes.

Unit 3 Thermal Analysis

Principle of thermo gravimetry (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) - Instrumentation and Characteristics of TGA and DTA curves, factors affecting TGA and DTA curves. Applications - TGA of calcium oxalate monohydrate, DTA of calcium acetatemonohydrate - determination of purity of pharmaceuticals by DSC, Thermometric titrations.

Unit 4 Electro analytical Techniques

Conductometry - ion selective electrodes. Potentiometry, Amperometry, coulometry, polarography, voltametry - cyclic voltametry and anodic stripping voltametry - Principle and analysis of samples.

Unit 5 Crystallographic and Microscopic Techniques

XRD, X-ray crystallography, SAXD Optical microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Transmission Electron Microscopy, Atomic Force Microscopy.

TEXTBOOKS:

1. *Douglas A. Skoog and Donald M. West, F.J. Holler, 'Fundamentals of Analytical Chemistry', 7th edition, 7th edition, Suanders College publishers, 1995.*
2. *Usharani S., Analytical Chemistry, Macmillan, 2001.*

REFERENCES:

1. *Mendham J., Denney R.C., Barnes J.D., Thomas M., 'Vogel's Text book of Quantitative Chemical analysis', 7th edition, Pearson education, 2008.*
2. *Sharma, B.K., 'Instrumental Methods of Chemical Analysis', Goel Publishing House, Meerut, 1997.*
3. *Gopalan. R., Subramaniam P.S. and Rengarajan K., 'Elements of Analytical Chemistry', Sultan Chand and Sons, 2004.*

Learning Outcomes: This course provides the basic theoretical knowledge of important analytical techniques that are useful in the various industrial processes.

Evaluation Pattern – R.13 & R.16

18CHY313 ORGANIC CHEMISTRY III 3 1 0 4

Course Outcomes

After completing the course a student will be able

CO 1: To understand the classification, molecular structures, method of preparations and reactions of polyclic and heterocyclic aromatic compounds.

CO 2: To learn the configuration, method of preparation, reactions and to elucidate the structure of mono, di and poly saccharides.

CO 3: To explain the stereochemistry, structure, properties and biological roles of amino acids, proteins, vitamins and nucleic acids.

CO 4: To understand the field of natural products chemistry, enzyme functions and photochemistry of carbonyl compounds.

CO 5: To learn synthetic methodologies, properties and application of dyes, synthetic polymers, detergents, oils and fats.

Course Contents:

Unit 1 Polycyclic and Heterocyclic Aromatic Compounds

Classification – reactions and structure of naphthalene, anthracene and phenanthrene. Elementary idea of naphthyl amines, naphthols, naphthaquinone and anthraquinone. **Five-membered heterocycles with one hetero atom** – Nomenclature - Pyrroles – synthesis (knorr

synthesis, Paal-Knorr synthesis etc), Furan – synthesis, Thiophene – synthesis. **Six-membered heterocycles with one hetero atom -** Pyridines – synthesis. Quinoline and isoquinolines – synthesis. Reaction mechanisms of electrophilic and nucleophilic substitutions, oxidation/reduction reactions. Resonance structures of heterocyclic compounds, applications. Fused ring heterocycles – Synthesis, Structure and reactivity.

Unit 2 Carbohydrates

Classification and nomenclature. Preparation, properties and structural elucidation. Glucose – structure and configuration of mono saccharide, interconversion, mutarotation, epimerization, cyclic structure. Disaccharide – sucrose, maltose – structure. Polysaccharide – starch, cellulose, glycogen – structure and utility. Reducing and non-reducing sugars.

Unit 3 Amino acids, Proteins, vitamins and Nucleic acids

Amino acids: Classification, structure and stereochemistry of amino acids, preparation and reactions of α, β, γ - amino acids. Essential and non-essential amino acids, zwitter ion, isoelectric point. **Peptides**: structure and synthesis (Carbo benzoxy method, Sheehan method only). **Proteins**: - Structure of proteins, denaturation and colour reactions. Biosynthesis of protein. **Nucleic acids**: Classification and structure of DNA and RNA. Replication of DNA, Genetic Codes. **Vitamins –** Classification and important sources, physiological action and deficiency symptoms of vitamin A, B1, B2, and B12. C, D, E and K

Unit 4 Alkaloids, terpenes, enzymes and Photochemistry

Alkaloids – General properties and classification – Quinine – nicotine. **Terpenes** – isoprene rule – classification – examples – citral – geraniol. **Enzymes**: General nature and classification, specificity of enzymes. **Photochemistry** - Basic principles of photochemistry – jablonskii diagram, photochemical reactions of carbonyl compounds.

Unit 5 Synthetic polymers, oils, fats and detergents

Synthetic polymers: Addition polymerization – mechanism – condensation polymerization – terylene – nylon 6,6- phenolic resins – natural and synthetic rubbers. Colour dyes and pigments. Dyes: Theory of colour and constituents, classification of dyes, synthesis of methy orange, malachite green, phenolphthalein alizarin, indigo. **Oils and fats** – structure and composition – physical and chemical properties – analysis of fats and oils. **Soaps and detergents** - composition - mechanism of cleaning action of soap – soap manufacture – detergents – advantages – preparation.

TEXTBOOKS;

1. *Morrison and R. N. Boyd, 'Organic Chemistry', 6th Edition, Prentice Hall, 1992.*
2. *I.L. Finar, "Organic Chemistry", 7th edition Vol I & II, Longmann, 2009.*
3. *S M Mukherji & S P Singh, "Reactions, Mechanisms of Organic Chemistry", 3rd edi tion, Macmillan Publishers India Ltd., 2009.*

REFERENCES:

1. *L.G. Wade, J.R., 'Organic Chemistry', 5th edition, Pearson Education, Singapore, 2004.*
2. *Solomons and Fryhle, Organic Chemistry, 7th edition, Wiley India Pvt. Ltd., 2004.*
3. *John McMurry, 'Fundamental of Organic Chemistry', 7th edition, Brook and Cole, 2011.*

Learning Outcomes: This course gives advanced knowledge on classification, preparation and reactions of polynuclear aromatic compounds, heterocyclic compounds, carbohydrates, amioacids, peptides, nucleic acids and natural products. By learning this course students will be able understand the importance and application of these compounds in organic, pharmaceutical and biological chemistry.

Evaluation Pattern – R.13 & R.16

18CHY314 INORGANIC CHEMISTRY III 3 1 0 4

Course Outcomes

After completing the course, a student gains

CO 1: Perfect understanding of nanomaterials, their preparation and properties.

CO 2: Basic knowledge in structure, bonding and properties of supramolecular compounds

CO 3: A sound understanding of molecular recognition.

CO 4: Wide knowledge in structure, bonding and reactivity of silicates, and other inorganic polymers and minerals.

CO 5: A thorough knowledge of soil, its structure, texture, sampling, testing and composition.

Course Contents:

Unit 1 Inorganic Polymers
Properties of Inorganic polymers - silicones - composition, manufacture, structure properties and uses, silanes and their polymers, applications of phosphazenes, silicates and their polymers - classification into discrete anions - one, two and three dimensional structures with examples - composition, properties and uses of beryl, asbestos, talc, mica, zeolites and ultramarines.

Unit 2 Inorganic Nanomaterials
General introduction to nanomaterials and emergence of nanotechnology; Moore's law; synthesis of nanoparticles of gold, rhodium, palladium, platinum, iron and silver; Synthesis of nanoparticle semiconductors, nanowires and nanorods; Techniques of synthesis: electroplating and electrophoretic deposition, conversion through chemical reactions and lithography; Thin films:
Chemical vapor deposition and Atomic layer deposition techniques; Carbon fullerenes and Nanotubes - applications of nanoparticles.

Unit 3 Molecular Recognition
The concepts of Molecular Recognition, Host, Guest receptor systems. Forces involved in Molecular Recognition – Hydrogen bonding, ionic bonding, p-stacking, van der Waal's and hydrophobic interaction.

Unit 4 Supra molecular Chemistry

Supra molecular Chemistry - Introduction to molecular receptors - design principles - tweezers, cryptands and carcerands – cyclophanes - cyclo dextrins and calixarenes - typical examples for Molecular Recognition and catalysis - catalysis by cation receptor, anion receptor and cylophanes - Molecular Recognition in DNA and protein structure.

Unit 5 Chemical Aspects of Soil

Origin of soil - igneous - metamorphic and sedimentary rocks - rock systems – weathering of rocks and minerals - main components of soil - organic, inorganic, liquid and gaseous phase - Physical properties of soil - Factors affecting soil pH - Soil pH and nutrient availability - Causes of soil degradation. Origin of problem soils, their properties - acid, alkali and saline soils - diagnosis - remediation of acid and salt affected soils - Quality of irrigation water – causes for poor quality waters for irrigation, their effects in soils and crops. Soil testing - concept, objectives and basis - soil sampling, collection processing, despatch of soil and water samples. soil organic matter - its decomposition and effect on soil fertility - source of organic matter in soil - maintenance and distribution - soil organism - their role - nitrification - denitrification, nitrogen fixation in soils - biological nitrogen fixation - microbial interrelationship in soil - microbes in pest and disease management - Bio-conversion of agricultural wastes.

TEXT BOOKS:

1. *F. A. Cotton, G. Wilkinson, C. A. Murillo & M. Bochmann, 'Advanced Inorganic Chemistry', 6th edition, John Wiley, 1999.*
2. *J.E. Huheey, 'Inorganic Chemistry - Principles, Structure and Reactivity', 4th edition, Harper Collins, New York, 1993.*
3. *Daji, A.J. 'A Textbook of Soil Science', Asia Publishing House, Madras, 1970.*

REFERENCE BOOKS:

1. *Jonathan W. Stead, David R. Turner andkarl. J. Wallace., 'Core concepts in Supramolecular Chemistry and Nanochemistry', John Wiley sons Ltd, 2007.*
2. *R. W. Hay, 'Bioinorganic chemistry', Halsted Press, 1984.*
3. *Tisdale, S.L., Nelson, W.L. and Beaton, J. D, 'Soil Fertility and Fertilizers', Macmillian Publishing Company, New York, 1990.*

Learning Outcomes: This course provides the information about the inorganic polymers and inorganic nano-materials, their synthesis, structures and applicatons. Detailed information on chemistry of soil is also provided.

Evaluation Pattern – R.13 & R.16

18CHY315 BASIC SPECTROSCOPIC TECHNIQUES 3 1 0 4

Course Outcomes

After completing the course, a student is well versed with

CO 1: Various kinds of spectroscopic techniques and will be able to get the theoretical

understanding of these techniques.

CO 2: Interpretation of the spectra of various compounds from given spectral data and to deduce the spectral properties.

CO 3: Compariso between the different regions of the spectrum and will be having expertis to predict chemical structure from various spectral data.

CO 4: Analytical techniques used for the structural elucidation of unknown compounds.

CO 5: The mechanisms of these techniques.

Course Contents:

UNIT 1 – Electromagnetic spectrum

Introduction – Definition of spectrum – electromagnetic radiation – regions of spectrum, quantization of different forms of energies in molecules (translational, rotational, vibrational and electronic) - Born Oppenheimer approximation.

UNIT 2 – Electronic Spectroscopy

Principle – Absorpation laws. Calculations involving Beer Lamberts' law – Instrumentation - photo colorimeter and spectrophotometer - block diagrams with description of components - theory - type of electronics transitions - chromophore and auxochromes – Absorption bands and intensity – factors governing absorption maximum and intensity. Calculation of λmax using Woodward Fischer rule for simple molecules.

UNIT 3 – Vibrational Spectroscopy

Principle - vibrational frequency - fundamental vibrations – modes of vibration of diatomic, triatomic linear (CO_2) and nonlinear triatomic molecules(H_2O) - stretching and bending vibrations - selection rules. Hook's law. Instrumentation - sampling techniques. Applications of IR spectroscopy - interpretation of the spectra of alcohols, aldehydes, ketones and esters – aliphatic and aromatic.

UNIT 4 - NMR Spectroscopy

Principle of nuclear magnetic resonance – basic instrumentation – number of signals - chemical shift – shielding and deshielding. Spin-spin coupling and coupling constants. TMS as NMR standard. Introduction to H1 and C13 NMR spectrum. Interpretation of proton NMR spectra of simple organic compounds such as Acetone, Anisole, Benzaldehyde, Ethyl acetate, Ethylamine , Ethyl Bromide, Toluene and Isopropyl phenyl ketone.

UNIT 5 – Mass Spectrometry

Basic Principles – instrumentation – molecular ion peak, base peak, metastable peak, istopic peak their uses. Fragmentation pattern – Nitrogen rules- determination of molecular formulae – Types of mass analysis. Interpretation of mass spectra of simple organic compounds such as acetone, anisole , Benzaldehyde, Ethyl acetate, Ethylarmine, wethyl Bromide, Toluene and Isopropyl ketone. Mc-Lafferty Rearrangement.

Text Books:

1. P.S.Kalsi *'Spectroscopy of organic Componts'*, *6th edition*, *New age international*

publishers, 2005.

2. *W. Kemp, 'Organic Spectroscopy, Macmillan, 1987*

Reference Books:

1. *R.M.Silverstein, F.Webster and D.Kimle 'Spectroscopic Identification of Organic Compounds 7th edition, 7 wiley and Sons, 2005.*
2. *C.N.Banwell 'Fundamentals of Molecular Spectroscopy' 4th edition, Mcgraw –Hill College, 1994.*
3. *Dyer Jhon R, 'Applications of Absorpation Spectroscopy of Organic Compounds', PHI learning Publishers, 1965.*

Learning Outcomes: The students will get the basic knowledge about the light-matter interaction, various spectroscopic methods, including IR, UV and NMR, theory, their importance, and their applications. Which will help them to get the expertise in the spectroscopy and analytical chemistry.

Evaluation Pattern – R.13 & R.16

18CHY331 BATTERIES AND FUEL CELLS 3 0 0 3

Course Outcomes

After completing this elective course, a student will

CO 1: Gain an understanding of the theoretical background of batteries and fuel cells

CO 2: Be able to differentiate primary and seconadary batteries

CO 3: Be gaining an insight into the types of fuel cells, fuels required for fuel cells and their applications

Course Contents:

Unit 1 Background Theory

Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients**.**

Unit 2 Batteries: Primary Batteries

The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells (comparative account).

Unit 3 Secondary Batteries

Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells

(comparative account) Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries**.**

Unit 4 Fuel Cells

Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspectsof the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells. **Membranes for fuel cells:** Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.

Unit 5 Fuels For Fuel Cells

Hydrogen, methane, methanol - Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.

TEXTBOOKS:

1. *Dell, Ronald M Rand, David AJ, 'Understanding Batteries', Royal Society of Chemistry, (2001).*
2. *M. Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India (2006).*

REFERENCES:

1. *Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
2. *Curtis, 'Electroforming', London, (2004).*
3. *F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA, (2005).*
4. *G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL, (2003).*

Learning Outcomes: Students will get the knowledge of construction and functioning of various types of batteries, their specific applications and limitations. This basic knowledge will help them to advance in the energy related fields either for higher studies, research or employment.

Evaluation Pattern – R.13 & R.16

18CHY332 CORROSION SCIENCE 3 0 0 3

Course Outcomes

After the completion of the course a student will

CO 1: Get the knowledge about significance, fundamentals of corrosion and types of corrosion

CO 2: Gain awareness on application on analytical techniques in corrosion rate dtermination.

CO 3: Get an understanding of thermodynamics and kinetics of corrosion.

CO 4: Understand how to establish a relationship with industries by exercising applied science

Course Contents:

Unit 1 Introduction to corrosion
Mechanisms of Chemical corrosion, electrochemical corrosion, Concentration cell corrosion, Pitting corrosion, Intergranular corrosion, Waterline corrosion, Stress corrosion.

Unit 2 Cathodic protection
Basis of cathodic protection, working of cathodic protection, electrochemical theory of cathodic protection, design parameters in cathodic protection, cathodic protection interferences.

Unit 3 Corrosion kinetics
Faradays laws of electrolysis and its application in determining corrosion rates, The laws, Corrosion kinetics, Mixed potential theory and its application, Resistance polarization, Determination of corrosion rates by electrochemical measurements, Kinetics of passivity.

Unit 4 Corrosion prevention by design
Corrosive environment, Stages in design processes, Soldering and threading, crevices, flowing water systems, design for liquid containers, design in packaging, coating and design, storage of combat vehicles.

Unit 5 Selection of materials for corrosive environment
Factors affecting the performance of materials, Materials classification, materials and fluid corrossivity, Corrossion behavior of several materials.

TEXTBOOKS:
1. Mars G.Fontana, 'Corrosion Engineering', 3rd edition, Tata Mcgraw-Hill, 2005.
2. P.E.Philip A.Schieitzer, 'Corrosion Engineering Handbook', 2nd edition, Inco alloys Internaional, 1996.
REFERENCES:
1. R.Winston Revie and Herbert H Uhlig, 'Corrosion and Corrosion Control', 4th edition, John Wiley & Sons, 2008.
2. Zaki Ahmad, 'Principles of Corrosion Engineering and corrosion', 3rd edition John Wiley & Sons, 2006.

Learning Outcomes: Students will get the knowledge of corrosion, mechanism of corrosion, kinetics, prevention methods, along with the current developments in the corrosion prevention. This course will help them to look further into the related fields for higher studies, research or employment.

Evaluation Pattern – R.13 & R.16

18CHY333 GREEN CHEMISTRY 3 0 0 3

Course Outcomes

After completing the course, a student

CO 1: Learns the 12 basic principles of green chemistry. They will be able to do and understand stoichiometric calculations and relate them to green process metrics.

CO 2: Will be able to learn alternative solvent media and energy sources for chemical processes.

CO 3: Will be able to understand renewable feedstock for the chemical industry, present and under development.

CO 4: Has an ability to review the principles of catalysis, photochemistry and other interesting processes from the viewpoint of green chemistry.

CO 5: Will be able to perform laboratory experiments in which they apply some of the concepts previously learnt (stoichiometry, green metrics …) and they put into practice some of the principles of green chemistry.

CO 6: Develops an understanding of several real world examples where organizations used green chemistry to improve the sustainability performance of their products.

CO 7: Learns to appreciate how the practice of green chemistry enhances competitiveness, innovation and swiftness to market.

CO 8: Will be able to analyse and compare chemical/industrial processes based on their relative "greenness.

Course Contents:

Unit 1 Introduction to Green Chemistry
Introduction - inception and evolution of green chemistry - principles of green chemistry - the green chemistry expert systems - the measure of greenness - safety and risk indices - the hierarchial approach - green chemistry and sustainable development - pollution control to pollution prevention - Indian perspective on green chemistry - information technology and sustainable development.

Unit 2 Green reagents
Green reagents - safer solvents - green solvents - water as a solvent - solvent free conditions - supports reagents - ionic liquids and their applications - super critical systems (CO_2) as green solvents - hydrogen peroxide in green oxidation reactions - dimethyl carbonate, a green solvent and an ambient reagent.

Unit 3 Green chemical techniques I
Environmentally benign technologies by green chemistry (with examples) - microwave assisted synthesis - electro-organic synthesis - photochemical degradation as a green approach for waste treatment - catalysis and green chemistry - supported catalysts and reagents for green chemistry - heterogenized reactions for green chemistry - oxidation technology for waste water treatment - green chemistry using biocatalytic reactions.

Unit 4 Green chemical techniques II
Aqueous phase reactions, solid state reactions, enzymatic transformations, sonicated reactions - usual organic reactions (Benzoin condensation, Michael Addition, Heck Reaction, Darzen reaction, Heck reaction, Claisen arrangement) in a greener way.

Unit 5 Green industrial processes and operations
Cleaner production - industrial perspectives - reactions and reactor designs - micromixers - unit operations - reactions with separation processes alternate energy resources - inherent

safety - green chemistry and industries - the pharmaceutical industries and green chemistry - the polymer industry - pesticides, antifoulants, and herbicides - solvents and green chemistry - the food and flavor industry - the maleic anhydride manufacturing process - chelants - the surfactant industry - industries in need of support to go green - the semiconductor manufacture industry - the dye industry - the textile industry - the tannery industry - the sugar and distillery industries - the paper and pulp industry - the paint industry - Green chemistry in future.

TEXTBOOKS:

1. *Mukesh Doble and Anilkumar Kruthiventi, 'Green Chemistry and Processes', reprint, Science Press, 2007.*
2. *Paul T. Anastas and Tracy C. Williamson, 'Green chemistry: frontiers in benign chemical syntheses and processes', Oxford University Press, 1998.*

REFERENCES:

1. V. K.Ahluwallia, 'Green Chemistry - Environmentally Benign Reactions', 1st edition, Ane books Pvt Ltd, 2009.

2. M. M. Srivastava, Rashmi Sanghi, 'Green Chemistry - Environment Friendly Alternatives', 2nd edition, Narosa Publishing House, 2005.

Learning Outcomes: Students learn the 12 basic principles of green chemistry and understand the importance green practices in the daily life to the industrial level, and also get a concise information about various renewable energy sources and their development and applications.

Evaluation Pattern – R.13 & R.16

18CHY334 INDUSTRIAL CATALYSIS 3 0 0 3

Course oucomes

After completing the course students will

CO 1: Develop the fundamental understanding of catalyst working in different reactors

CO 2: Understand the structure, composition, method of preparation and properties of supports used in catalytic systems.

CO 3: Analyze industrial catalytic processes regarding sustainability.

Course Contents:

Unit 1 Catalysis

An introduction, general principles of catalysis, activation energy plots for catalytic processes, classification for catalysis - heterogeneous and homogeneous catalysis, van't-Hoff's and Arrhenius treatment of homogeneous catalysis - kinetic aspects, adsorption and general principles of heterogeneous catalysis - kinetic aspects, determination of surface area and pore-structure of the catalyst, definition of performance criteria of catalysts, activity, selectivity, temperature response, catalyst life.

Unit 2 Catalysis in Solutions

Acid and base catalysis, catalysis in gas phase, catalysis in dilute aqueous solutions, catalysis in concentrated strong acid solutions, catalysis by bases, catalysis by metal ions, electron

transfer catalysis, catalysis by co-ordination and organometallic compounds, catalysis in Ziegler-Natta, metallocene, metathesis, catalysis by enzymes.

Unit 3 Polymers and Zeolites in Catalysis

Catalysis by polymers, polymer supported catalysts, catalysis in polymer gels, phase transfer catalysis, catalysis in molecular scale cavities, zeolites - molecular sieves, shape selective and size selective catalysis

Unit 4 Catalysis by Metals, Metal Oxides and Supported Metals

Electronic factors in catalysis by metals, valence bond and electron band theories, electronic factors in catalysis by semiconductors, co-operative electronics interactions and catalysis, localized interactions and catalysis, surface states and catalysis, role of supports, preparation and structure of supports, silica, alumina, silica-alumina, carbon, monolithic supports, surface properties, catalyst manufacture, catalyst size and shape, pretreatments, deactivation processes, sintering, poisoning and catalyst fouling.

Unit 5 Industrially Important Catalytic Processes

Catalysis and green chemistry, catalysis by ionic liquids, catalytic reforming, catalytic cracking, hydrotreatment, steam cracking, Fisher Tropsch process, mobil process for conversion of methanol to gasoline hydrocarbons, catalysis for environmental protection, removal of pollutants from exhausts, mobile and static sources, effluent clean up analysis, applications in the production of fertilizers, acetic acid, formaldehyde, washing powder additives, pharmaceuticals.

TEXTBOOKS:

1. *Bruce G Gates, 'Catalytic Chemistry', John Wiley & Sons, 1992.*
2. *J. A. Jensen, K. B. Rider, Y. Chen, M. Salmeron and G. A. Somorjai and E. K. Rideal, 'Concepts in Catalysis', Academic Press, New York, 1968.*
3. *Alfred Clark, 'The Theory of Adsorption and Catalysis', Academic Press, 1970.*

REFERENCES:

1. *W.B.Innes, 'Experimental Methods in Catalytic Research', Volume 1, R.B.Anderson Academic Press, 1968.*
2. *J.M.Betty, 'Applied Industrial Catalysis', Volume 1, Academic Press, 1983.*
3. *Ronald Pearce, William R. Patterson, 'Catalysts and Chemical Processes', Wiley, 1981.*
4. *Michael Bowker, 'The Basis and Applications of Heterogeneous Catalysis', Oxford University Press, 1998.*
5. *J.C. Kuriacose, 'Catalysis', Macmillian India LTD, 1991.*

Learning Outcomes: This course provides the students with the importat aspects of industrial processes. The knowledge they get about the catalyses and processing of the various commercially important Students chemicals and materials as well as the development of catalytic system will help them land in the mass production industrial jobs or will motivate them to look into research and development for the further improvements that can be bought in.

Evaluation Pattern – R.13 & R.16

18CHY335 INTRODUCTION TO FOOD CHEMISTRY 3 0 0 3

Course Outcomes

After completion of the course, a student is equipped with

CO 1: Ability to apply basic scientific principles to food systems and practical applications

CO 2: Anu nderstanding of chemical/ biochemical reactions of carbohydrates, lipids, proteins, and other are discussed.

CO 3: Knowledge of constituents in fresh and processed foods with respect to food quality.

CO 4: a know-how of reaction conditions and processes that affect color, flavor, texture, nutrition, and safety of food .

CO 5: A thorough understanding of the various possible ways in which adulteration of food happens, methods to identify them and the legal ways to rectify them

Course Contents:

Unit 1 Introduction
Introduction: Definition of Food, major components of food, **Physical States of Food -** Dispersions true solutions, colloidal, emulsions, foam and gel, factors affecting stable dispersion of food ingredients, functions of emulsifiers and stabilizers. **Water -** Functions of water in food systems, hydrogen bonds, permanent dipole moment dielectric constant, theories of solvent action, water activity and food stability, absorption isotherm curve, roles of water in physical properties and chemical reactions in food theories and applications of different moisture determination methods.

Unit 2 Proteins and Carbohydrates
Protein - Classifications, nomenclature, and structures of aminoacids, basic properties of protein, structure of proteins, protein functional groups and their chemical, hydrophobic, and hydrophobic properties, isoelelctric point and solubility as a function of pH, protein denaturation and its effects on food systems, nutritional quality of protein, theories & applications of analytical methods for protein and amino acids determination. **Carbohydrates -** Classification, nomenclature, and structures of Carbohydrates, isomers and absolute configurations of Carbohydrates, physical – chemical properties of Carbohydrates, sweetness of Carbohydrates, functions of Carbohydrates in foods, chemical reactions of Carbohydrates, analytical methods for Carbohydrate determination.

Unit 3 Lipids and minerals
Lipids - Nomenclature and structures of fatty acids, classifications of lipids, physical and chemical characteristics of different fats, relationship between chemical structure and fat melting properties, analytical methods for determining different physical and chemical characteristics of fat, lipid oxidation mechanisms, principles and applications of analytical methods for the determination of fat content and fatty acid composotions of foods. **Minerals -** Ash determination methods, principles and applications of different methods for determining individual minerals – atomic absorption and flame spectrometry's, and chemical methods.

Unit 4 Vitamins
Vitamins - Water soluble and fat soluble vitamins, chemical reactions and losses of vitamins during processing and storage. Principles and techniques for the determination.

Unit 5

Pigments in food flavours, browing reaction in foods, Enzymes in foods, and food industry, bio-deterioration of foods, food contaminants, Food additives and toxin.

REFERENCE:

Fennema's Food Chemistry fourth edition,edited by S. Damodaran, K.L. Parkin, and O.R Fennema, 2007 published by CRC Press .

SUGGESTED READINGS

1. *Aurand, L.W. and Woods, A.E. 1973. Food Chemistry. AVI, Westport*
2. *Birch, G.G., Cameron, A.G. and Spencer, M.1986. Food Science, 3rd ED.Pergamon Press, New york.*
3. *Fennema O.R. Ed. 1976. Principles of Food Science: Part – I Food Chemistry. Marcel Dekker, New york.*
4. *Meyer, L.H. 1973. Food Chemistry. East – West Press Pvt. Ltd., New Delhi.*
5. *Potter, N.N. 1978. Food Science. 3rd Ed. AVI, Westport*

Learning Outcomes: This course gives the basic information about the food, components of food, nutritional values, method of analyses. This basic knowledge will help the students to proceed with the advanced courses related to food industry or seek a job in the related fields.

Evaluation Pattern – R.13 & R.16

18CHY336 POLYMER CHEMISTRY 3 0 0

Course Outcomes

After completing the course, the students will be in a position to

CO 1: Understand the basic concepts of polymers and polymerization, classification of polymers based on different criteria, methods of preparation of polymers, theory of copolymerisation, mechanism of polymerization etc.

CO 2: Understand the stereochemistry and characterization of polymers, concept of molecular weights of polymers, different methods of determination of molecular weights, structure-property relationships etc.

CO 3: Learn the basics of polymer solutions, structure – property relations etc.

CO 4: Understand the use of additives, polymer blends and composites, learn to tailor make polymers depending on the properties required by adding additives.

CO 5: Get adequate familiarity with industrial and speciality polymers.

Course Contents:

Unit 1 Introduction to polymers and polymerization

History of polymer Science. Concept of macromolecules, Nomenclature and Classification. Polymer, monomer, oligomer, repeating unit, degree of polymerization, functionality, copolymer - random, alternating, graft, block, Tacticity. Polymerization processes. Free radical addition polymerization. Kinetics and mechanism. Chain transfer. Mayo-walling

equation of the steady state. Molecular weight distribution and molecular weight control. Radical Atom Transfer and Fragmentation – Addition mechanism. Free radical living polymers. Cationic and anionic polymerization. Kinetics and mechanism, Polymerization without termination. Living polymers. Step Growth polymerization. Kinetics and mechanism. Molecular weight distribution. Linear vs cyclic polymerization, other modes of polymerization. Group Transfer, metathesis and ring opening polymerization. Copolymerization. The copolymerization equation, Q-e scheme, Gelation and Cross linking. Copolymer composition drifts Polymerization techniques. Bulk Solution, melt, suspension, emulsion and dispersion techniques.

Unit 2 Polymer Stereochemistry and characterization

Organizational features of polymer chains. Configuration and conformation, Tacticity, Repeating units with more than one asymmetric center. Chiral polymers - main chain and side chain. Stereo regular polymers. Manipulation of polymerization processes. Zeigler-Natta and Kaminsky routes. Coordination polymerization. Metallocene and Metal oxide catalysts. Polymer Characterization. Molecular weights. Concept of average molecular weights, Molecular weight distribution. Methods for determining molecular weights. Static and dynamic methods, Light scattering and GPC. Crystalline and amorphous states. Glassy and Rubbery States. Glass transition and crystalline melting. Spherullites and Lamellar. Degree of Crystallinity, X-ray diffraction, Thermal analysis of polymers. TG/DTG, DTA/DSC, DMA/TMA/DMTA. Spectroscopy of polymers. Microstructure determination by IR, Raman, UV, NMR and MS techniques. Solid State NMR and polymer stereochemistry. Structure-property relationship. Elastomeric and Viscoelastic states. Rubber-like elasticity. Maxwell and Kinetic model of viscoelasticity.

Unit 3 Polymer Solutions

Treatment of dilute solution data. Thermodynamics. Flory-Huggins equation. Chain dimension - chain stiffness - End-to-end distance. Conformation-random coil, Solvation and Swelling. Flory-Reiner equation. Determination of degree of cross linking and molecular weight between crosslinks. Polymer structure - property relationship, crystalline and amorphous combinations.

Unit 4 Polymer additives, blends and composites

Introduction - General principles, use of additives to enhance and protect properties of polymer, Classes of polymer additives - Type, Structure, Chemistry, Mechanism and suitability: for antioxidant-heat stabilizers - UV Stabilizers - HAL-antistatic - Blowing agents - lubricants nucleating agents - cross linking agent - flame retardant-compatibiliser. Fillers - effect and type of fillers - surface treatment and coupling agent. Coloration of polymers – pigment - colour measurement. Plasticizer – function - mode of operation - types. Compounding Eqmain types of colorant – uipments - internal mixer, two roll mill, Banbury mixer, single screw extruder, twin screw extruder - co rotating - counter rotating - intermeshing. Fabrication methods, polymer blends, toughened plastics and phase separated blends, interpenetrating network, mechanical properties, composite fabrication.

Unit 5 Industrial and speciality polymers

Synthesis, Structure and applications of polyethylene, polypropylene, polystyrene. Homo and Copolymers. Diene rubbers. Vinyl and acrylic polymers. PVC, PVA, PAN, PA. Poly (vinyl carbazole), poly (vinylimidazole). PMMA and related polymers. Copolymers. EVA polymers. Flourine containing polymers. Polyacetals. Reaction polymers. Polyamides, polyesters. epoxides, polyurethanes, polycarbonates, phenolics, PEEK, Silicone polymers. Reactions of polymers. Polymers as aids in Organic Synthesis. Polymeric Reagents, Catalysts, Substrates, Liquid Crystalline polymers. Main chain and side chain liquid

crystalline polymers. Phase morphology. Conducting polymers. Polymers with high bandwidth. Polyanilines, polypyrrols, polythiophines, poly (vinylene phenylene). Photoresponsive and photorefractive polymers. Polymers in optical lithography. Polymer photo resists. Electrical properties of Polymers, Polymers with NLO properties, second and third harmonic generation, and wave guide devises.

TEXTBOOKS:

1. F.W. Billmayer, 'Textbook of Polymer Science', 3rd Edition, Wiley. N.Y. 1991.
2. J.M.G Cowie, 'Polymers: Physics and Chemistry of Modern Materials', 2nd edition, Blackie Academic and professional, 1991.
3. P.J. Flory, 'Principles of polymer chemistry', reprint, Cornell University Press, 1953.

REFERENCES:

1. F. Ullrich, 'Industrial Polymers', Kluwer, N.Y. 1993.
2. H.G.Elias, 'Macromolecules, Vol. I & II', Academic, 1991.
3. Harry A Allcock, Frederick W Lampe and James E Mark, 'Contemporary Polymer Chemistry', 3rd edition, Pearson Prentice Hall, 2003.

Learning Outcomes: This course provides the students with the importat facets of polymer science. They will come to know the details of various polymeric materials and polymer composits their preparations, their properties, structural and functional modifications and specific industrial and domestic appliations. This knowledge will help and motivate them to pursue higher studies and research to import further developments in this area.

Evaluation Pattern – R.13 & R.16

18CHY337 SURFACE SCIENCE AND COATING TECHNOLOGY 3 0 0 3

Unit 1 Introduction to Paints and Paint Technology

General introduction to paint industry - definition of paints, varnishes and lacquers their constitution and functions, general classification of surface coatings - decorative and protective coatings - paint industries in India.

Unit 2 Pigments Dyes and Extenders

Definition and classification of pigments and dyes - properties and evaluation of pigments such as crystal structure particle size and shape, refractive index and Hiding power, oil absorption, colour, specific gravity and bulking value, UV and IR absorption, light fastness, resistance to heat water, alkali and acid, corrosion inhibition, toxicity, reducing power, tinting strength, flooding and floating, settling, volatile and water soluble matter, residue on sieve, bleeding - white pigments and colored pigments - organic and inorganic pigments - industrial manufacture of pigments - special effect pigments - Extenders - use and functions of extenders - examples for extenders.

Unit 3 Binding media, solvents and additives in paints

Fundamentals of film formers, chemical structure of monomers, functionality and its determination, degree of polymerization and molecular weight, non-convertible and convertible film formers, linear, branched and cross linked film formers, homopolymers and copolymers - Manufacture, chemistry and applications of alkyd resins, Polyester resins, Phenolic Resins, amino resins, epoxy resins, polyamide resins, polyurethanes, silicone resins, vinyl and acrylic resins - emulsions - polystyrene and styrene-acrylic emulsions. Solvents, dryers, surfactants and other additives in paints.

Unit 4 Paint Formulation, Manufacture and application techniques

Principles of paint formulation, formulation elements, mathematics & steps: PVC, CM, P/B ratio, Sp gravity, etc; Typical formulations of primers, undercoats and finish coats - Steps in paint manufacturing, phenomenon of wetting, grinding and dispersion, important considerations in pigment dispersion and rheology - different miiling and mixing techniques - factors affecting effectiveness of milling such as size, speed and type of mill; volume, composition, size and shape of grinding medium - mill base. Surface preparation techniques - Physical and chemical surface treatment techniques - Common application techniques - packaging technology.

Unit 5 Colour Technology, Paint properties and Quality Control in Paint Industries

Colour science and technology - light spectrum, primary and complemenary colours, colour mixing, dimensions of colour and colour systems, colour measurements, computer colour matching - colour coding system - General properties of paints, classification of paint properties - adhesion and cohesion properties, factors affecting adhesion wetting power, optical properties; colour, gloss, hiding, etc, physical, chemical and mechanical properties of paint films - factors affecting coating properties - rheological properties - Newtonian and non-Newtonian liquids, thixo-tropy, factors affecting viscosity, objectives of paint testing - Quality control procedures, standard specifications and test methods - tests on liquid paints density, dispersion, viscosity and consistency, wet opacity and dry hiding, spreading capacity and spreading rim, wet and dry rim thickness, drying time, etc. - Tests of dried coatings, colour and colour fastness, light fastness, gloss, flexibility, adhesion impact test, hardness mar resistance, abrasion resistance water and moisture resistance; water vapour transmission, PAC and salt spray test resistance, resistance to chemicals and solvents, resistance to heat and fire, air permeability - evaluation of water based paints, biological effects on paint films. Analysis of paints and varnishes; volatile and nonvolatile matter pigment content, binder or solid vehicle content, water content, ash content, pigment binder and solvent analysis - Ageing properties of coatings, weatherometery, natural outdoor durability test accelerated outdoor weathering, artificial weathering tests, defects observed in paint film on exposure.

TEXTBOOKS:

1. *Australian OCCA, 'Surface Coating Technology Volume 1', Chapman and Hall, 1974.*
2. *W.M. Morgan, 'Outline of Paint Technology', John Wiley sons, 1990.*

REFERENCES:

1. *L. S. Pratt, 'Physics & Chemistry of Organic Pigments', Wiley, 1947.*
2. *H.Y. Payne, 'Organic Coating Technology Vol, 1 & 11', John Wiley & Sons, 1954.*

Learning Outcomes: This course gives the detailed information about the paints and paint technology, pigments dyes and extenders, paint formulation, manufacture and application techniques, colour technology, paint properties and quality control in paint Industries.This knowledge will help the students to proceed with the advanced studies related paint industry or seek a job in the related fields.

Evaluation Pattern – R.13 & R.16

18CHY353 FORENSIC SCIENCE 3 0 0 3

Course Outcomes

After comp-leting the course, a student will

CO 1: Understand what are the basic methods used in forensic labs for evidence.

CO 2: Learn the methods used for chemical screening of drugs and identification of drugs using analytical techniques.

CO 3: Get knowledge about fingerprinting and firearm analysis

CO 4: B able to detect toxins – radioactive, inorganic, nerve agents, biological poisons and detailed understanding of post mortem toxicology

Course Contents:

UNIT I-INTRODUCTION
Origin of forensic science, need for forensic science, trace and contact evidence, marks and impression, examination of documents, blood stain analysis, microscope in analysis, explosives, chemical analysis of explosives, forensic laboratories and courses in India.

UNIT II-NARCOTICS
Narcotics, classification of drugs, specific drugs- Psychotropic drugs, chemical screening of drugs, chemical extraction and sample preparation, chemical identification of drugs using analytical methods.

UNIT III – FINGERPRINTING and FIREARM ANALYSIS
History of fingerprinting, principles of fingerprinting, constituents of latent finger marks, fingerprint detection, chemical methods of detection, firearm examination, chemical analysis of firearm, analysis of gunshot residue.

UNIT IV –TOXICOLOGY
Introduction to Toxicology, alcohol and human body, testing of blood alcohol concentration, Toxins & Biological Poisons, Measuring Toxicity as LD50, sample and analysis, inorganic poisons, nerve agents, radioactive toxins, Pharmacokinetics and Toxicokinetics, tests for toxins, reported case studies.

UNIT V- POSTMORTEM TOXICOLOGY
Introduction, tissue and fluid specimens, specimen collection and storage, extraction procedure, analytical techniques, interpretation, case studies.

Reference Books:

1. Lawrence Kobilinsky, Forensic Chemistry Handbook, John Wiley & Sons, New Jersey, 2012
2. David E. Newton, Forensic Chemistry, Facts On File, Inc, New York, 2007
3. Jay A. Siegel, Forensic Chemistry fundamentals and applications, Wiley Balckwell.
4. Suzanne Bell, Drugs, Poisons, and Chemistry, Facts On File, Inc. New York, 2009.

Learning Outcomes: This course familiarizes students with the principles, theories and practices of forensic science, with emphasis on Narcotics, Fingerprinting and Firearm analysis, Toxicology and Postmortem toxicology. This knowledge will help them to get into the professional courses related to the Forensic science and ultimately a profession.

18CHY383 Basic Physical Chemistry Lab. 0 0 5 2

Course Outcomes

After completing the course, students will be

CO 1: Acquiring skills in different methods of finding the molecular weights.

CO 2: Acquiring the concept of miscibility of liquids and perform the experiment.

CO 3: Gaining knowledge on how impurity affects the physical characteristics of a compound and using that to find the CST, Eutectic temperature and molecular weight.

CO 4: Gaining the skill in obtaining data and to derive the adsorption isotherm for adsorption processes.

CO5: Skilled in performing the experiments involving kinetics.

Course Contents:

1. Determination of CST of phenol-water system - effects of KCl/ NaCl salts on CST.
2. Phase diagram of simple eutectic system.
3. To determine the molecular weight of a high polymer by viscosity method.
4. To determine the molecular weight of a solute by Rast method using naphthalene or diphenyl as solvent using Beckmann thermometer.
5. To determine the solubility of benzoic acid at different temperatures and to determine ΔH of the dissolution process.
6. Determination of rate constant of acid catalyzed hydrolysis of an ester.
7. To study the adsorption of acetic acid from its aqueous solution by charcoal.
8. To determine the distribution coefficient of iodine between water and carbon tetra chloride.
9. Determination of transition temperature of the given salt hydrate.

TEXTBOOKS:

1. R.C. Das and B.Behara, 'Experiments in Physical Chemistry', Tata McGraw-Hill, 1983.

2. Alexander Findly,' Practical Physical Chemistry', 9th edition, Wiley, 1972.

REFERENCE BOOKS:

1. Gilbert William Castellam,' Physical Chemistry', Addison-Wesley Publishing Company, 1964.

2. James Brierley Firth, 'Practical Physical Chemistry', D. Van Nostrand Company, 1916.

3. Dr. J. B. Yadav, 'Advanced Practical Physical Chemistry', Krishna Prakashan Media, 29th edition, 2010.

Learning Outcomes: The basic physical chemistry experiments students perform in this lab course help them in better understanding of the various principles of physical chemistry. This training will be very useful to continue studies in chemistry.

18CHY384 Organic Synthesis and Estimation Lab. 0 0 2 1

Course Outcomes

After completion of the course, the students will be

CO 1: Able to calculate limiting reagent, theoretical yield, and percent yield of simple organic reactions.

CO 2: Able to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration, and thin-layer chromatography

Course Contents:

1. Basic concepts on theoretical yield, practical yield, samples % conversion etc, Organic preparations including recrystallisation,
2. Synthesis of a) Acetanilide to p-nitroacetanilide b) Acetanilide to p-bromoacetanilide c) Benzyl chloride to Benzoic acid, d) Nitrobenzene to dinitrobenzene e) Ester hydrolysis f) Benzoylation (phenol to phenyl benzoate)
3. Separation Techniques: Thin Layer Chromatography, Column chromatography

REFERENCES:

1. F. G.Mann and B. C.Saunders, 'Practical Organic Chemistry' 4th edition, Pearson Education, 2009.
2. V. K.Ahluwalia and S. Dhingra 'Comprehensive Practical Organic Chemistry' Universities Press, 2000.
3. B. S.Furnis, A. J.Hannaford, P. W. G. Smith and T. R.Tatchell, 'Vogel's Text book of Practical Organic Chemistry', ELBS/Longman, 1989.
4. O. P. Pandey, D.N Bajpai, S. Gini, 'Practical Chemistry, for I, II & III BSc. Students', S. Chand & Company Ltd reprint, 2009.
5. V. K.Ahluwalia, Sunitha Dhingra, Adarsh Gulate, 'College Practical Chemistry', Universities Press (India) Pvt Ltd, 2008.

Learning Outcomes: In this lab course, students learn to prepare, separate, charecterise some simple but important organic molecules, they will also get the idea of reaction conditions, mechanisms and related stoichiometric calculations. The training they get here is very useful for their further studies with advanced chemistry courses as well as for seeking synthetic chemistry related jobs.

Evaluation Pattern – R.13 & R.16

18CHY385 Inorganic Quantitative Lab. – Gravimetric Analysis 0 0 5 2

Course Outcomes

After completion of the course, the students will

CO 1: Gain skill in estimating the given unknown substance by simple precipitation method

CO 2: Develop skills in preparing, collecting, treating, and weighing a precipitate

CO 3: Develop skills for producing accurate and reliable results

Course Contents:

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of iron as iron (III) oxide.
3. Estimation of sulphate as barium sulphate.
4. Gravimetric estimation of copper as copper (I) thiocyanate.
5. Gravimetric estimation of nickel as nickel dimethyglyoximate.
6. Gravimetric estimation of magnesium as magnesium 8-hydroxy quinolate.
7. Estimation of iron in the given sample of haematite by dichromate method.
9. Estimation of copper in bronze by iodometric method.
10. Estimation of tin in solder using EDTA.

TEXTBOOKS:

1. G.H.Jeffery, J.Bassett, J.Mendham and R.C.Denny 'Vogel's Text Book of Quantitative Chemical Analysis', 5th Edition, ELBS, 1989.

2. D.A.Skoog and D.M.West 'Analytical Chemistry-An Introduction', 4th Edition, CBS Publishing Japan Ltd., 1986.

REFERENCES:

1. *E.J.Meehan, S.Bruckenstein and I.M.Kolthoff and E.B.Sandell, 'Quantitative Chemical Analysis', 4th Edition, The Macmillan Company, 1969.*
2. *R.A. Day (Jr) and A.L. Underwood, 'Quantitative Analysis', 6th Edition, Prentice Hall of India, 1991.*

Learning Outcomes: In this lab course, students learn various methods of analysis (gravimetric and volumetric) of different metal ions, which are of prominent importance in pollution controle, food saftery, etc,.The training they get here is very useful for their further studies with advanced chemistry courses as well as for seeking analytical chemistry related jobs.

Evaluation Pattern – R.13 & R.16

18CHY386 Physical Chemistry Lab. – Instrumental Analysis 0 0 3 1

Course Outcomes

After the completion of the course, the student will be able to

CO 1: Develop skills in working with analytical instruments and understanding its working principle and different applications in analytical chemistry.

CO 2: Analyze the effect of different electrochemical parameters for industrial anodization and learning the selection of proper reaction conditions.

CO 3: Apply the principles of electrolyte conductance and electrode potential for analytical applications.

CO 4: Evaluate the optical properties of chemical species for analytical applications.

CO 5: Understand the rate of electrochemical reactions and apply it for minimizing industrial corrosion.

Course Contents:

1. Determination of cell constant and equivalent conductivities of different electrolyte by conductometrically.
2. Determination of the strength of strong and weak acids in a given mixture conductometrically.
3. Determination of the velocity constant, order of the reaction and energy of activation for specification of acetate by sodium hydroxide conductometrically.
4. Determination of solubility and solubility product of sparingly soluble salt by (e.g. $PbSO_4$, $BaSO_4$) conductometrically.
5. Determination of the strength of strong and weak acids in a given mixture using a potentiometer.
6. Determination of the strength of strong and weak acids in a given mixture using a pH meter.
7. Determination of unknown concentration using photoelectric calorimeter.
8. Determination of pKa of acetic acid using pH meter.
9. Determination of concentration of an electrolyte by Nernst equation.
10. Determination of concentration of ions by Spectrophotometer.\
11. Determination of concentration of potassium and sodium ion by flame photometry.
12. Determination of transport number of silver ion.

TEXTBOOKS:

1. R.C. Das and B. Behara, 'Experiments in Physical Chemistry', Tata McGraw-Hill, 1983.

2. Alexander Findly,' Practical Physical Chemistry', 9th edition, Wiley, 1972.

REFERENCE BOOKS:

1. Gilbert William Castellam,' Physical Chemistry', Addison-Wesley Publishing Company, 1964.

2. James Brierley Firth, 'Practical Physical Chemistry', D. Van Nostrand Company, 1916.

3. Dr.J. B. Yadav, 'Advanced Practical Physical Chemistry', Krishna Prakashan Media, 29th edition, 2010.

Learning Outcomes: In this lab course, students learn to use various analytical instruments for the analyses of different paramaters of the chemical compounds. The training they get here is very useful for their further studies with advanced chemistry courses as well as for seeking analytical chemistry related jobs.

Evaluation Pattern – R.13 & R.16

18CHY501 QUANTUM CHEMISTRY 3 0 0 3

Course Outcomes

After completing the course, students will acquire

CO 1: Knowledge on origin of quantum mechanics, postulates of quantum mechanics and Schrodinger wave equation

CO 2: Knowledge on application of Schrodinger wave equation to various systems such as particle in a one-dimensional box and in a three-dimensional box, harmonic oscillator, rigid

rotator, particle on a ring, and hydrogen atom and hydrogen-like species

CO 3: Knowledge and application of approximation methods such as independent particle model, variation method, perturbation method, and self-consistent field methods

CO 4: Application of quantum mechanics in chemical bonding – hydrogen molecule, hydrogen molecule ion, molecular orbital and valence bond theory, directed valences and hybridisation, band theory of metallic solids

CO 5: A knowledge on the different methods in computational quantum chemistry – molecular mechanics, molecular dynamics, semi-empirical, ab-initio, and DFT

CO 6: Theory and application of HMO and EHMO

Course Contents:

Unit I: Quantum Chemistry - Introduction
Origin of quantum mechanics, de Broglie relationship, the uncertainty principle (no derivation); Postulates of quantum mechanics:postulate I – wave functions, postulate II-Operators in quantum mechanics, operator algebra, postulate-III – eigen values, eigen value equations, postulate IV – Expectation value, postulate V – time dependent and time independent Schrodinger equation.

Unit II: Applying Schrodinger equation to various general systems
Translational motion of a quantum entity (particle in one dimensional box and three dimensional box); vibrational motion (harmonic oscillator); rotational motion (rigid rotator, particle on a ring and particle on a sphere); angular momentum.

Unit III: Atomic structure and chemical bonding
Hydrogen and hydrogen-like atoms; Multi electron systems- variation methods, perturbation methods,application to the ground state of Helium atom, SCF method, the exclusion principle
Chemical bonding: Hydrogen molecule ion and hydrogen molecule - molecular orbital and valence bond theory, homo and hetero nuclear diatomic molecules from VB and MO theory, the concept of directed valences and hybridization; quantum mechanics in band theory of metallic solids

Unit IV: Electronic structure of polyatomic systems: Computational quantum chemistry
Semi empirical and ab-initio methods; QM approximations, Details of HMO and EHMO and its application to chemical bonding in unsaturated molecules(ethylene, 1,3butadiene etc) ; Details of SCF procedure, Hartree and Hartree Fock methods (up to ground and excited states of hydrogen molecule); the basis sets, STOs and GTOs, nomenclature of basis sets, basis set errors, introductory ideas on DFT.

Unit V: Molecular properties: Computational quantum chemistry
Calculations of molecular properties like atomic charges, dipole moments, electronic distributions, vibration frequencies, NMR chemical shift etc using Gaussian program, specification of molecular geometry using Cartesian coordinates and internal coordinates, Z-matrix, Z-matrix of some simple molecules, structure of a Gaussian input file

TEXTBOOKS:

1. *Ira N. Levin, 'Quantum Chemistry', 6th Edition, Prentice-Hall, 2008*
2. *Peter Atkins, Ronald Friedman, 'Molecular Quantum Mechanics', 4th edition, Oxford university press*
3. *R K Prasad, 'Quantum Chemistry', New Age International (P) LTD publishers*

.

REFERENCES:

1. *Andrew R Leech,' Molecular Modeling – Principles and Applications', 2nd Edition, Pearson Education.*
2. *Donald A. McQuarrie, 'Quantum Chemistry', Viva Books 2016.*

Learning Outcomes: In this course students learn the basics of quantum chemistry and its application in various types of the systems. This knowledge is essential for the students to continue their studies in chemistry and to seek a profession related to chemistry.

Evaluation Pattern – R.13 & R.16

18CHY502 Concepts in Inorganic Chemistry 3 1 0 4

Course Outcomes

After completion of the course, students wil be

CO 1: Able to qualitatively interpret a decay series and compare the penetrating power of alpha, beta, neutron, and gamma radiation

CO 2: Able to understand the factors that determine the biological effects of radiation.

CO 3: Able to criticize how nuclear chemistry and radiochemistry methods can be used to make issues more visible and solve problems, particularly in relation to environmental problems and metal production.

CO 4: Aware of the contributions of chemistry to society, interaction of radiation with matter and improve their knowledge of instrumentation and introduction to health – physical applications in nuclear and radiochemistry.

CO 5: Able to explain new functional materials like fullerenes, carborenes, crown ethers etc. and their applications.

CO 6: Able to predict the structure based on Styx numbers.

CO 7: Able to draw the structures of inorganic chains and polymers and the different silicate structures.

CO 8: Able to differentiate pseudo halogen and inter halogen compounds and their applications.

CO 9: Able to correlate electronic, magnetic and optical properties with the electronic

structures of the 4f elements.

CO 10: Able to compare the properties of lanthanides and actinides and also get a general awareness of mineral wealth of our country.

Course Contents:

Unit 1 Nuclear Chemistry

Nuclear structure, mass and charge, mass defect, binding energy, stability rules, magic numbers, nuclear quantum numbers, nuclear parity and statistics, models of nucleus, shell model, liquid drop model, , semi empirical mass equation, equations of radioactive decay and growth, half-life, average life determination of half-lives, nuclear reactions, energetics of nuclear reactions, types of nuclear reactions, spontaneous and induced fission, neutron capture cross sections- critical size principle and working of nuclear reactor. Numerical problems relevant to each session.

Unit 2 Radiation Chemistry

Radioactive elements, decay kinetics, parent-daughter decay relationships, radioactive equilibrium - transient and secular equilibrium, alpha and beta decay, gamma emission, Radiochemical methods - measurement of radioactivity, measurement of radiations - ionization chamber, proportional counter, the Geiger counter, scintillation counter, semiconductor detectors. Applications of nuclear and radiation chemistry, isotope dilution analysis - activation analysis, radioactive tracers, radiometric titrations, radiation dosimetry, hydrated electron.

Unit 3 Inorganic materials I

Alkali and alkaline earth metals, their compounds, crown ethers and cryptands as complexing agents for alkali metal ions, Be and Mg compounds, boron cage compounds, boron hydrides, structure and bonding, 3-centre-2-electron bonds, styx numbers, the importance of icosahedral frame work of boron atoms in boron chemistry, closo, nido and arachno structure, carboranes, metallocene carboranes, B-N compounds, interstitial compounds, metal carbides, nitrides and hydrides, fullerenes, functionalized fullerenes, C-nanotubes.

Unit 4 Inorganic materials II

Inorganic chains and polymers, rings, cages, and clusters, sulphur-nitrogen compounds, polymeric sulphur nitride, isopoly anions, heteropoly anions, Keggin and Dawson polyoxometallates, borazines, metal clusters, nature of Si-Si bonds, silicates, silicates with zero-, one-, two- and three-dimensional structures, structure of elemental P, phosphonitrilic compounds, polymers with P-N bonds, interhalogen and pseudo halogens, intercalation chemistry, intercalation in layered materials like graphite, xenon fluorides & other xenon compounds.

Unit 5 Chemistry of f-block elements

The lanthanides and actinides, stable oxidation states, the lanthanide and actinide contractions, the f-orbitals, spectral and magnetic properties - comparison with inner transition and transition metals, separation of lanthanides, use of lanthanide compounds as shift reagents, photo-emission of lanthanide compounds, organometallic compounds of lanthanides and actinides and their structural features, reactions of lanthanide and actinide compounds, mineral sands of south west India - Ilmenite, Monazite, etc.

TEXTBOOKS:

1. H J Arnikar, Essentials of Nuclear Chemistry, 4th revised edition, New Age International (P) Limited publishers, 2015.

2. H J Arnikar, Nuclear Chemistry through Problems, New Age International Publishers.
3. J. Huheey, Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, 2006.
4. F.A. Cotton, Advanced Inorganic Chemistry, Wiley; 6th Edition edition (22 April 1999)
5. J.D. Lee Concise Inorganic Chemistry, Oxford University Press, 5th edition, 2008

REFERENCES:

. 1. Gregory R. Choppin, Jan-Olov Liljenzin and Jan Rydberg, Radiochemistry and Nu Clear Chemistry (Third Edition), Elsevier, 2002
2. Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg, Modern nuclear chemistry, A JOHN WILEY & SONS, INC., PUBLICATION, 2017.
3. Shriver and Atkins' Inorganic Chemistry, Oxford; 5 edition, 2009.

Learning Outcomes: In this course students learn the basics of nuclear and radiochemistry and their applications along with the structures and applications of functional materials like fullerenes, carborenes, crown ethers etc. They will also get to learn about the properties of lanthanides and actinides and their applications. This knowledge is essential for their progress in chemistry related courses and/or jobs.

Evaluation Pattern – R.13 & R.16

18CHY503 Principles in Organic Chemistry 3 0 0 3

Course Outcomes

After completing the course, students will

CO 1: Understand the concepts of aromaticity and field effects

CO 2: Understand and reproduce accepted mechanisms of organic reactions including all intermediates, arrows, charges, and resonance structures.

CO 3: Be able to draw all the stereoisomers of organic compound and recognise enantiomers, diastereomers, meso compounds

CO 4: become familiar with the relative stability of conformational isomers of cyclohexanes and related compounds.

CO 5: Be able to predict the major and minor products of a variety of organic reactions with appropriate stereochemistry and regio-chemistry.

Course contents

Unit 1 Aromaticity: Review of inductive and field effects – Resonance effects. Criteria for aromaticity – structural and electronic. Types – Huckel and Craig's rule, homo (Five, Six, seven and eight, membered rings), hetero (furan, thiophene and pyrrole) and nonbenzenoid aromatic systems. Aromaticity of fused rings, annulenes, catenanes, rotaxanes, mesoionic compounds, metallocenes, cyclic carbocations and carbanions.

Unit 2 Structure activity relationships – Orientation effects of substituent, Quantitative treatment of structure on reactivity - free energy relationships – Hammet equations, Taft equation.

Reactive Intermediates: Generation, structure and reactivity - reactions and rearrangement involving) of carbocations - non-classical carbocations, carbanions, carbon radicals, radical

ions, carbenes, nitrenes, isonitrenes, arynes.

Unit 3 Mechanism and methods to determining them: Thermodynamic and kinetic requirement, Baldwin rules for ring closure – Kinetic and thermodynamic control – Hammond postulates, microscopic reversibility, Marcus theory, methods of determining reaction mechanisms - solvents and their effect on course of a reaction.
Acids and Bases: Bronsted and Lewis acids - HSAB concept and bases, pH and pKa, effect of structure on acidity and basicity, effect of medium.

Unit 4 Stereochemistry
Optical and geometrical isomerism, absolute and relative configuration, Cahn-Ingold-Prelog system, prochirality, prochiral centre, atoms, groups and faces, designations. Atropisomerism, optical isomerism in biphenyls, allenes, spirans and "ansa" compounds, compounds containing chiral nitrogen and sulfur atom, geometrical isomerism of cyclic compounds, cumulenes and oximes. Asymmetric synthesis, stereospecific and stereoselective synthesis, regioselective and regiospecific reactions.

Unit 5 Conformational Analysis
Conformational analysis of cyclic and acyclic systems with special emphasis on six membered rings, conformational effects on the reactivity of acyclic and cyclic systems - elimination, substitution and addition, strain, structure and stability of small, medium, and large rings, anomeric effect - cycloalkenes and cycloalkynes - kinetically and thermodynamically favoured products stereochemistry of SN1, SN2, SNi, E1 and E2

Selectivity in organic reactions: Chemoselectivity, regioselectivity, enantio- and stereo-selectivity. Stereoaspects of the addition of X_2, HX, boranes and hydroxylation to C=C systems. *Cis*- and *trans*- hydroxylation of cycloalkenes.

TEXT BOOKS

1. Michael B Smith, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th edition, Wiley (2015).
2. Francis A. Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part A: Structure and Mechanisms", 5th Edition, Springer, 2008
3. P. S. Kalsi, "Stereochemistry, Conformation and Mechanism", New Age Publications, 2008.

REFERENCES

1. E. L. Eliel and S. H. Wilen, "Stereochemistry in Organic Compounds", John Wiley, 2008.
2. D. Nasipuri, "Stereochemistry of Organic Compounds - Principles and Applications", 4th Revised Edition, New Academic Science, 2012.
3. Peter Sykes, "A Guidebook to Mechanism in Organic Chemistry", Pearson Education; 6th edition, 2003.

Learning Outcomes: In this course students learn about the concepts of organic chemistry, principles, theories, classifications, synthetic methods, structure and bonding, reaction mechanisms the applications of organic compounds in various fields. This knowledge is essential for the students to pursue their higher studies in chemistry and to seek a profession related to synthetic or analytical chemistry.

Evaluation Pattern – R.13 & R.16

18CHY504 Coordination Chemistry 3 0

0 3

Course Outcomes

After completing the course, the students will be in a position to

CO 1: Apply the various theories of coordinate bonding to predict the geometry and properties of complexes.

CO 2: Interpret the electronic spectra and magnetic properties of complexes.

CO 3: Improve their analytical and critical thinking through the reaction mechanism and stereochemistry of reactions.

CO 4: Obtain a sound theoretical knowledge in bonding, reactivity and geometry of f-block metal coordination compounds.

Course contents

Unit 1 Theories and Concepts on *d*-block Coordination Compounds

Introduction - ligands, nomenclature of coordination compounds, coordination compounds of *d*-block ions with coordination numbers of 2, 3, 4, 5, 6, 7 and 8. Werner's coordination theory, Valence bond theory (VBT), Crystal field theory (CFT), CFSE, effects of CFSE on hydration energies and spinel groups (normal and inverse), types of ligands – spectrochemical series, spectral and magnetic properties (spin-only magnetic moments), nephelauxetic effect. Crystal field splitting patterns in complexes having Oh, Td, square planar, square pyramidal and trigonal pyramid geometries, factors affecting the magnitude of CFSE, various types of isomerism in coordination complexes, Jahn-Teller (JT) distortion, manifestation of JT on spectral properties. Molecular orbital theory (MOT), ligand field theory (LFT), molecular orbital energy level diagram for octahedral complexes without pi-bonding, metal-ligand pi-bonding, metal-metal multiple bonds, *d*-orbital based metal-metal σ, π and δ bonds in compounds like $[Re_2Cl_8]^{2-}$, $[Os_2Cl_8]^{2-}$, $Cr_2(CH_3COO)_4$ and R-Cr(I)-Cr(I)-R. Application of group theory to coordination compounds.

Unit 2 Reaction Mechanism

Complex equilibrium - formation constants, chelate and macrocyclic effects, factors affecting stability of complexes, methods of determination of stability constants, stability of complex ions in solutions, inert and labile complexes, mechanisms of ligand displacement and addition reactions in octahedral complexes and square planar complexes of platinum *cis*- and *trans*-effect, substitution reactions, mechanisms of substitution, kinetic consequences of reaction pathways, dissociation, interchange, association, dissociation, linear free energy relationships, conjugate base mechanism, stereochemistry of reactions (substitution in *trans*-complexes and substitution in *cis*-complexes), isomerisation of chelate rings, sigma-bonding and pi-bonding effects, oxidation-reduction reactions, inner and outer sphere electron transfer reactions, conditions for high and low oxidations numbers, reactions of coordinated ligands, hydrolysis of esters, amides and peptides, template reactions, electrophilic substitution, photochemical reactions of coordination compounds.

Unit 3 Coordination Chemistry of Inner-transition (*f*-block) Elements

f-block metal ions – oxidation states preferences, ligand preferences, coordination numbers and the geometry of the complexes, influence of lanthanide contraction and actinide contraction in their coordination behaviour, shapes of *f*-orbitals (4*f* and 5*f*), nature of bonding of *f*-orbitals with ligands, various types of coordination compounds of lanthanides and actinides, stereochemistry and reaction mechanism of *f*-block metal complexes.

Unit 4 Spectral Properties

Stabilization of unusual oxidation states, electronic spectra of transition metal complexes – color wheel, Russell-Saunders coupling schemes, term symbols for various d^n ions, Orgel diagrams for d^n systems, ligand field parameters, *Dq*, Racah parameter *B* and nephelauxetic constant *b*, Tanabe-Sugano (TS) diagrams, evaluation of *Dq* and other parameters from electronic spectra of transition metal complexes using TS diagrams, charge-transfer transitions, MLCT and LMCT, selection rules and band intensities, Laporte- and spin-selection rules, symmetry, spin-orbit and vibronic coupling effects. Photochemistry of transition metal complexes like $[Ru(bipy)_3]^{2+}$, spectral behaviour of *f*-block coordination complexes, special features of their absorption and emission properties.

Unit 5 Magnetic Properties

Magnetic properties of coordination complexes - magnetic susceptibility, contribution of spin-orbit coupling on μ_{eff}, types of magnetic behavior - para-, ferro, anti-ferro and ferri-magnetic systems, Curie law, Curie-Wise law, Guoy, Faraday and superconducting quantum interference device (SQUID) methods, Kotani plots, giant magnetoresistance (GMR), anisotropic magnetoresistance (AMR) effect, effects of temperature on magnetic behavior, tunnelingmagnetoresistance (TMR). Magnetism of coordination complexes by multinuclear homo- and heterometallic 3*d* systems (also with exclusive 4*d* and 5*d* metal ions), mixed 3*d*-4*f* systems, importance of 4*f*-metal ions for functional applications. Nanoscale magnetic systems based on coordination complexes - Single Molecule Magnets (SMMs), Single Ion Magnets (SIMs), Single Chain Magnets (SCMs), Spin-crossover complexes, magnetic refringents (magnetic coolers), magnetic storage systems - magnetic random access memory (MRAM).

TEXTBOOKS:

1. F. A. Cotton and G. Wilkinson, 'Advanced Inorganic Chemistry', John Wiley & Sons, 2009.
2. James E. Huheey, Ellen A. Keiter and Richard L.Keiter, 'Inorganic Chemistry, Principles of Structure and Reactivity', Pearson education, 5th edition, 2009.
3. J. D. Lee, 'Concise Inorganic Chemistry', 5th edition, John Wiley & Sons, 2009.
4. P Atkins, T. Overton, J. Rourke, M.Weller, F. Armstrong, "Shriver & Atkins Inorganic chemistry", 4th Edition, Oxford University Press, 2008.

REFERENCES:

1. B. Douglas, D. McDaniel and J. Alexander "Concepts and Models in Inorganic Chemistry", 3rd Edition, Wiley, 2006.
2. SushantaDattagupta, 'A Paradigm Called Magnetism', World Scientific Publishing Co. Pte. Ltd., 2008.
3. Helen C. Aspinall, 'Chemistry of the *f*-Block Elements', Volume 5 of Advanced chemistry texts, CRC Press, 2001.
4. N. N. Greenwood and A. Earnshaw, 'Chemistry of Elements', Butterworth and Heinemann, 2nd Edition, 2002
5. J. E. House, "Inorganic Chemistry", Academic Press, 2008.
6. T. Shinjo (Editor), 'Nanomagnetism and Spintronics', Elsevier, USA, 2nd Ed., 2014.
7. R. A. Layfield and M. Murugesu (Editors), 'Lanthanides and Actinides in Molecular Magnetism', Wiley-VCH Verlag& Co., 2015.

Learning Outcomes: In this course students learn about the concepts of coordination chemistry, theories, synthesis, bonding, structure, charecterizations, functional properties and the applications of coordination compounds in various fields, like, medicine and catalysis.

This knowledge is essential for the students to pursue their higher studies in inorganic chemistry and to seek a profession related to catalysis or medicinal chemistry.

Evaluation Pattern – R.13 & R.16

18CHY505 GROUP THEORY AND ITS APPLICATIONS 3 0 0 3

Course Outcomes

After compoleting the course, student gains

CO 1: A knowledge on basis sets and nomenclature of basis sets

CO 2: Specification of molecular geometry

CO 3: A knowledge in group in mathematics, elements of symmetry in molecules, symmetry operations, molecular point group, abelian and cyclic group.

CO 4: A knowledge in similarity transformation and classes of point group, group multiplication table, and Schoenflies symbols

CO 5: A knowledge in reducible and irreducible representations, great Orthogonality Theorem and its consequences, and construction of character table for point groups

CO 6: A knowledge in the application of group theory to spectroscopy – IR and Raman activity of molecular vibrations, and electronic spectroscopy

CO 7: A knowledge in the application of group theory to chemical bonding – hybridisation, and molecular orbital formation

Course contents

Unit I Introduction to molecular point groups
Definition of a mathematical group, Symmetry in molecules, elements of symmetry, , matrix representation of symmetry operations, molecular point groups, , abelian group, cyclic group, symmetry operations as group elements, similarity transformation and classes, group multiplication table, symmetry classification of molecules into pointgroups (Schoenflies symbol)

Unit II Construction and interpretation of character tables
Reducible and irreducible representations, Great Orthogonality Theorem and its consequences, character tables, reduction formula, construction of character tables for point groups with order ≤6, interpretation of character tables.

Unit III Applications of Group theory - I (vibrational and electronic spectroscopy)
Infrared and Raman activity of molecular vibrations in H_2O, N_2F_2, BF_3, AB_4type molecules (Td and D_4h) and AB_6 type (Oh) of molecules; selection rules; Electronic structure of free atoms and ions, splitting of terms in a chemical environment, construction of energy level diagrams, estimations of orbital energies, selection rules and polarizations, double groups, a brief idea on electronic spectra of transition metal complexes – selection rules, Orgel diagrams, Tanabe Sugano diagrams.

Unit IV: Applications of Group theory (Chemical bonding - Hybridization and molecular orbital formation)
Group theory to explain hybridization - wave functions as bases for irreducible

representations, construction of hybrid orbitals for AB_3 (planar), AB_4 (Td), AB_5 (D_{3h}) and AB_6 (O_h) type of molecules, symmetry adapted linear combinations, projection operators, application of projection operators to pi-bonding in ethylene, cyclopropenyl systems and benzene, application of symmetry to predict polar and chiral compounds;

Unit V: Symmetry in solid state
Symmetry elements and operations in solid state – proper axis of rotation, mirror planes of symmetry, roto- reflection and roto-inversion axes of symmetry, screw axes of symmetry, glide planes; a brief introduction to the crystallographic point groups and space groups

TEXTBOOKS:

1. *F.Albert Cotton, 'Chemical Applications of Group Theory', 3rd Edition, John Wiley, 1990.*
2. *A Salahuddin Kunju, G Krishnan ; 'Group theory and its application in chemistry', second edition, PHI Learning private limited-2015*

REFERENCES:

1. *Robert L Carter, 'Molecular symmetry and Group theory', John Wiley & Sons, Inc.*
2. *V.Ramakrishnan and M.S.Gopinathan, 'Group Theory in Chemistry', 2nd reprint edition, Vishal Publications, 1996.*
3. *P.H.Walton, "Beginning Group Theory for Chemistry", Oxford University Press Inc., New York, 1998.*

Learning Outcomes: In this course students learn the basics of group theory and its application in various types of the systems in chemistry. This knowledge is essential for the students to continue their studies in chemistry and to seek a profession related to chemistry.

Evaluation Pattern – R.13 & R.16

18CHY511 CHEMICAL THERMODYNAMICS AND EQUILIBRIA 3 1 0 4

Course Outcomes

The course helps students to gain

CO 1: Knowledge in equilibrium chemical thermodynamics

CO 2: Ability to apply theories and laws of equilibrium chemical thermodynamics

CO 3: A knowledge in irreversible thermodynamics

CO 4: A knowledge in statistical thermodynamics

CO 5: Ability to apply statistical thermodynamics to solve problems

CO 6: A knowledge on chemical and phase equilibria

Course contents

Unit 1 Chemical Thermodynamics
First and second laws of thermodynamics, thermodynamic functions, heat capacity, thermo chemistry, need for second law of thermodynamics, entropy and free energy functions,

calculation of changes in thermodynamic function for ideal and non-ideal gases in isothermal and adiabatic process, relation between thermo dynamic functions - Maxwell relations, Joule Thomson effect, coefficient of thermal expansion and compressibility factor, applications of free energy function to physical and chemical changes, equilibrium in chemical reactions, third law of thermodynamics - need for third law, calculation of absolute entropy, unattainability of absolute zero, thermodynamic systems of variable composition - fugacity functions, partial molar quantities, thermodynamics of ideal solutions, real solutions and regular solutions, dilute solutions of nonelectrolytes, Henry's law, Raoult's law, Gibbs-Duhem equations, Gibbs-Duhem-Margules equations, and activity and standard states of non electrolytes.

Unit 2 Irreversible Thermodynamics

Examples for irreversible process, entropy production, non-equilibrium, steady state and near equilibrium conditions, linear relation, phenomenological coefficients, Onsagar reciprocal relations, one component systems with heat and matter transport, application of irreversible thermodynamics to thermal diffusion, thermal osmosis etc., electro kinetic effects, the Glansdorf-Pregogine equation.

Unit 3 Statistical Thermodynamics

Statistical concept, probability and thermodynamic states, entropy and probability, canonical ensemble, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Statistics, electron gas concept, Bose-Einstein condensation, relation among MB, FD & BE Statistics, partition function, partition function for free linear motion, free motion in a shared space, linear harmonic vibration, translational, rotational and vibrational partition function, molecular partition functions, partition functions and thermodynamic properties, calculation of equilibrium constant, heat capacity of gases, mono atomic solids, Einstein's and Deby's theory.

Unit 4 Equilibrium

Gibb's free energy, direction of spontaneous change of a reaction, chemical potential, chemical potential and equilibrium, ΔG in terms of K, equilibrium constants – real gases and real reactions, equilibrium respond to catalyst, temperature, pressure and $_{P}H$, application of ΔG and K – extraction of metals from their oxides, Ellingham diagram, and thermodynamics of ATP & respiration, biological energy conversion.

Unit 5 Phase Equilibrium

Gibb's Phase rule, one component system, two component systems, vapour pressure diagrams and their interpretation, lever rule, temperature-composition diagrams, liquid-liquid phase diagrams, distillation of partially miscible liquids, azeotropes, liquid-solid phase diagrams, phase diagram for the system Na/K/Na_2K, phase diagram - steel, alloys, Fe-C system, zone refining, three component system, triangular coordinates, three component system – partially miscible liquids - $H_2O/CHCl_3/CH_3COOH$, phase diagram - $NH_4Cl/(NH_4)_2SO_4/H_2O$

TEXTBOOKS:

1. Robert J. Silbey, Robert A. Alberty, Moungi G. Bawendi, Physical Chemistry 4th Edition, Wiley, 2004
2. Samuel H. Maron, Carl F. PruttonPrinciples of Physical Chemistry, The Macmillan Company; 4th edition (1970)
3. *Samuel Glasstone, 'Thermodynamics for Chemists', Lightning Source Incorporated, 2007.*

REFERENCES:

1. Francis Weston Sears and Gerhard L.Salinger, 'Thermodynamics, kinetic theory and statistical thermodynamics' 3rd edition, Addison-Wesley Publications, 1975.
2. Prigogine, 'Introduction to Thermodynamic Irreversible Processes', Interscience Publishers, 3rd edition, 1968.
3. R.P.Rastogi and R.R.Misra, 'An Introduction to Chemical Thermodynamics', 6th Revised edition, Vikas Publishing House Pvt. Ltd., 2006.
4. F.W.Sears, 'Introductions to Thermodynamics, Kinetic Theory of Gases and Statistical Mechanics', Addison Wesley Pub., Cambridge, 1972.

Learning Outcomes: In this course students learn about the various theories and concepts of thermodynamics and statistical thermodynamics as well as phase equilibrium. This knowledge is essential for the students to continue their studies in chemistry and to seek a profession related to chemistry.

Evaluation Pattern – R.13 & R.16

18CHY512 MOLECULAR SPECTROSCOPY 3 1 0 4

Course Outcomes

After the completion of the course, the students will have

CO 1: Thorough understanding of the fundamental theoretical concepts of spectroscopy, based on quantum chemistry, group theory and statistical thermodynamics.

CO 2: Thorough understanding of the fundamentals of instrumentation of spectroscopic techniques.

CO 3: Ability to apply the knowledge of spectroscopy to provide analytical solutions for problems of chemical interest.

Course contents

Unit 1 Rotational and Vibrational Spectroscopy

Introduction to spectroscopy, rotation spectra - diatomic and polyatomic molecules, selection rules, intensities of spectral lines, stark effect, instrumentation of micro wave spectroscopy, applications and structural determinations, vibration spectra of diatomic molecules, harmonic and anharmonic vibrations, diatomic vibrating rotor, selection rule, breakdown of Born Oppenheimer approximation, rotational character of vibration spectra, different modes of vibrations, vibration-rotation spectra, Fermi resonance, vibration spectra of polyatomic molecules, IR spectra of organic and inorganic compounds, phase, temperature and solvent dependence, FTIR technique, instrumentation, Raman spectra (including the use of laser) - theory, relation with IR spectroscopy, mutual exclusion principle, resonance Raman, stimulated hyper and inverse Raman effects, instrumentation and applications of Raman spectroscopy.

Unit 2 UV-Visible and Fluorescence Spectroscopy

Electronic spectra of atoms - single and multi electron systems, j-j and L-S coupling,

electronic spectra of diatomic and polyatomic molecules, its relation to electronic arrangement and symmetry of molecules, application of group theory in electronic spectra, selection rules, nature of electronic excitation, principles of absorption spectroscopy, Beer-Lambert law, presentation of spectra, chromophores, forbidden transition, different types of electronic transitions, p-p*, n-p* etc transitions, nature of transitions in carbonyl compounds, the effect of conjugation, effect of conjugation on alkenes, HOMOs and LUMOs, Woodward-Fieser rules for dienes, spectra of carbonyl compounds, enones, Woodward rule for enones, spectra of aromatic compounds, effect of substituents, structural information from electronic spectra, excited states of molecules, fluorescence and phosphorescence, Jablonski diagram in detail, lifetime of excited states, quantum yields, photosensitization, application of UV-Visible and Fluorescence Spectroscopy for structural elucidation of organic compounds, diffuse reflectance spectra.

Unit 3 NMR Spectroscopy

Nuclear magnetic resonance phenomenon - theory, relaxation effects, NMR uses active nuclei, Fourier Transformation in NMR, measurement of relaxation time, chemical shift, magnetic anisotropic effect, multiplets in NMR, spin-spin splitting, n + 1 rule, Pascal's triangle, tree-diagram, spin-spin splitting constant, J, ^{2}J and ^{3}J and long-range coupling, measurement of J, Karplus relationship, first and second order spectra, AX, AB, AX_2, AX_3, A_2X_3, AMX type spectra, double resonance and spin tickling, chemical shift reagents, spectra in higher fields, spectra of conformational isomers, homotopic, enantiotopic and diastereotopic systems, C^{13} spectra, factors related to ^{13}C spectra, ^{1}H coupled ^{13}C spectra, ^{1}H decoupled ^{13}C spectra, chemical shift values, nuclear Overhauser effect (NOE), cross-polarization, off-resonance resonance decoupling, application of ^{1}H and ^{13}C NMR spectroscopy for the structural elucidation of organic compounds, ^{11}B, ^{15}N, ^{19}F and ^{31}P NMR spectra, spectra of paramagnetic complexes, magnetic susceptibility, contact shift, fluxional molecules and their studies using NMR, solid state NMR.

Unit 4 ESR, NQR and Mossbauer Spectroscopy

ESR spectroscopy - theory, hyperfine and superfine splitting, ESR active simple organic systems, ESR of inorganic systems like Cu^{2+} and VO^{2+} complexes, 'g' markers like DPPH and TCNE, evaluation of spin Hamiltonian like A, g_{ll}, g-, covalency factor in Cu^{2+} complexes, analysis of ESR spectra of VO^{2+} complexes, NQR spectroscopy - theory, relationship between electric field gradient and molecular structure, quadrupole coupling constant and structural information of compounds, Mossbauer spectroscopy, principle, Doppler effect, isomer shift, Zeeman splitting, quadrupole splitting, application of Mossbauer spectroscopy for studying Fe and Sn compounds and phase transformation, application of ESR spectroscopy.

Unit 5 Mass Spectrometry and PES

Mass spectroscopy, base peak and molecular ion peak, isotope ratio data, fragmentation patterns of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, phenols, aldehydes, ketones, esters, carboxylic acids, amines, methods of desorption and ionization (EI, CI, LD, MALDI, PD, FAB, SIMS), MS/MS and determination of molecular formula, metastable ions and their significance, study of fragmentation pattern, application of MS in structural elucidation and other frontiers of science, application of MS for quantitative analysis, photoelectron spectroscopy (PES), principle, application of PES. Structure determination

using IR, UV-visible, NMR, MS and ESR spectral techniques.

TEXTBOOKS:

1. *Colin N. Banwell and Elaine M. McCash, 'Fundamentals of Molecular Spectroscopy', 4th Edition, Tata McGraw Hill, 2007.*
2. *W. Kemp, Organic Spectroscopy, 3rd Edition, McMillan International Higher Education*
3. *D. L. Pavia, G. M. Lampman, G. A. Kriz, and J. R. Vyvyan, Introduction to Spectroscopy, 5th Edition, Brooks-Cole, 2009*
4. *G. M. Barrow, 'Introduction to Molecular Spectroscopy', McGraw Hill, 1962.*
5. *R. M. Silverstein, F. X. Webster, D.J. Kiemle, Spectroscopic identification of organic molecules, 7th Edition, John Wiley*
6. P. S. Kalsi, Spectroscopy of Organic Compounds: New Age International Pvt Ltd 6th edition edition,, 2006

REFERENCE:

1. *Hollas, J.M., Modern Spectroscopy, John Wiley & Sons, Fourth Edition, 2004*
2. *J. Keeler, Understanding NMR spectroscopy, Wiley, 2009*
3. *D. A. Skoog, F. J. Holler and S. R. Crouch, 'Principles of Instrumental Analysis', 6th Edition, Thomson Brooks/Cole, 2007.*
4. *W. Kemp, NMR in Chemistry, McMillan, 1988*
5. *J. E. Wertz and J. R. Bolton Electron Spin Resonance, Springer Science*

Learning Outcomes: In this course students learn about the basic theories, concepts, instrumentations and specific applications of various spectroscopic techniques in details. This knowledge is essential for the students pursue higher studies in chemistry, to take part in research and development and or to seek a profession related to chemistry.

Evaluation Pattern – R.13 & R.16

18CHY513 Organic Reaction Mechanism 3 1 0 4

Course Outcomes

The course will help students to

CO 1: Understand nucleophile and electrophile groups and their properties.

CO 2: Describe and demonstrate the importance of molecular rearrangements in organic compound synthesis and understand the basics of photochemistry and pericyclic reactions.

CO 3: Describe the interaction of excited states with their surroundings and analyse photo-induced electron transfer/excitation energy transfer reactions.

Course contents

Unit 1 Nucleophilic Substitution:SN1, SN2, and Borderline (ion pair), SNi, SET mechanisms, Neighboring group participation, substitution at allylic carbons, substitution at

aliphatic trigonal carbon, substitution at vinylic carbon. Effect of substrate structure, nucleophile, leaving group and medium on reactivity. Ambident nucleophiles and substrates. Aromatic nucleophilic substitution: SNAr, SN1, benzyne and SRN1 mechanisms. Effect of substrate structure, leaving group and attacking nucleophile on reactivity.

Unit 2 Electrophilic substitution: SE2 and SEi, SE1, substitution accompanied by double bond shift. Effect of substrate, leaving group, and solvent on reactivity. Aromatic electrophilic substitution: Arenium mechanism, Structure – reactivity relationship, substituent effect, o/p ratio, ipso substitution, orientation and reactivity, quantitative treatment.
Free radical reactions: Radical addition. Effect of substrate (aliphatic, aromatic, bridgehead), nature of the radical and solvent on reactivity.

Unit 3 Addition reactions: Mechanism of Electrophilic, nucleophilic and radical addition. Addition to conjugated systems. Orientation and reactivity. Addition of hydrogen halides, Oxymercuration, halogenation, sulfenylation, selenylation, addition involving epoxides, addition via organoborane. Addition of water, alcohol, sulfides, to aldehydes, ketones, imines, isothiocyanates, nitrocompounds, nitriles. Mannich reaction,
Elimination reactions: Mechanism of elimination reactions E2, E1, E1CB, steric effect. Effect of substrate structure, base, leaving group and medium on reactivity. Mechanism of pyrolytic elimination.

Unit 4 Rearrangement reaction: Mechanism of Nucleophilic, electrophilic and radical rearrangements. Nature of migration, migratory aptitudes, memory effects. Wagner-Meerwein, Pinacol, Demyanov, dienone-phenol, Benzil-Benzilic acid, Favorskii, Wolff, Neber, Hofmann, Curtius, Lossen, Schmidt, Beckmann, Baeyer-Villiger, Stevens, benzidine, Hofmann-Loffler and Chapman rearrangements and their mechanisms.

Unit 5 Photochemistry and pericyclic reactions: General principles – Fate of excited state – Jablonsky diagram - chemical process – Photochemistry of alkenes, dienes and polyenes, Carbonyl compounds, Norrish type 1 and Type 2, Patterno –Buchi reaction.
Pericyclic reactions: Cyclo addition - Diels-Alder reaction, Substituent effect on reactivity, regioselectivity and stereochemistry, Catalysis of Lewis acids, Synthetic applications, Enantio selective Diels alder reactions, Intramolecular Diels-Alder reactions. 1,3 Dipolar Cycloaddition – reactivity, regio and stereoselectivity, Applications. [2+2] cycloaddition – ketenes and alkenes – photochemical Electrocyclic reactions, Orbital symmetry, charged species. Sigmatropic rearrangements – [1,3], [1,5], and [1,7] sigmatropic shifts – [3,3] sigmatropic rearrangements – Cope, Oxy-Cope and Claisen rearrangement. [2,3] rearrangements – oxides and ylides –Wittig and aza – Wittig rearrangements, Cheletropic reactions.

TEXT BOOKS

1. Michael B Smith, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th edition, Wiley (2015).
2. Francis A.Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part A: Structure and Mechanisms", 5th Edition, Springer, 2008
3. Francis A.Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part B: Reactions and Synthesis", 5th Edition, Springer, 2008.
4. Singh S P and SM Mukherji, "Reaction Mechanism in Organic Chemistry", 2014

REFERENCES

1. Reinhard Bruckner, Advanced Organic Chemistry, Reaction Mechanisms, Elsevier, 2002
2. R.O.C. Norman and J.M. Coxon, "Principles of organic synthesis", CRC press, 2014
3. Ian Fleming,Frontier Orbitals and Organic Chemical Reactions 1st Edition, Wiley,

1991.

Learning Outcomes: In this course students learn about the various types of the mechanisms observed in organic transformation reactions, including several named reactions of industrial applications. This knowledge is essential for the students to continue their studies in synthetic chemistry, to take part in research and development and to seek a profession related to synthetic chemistry.

Evaluation Pattern – R.13 & R.16

18CHY514 Heterocyclic and Natural Product chemistry 3 0 0 3

Course Outcomes

After completing the course, the students will be able to

CO 1: Explain on mechanistic level, reactions and synthesis of important nitrogen/oxygen/Sulphur containing heterocycles; pyrroles, pyridines, diazoles, diazines, benzo-condensed analogs, furan and thiophenes

CO 2: Understand the fundamentals of carbohydrate chemistry

CO 3: Provide an overview of field of biochemistry and natural product chemistry, their occurrence, structure, total synthesis, biosynthesis and properties.

Course contents

Unit 1 Heterocyclic compounds
Nomenclature and general characteristics of heterocyclic compounds, study of three and four-membered ring heterocyles containing one heteroatom, structure and synthesis of penicillin and cephalosporin-C, structure and synthesis of reserpine, heteroaromatic compounds (five and six-membered rings) containing one and two heteroatoms, fused ring compounds - indole, quinoline, isoquinoline, coumarin, flavones, purine and pyrimidine, bases present in nucleosides.

Unit 2 Carbohydrates and nucleic acids
Nomenclature – aldoses, ketoses, furanoses, pyranoses. Classification – monosaccharides, disaccharides and polysaccharides. Structure (Fischer, Haworth and chair projection) of ribose, glucose, fructose, maltose, sucrose, lactose, starch, cellulose and cyclodextrins. Preparation of alditols, glycosides, deoxysugars. Biosynthesis of vitamin C from glucose. Structure and synthesis of nucleic acids, genetic code, recombinant DNA. biosynthesis of shikimic acid

Unit 3 Chemistry of Natural Products
Alkaloids - classification, structure elucidation based on degradative reactions (quinine atropine), Terpenoids - classification, structure elucidation and synthesis of abietic acid, terpenoids. Total synthesis of quinine and papavarine (morphine, heroin).

Unit 4 Steroids
Steroids - classification, structure of cholesterol, conversion of cholesterol to progesterone, androsterone and testosterone, classification, structure and synthesis of prostaglandins, biosynthesis of fatty acids, prostaglandins, and steroids.

Unit 5 Amino acids, Peptides and Enzymes

Synthesis of amino acids - Strecker and azlactone synthesis, reactions of amino acids, structure of proteins, introduction to enzymes and coenzymes with special reference to the function of chymotrypsin, NAD, thiamine, pyridoxal, solid phase synthesis – choice of resin, classification and reactions leading to peptide formation.

TEXT BOOKS

1. I.L. Finar Organic Chemistry vol 2 (3rd.ed.) Longmans Green & Co. 1964
2. Sujata V. Bhat, Bhimsen A. Nagasampagi, Meenakshi Sivakumar, Chemistry of Natural Products, Springer 2005

REFERENCES

1. K. C. Nicolaou, Eric J. Sorensen, Classics in Total synthesis, Wiley, 1996.
2. Ashutosh kar, Chemistry of Natural Products, (Volume I and II), CBS

Learning Outcomes: This course gives advanced knowledge on classification, preparation and reactions of polynuclear aromatic compounds, heterocyclic compounds, carbohydrates, amioacids, peptides, nucleic acids and natural products. By learning this course students will be able understand the importance of these compounds in organic, pharmaceutical and biological chemistry.

Evaluation Pattern – R.13 & R.16

18CHY515 Organometallic Chemistry 3 0 0 3

Course Outcomes

After completing the course the students will be gaining

CO 1: An understanding of the history and overview on organometallic compounds (nomenclature, hepticity, 18-electron and 16-electron rules).

CO 2: An in-depth knowledge on metal carbonyls and their bondings, CVE based structure prediction and their IR spectral features is obtained.

CO 3: A great insight in to the organometallic compounds with interesting ligands and their bondings combined with structural features.

CO 4: Good knowledge of organometallic compounds with metal carbenes structures (Fischer carbenes, Schrock carbenes and *N*-heterocyclic carbenes, metal polyenes, metal carbines, metal alkyl/aryl derivatives).

CO 5: An understanding of the basics of fragment molecular orbitals (FMO) of various organic and inorganic moieties and their symmetry and shapes.

CO 6: The ability to predict the iso-electronic and isolobal relationships between various organic and inorganic (ML_n) fragments and their MO level diagrams.

CO 7: An understanding about stereochemically non-rigid molecules, fluxional nature of organometallic compounds and their characterisation by NMR spectroscopy.

CO 8: An insight into the basics of reactions involving various organometallic compounds:

oxidative addition reactions, reductive elimination reactions, migratory insertion reactions, 1,1-type and 1,2-type insertion reactions, elimination reactions, β-hydride elimination reactions.

CO 9: An in-depth knowledge on the application of basic organometallic reactions into the various types of catalytic processes for the synthesis of various organic compounds is obtained.

CO 10: A knowhow of the importance of organometallics in industry, in medicine, in agriculture and in environmental science.

Course contents

Unit 1: Concepts and Metal Carbonyls

History and overview on organometallic compounds. Classification and nomenclature – hapticityof fragments, 18-electron and 16-electron organometallic compounds. Structure prediction based on '18 electron rule'. Metal carbonyls – synthesisand bonding of metal carbonyls (based on MO theory), donor and acceptor properties of CO, different types of binding modes of CO, poly-nuclear carbonyls with and without bridging groups, metal-metal bonding in M-CO clusters, cluster valence electron (CVE) count, CVE based structure prediction. IR spectral features of metal carbonyls, activation of CO by bonding with metal ions.

Unit 2: Types of organometallic compounds

Metal phosphines compounds of transition metals, M-N_2 (metal dioxygen), M-O_2 (metal dioxygen), M-NO (metal nitrosyl) and M-CN (metal cyanide/isocyanide) complexes, bonding and structural features. Organometallic compounds with π-donor ligands like olefins, acetylenes and allyl moieties. Metal derivatives of cyclic π-donors (metallocenes, sandwich/half-sandwich compounds, bent metallocenes), metal-carbon σ-donors (metal carbenes – Fischer carbenes, Schrock carbenes and *N*-heterocyclic carbenes, metal polyenes, metal carbines, metal alkyl/aryl derivatives). Organometallic chemistry of lithium and magnesium, aluminum alkyls and all other main-group organometallics. Structural features and nature of bonding in above compounds.

Unit 3: Structure and Bonding

Fragment molecular orbitals (FMO) of various organic and inorganic moietieslike CH_3, CH_2, CH, BH_2, BH, NH_2, NH. FMO's (π-orbitals) of C_3H_5, C_4H_4, C_4H_6, C_5H_5, C_6H_6, C_8H_8. Inorganic fragments MLn with varying number of L's. Symmetry and shape of their FMO's. Isolobal concept, iso-electronic and isolobal relationships between various organic and inorganic (ML_n) fragments. Structure and bonding between various organic and inorganic fragments based on MO level diagrams – metal-olefins, ML_n-cyclobutadiene, ML_n-carbene, ML_n-carbyne, ML_n-cyclopentadienyl systems, compounds with metal-metal multiple bonds (metal-metal σ, π and δ bonds).

Unit 4: Stereochemistry and reactions

Stereochemically non-rigid molecules, fluxional nature of organometallic compounds (including Li-C, Mg-C), characterization of non-rigidity of organometallic compounds by NMR spectroscopy. Difference in NMR spectra of fluxional organometallic compounds at high and low temperatures. Characterization techniques of organometallic compounds (by NMR – ^{1}H, ^{13}C and ^{31}P NMR spectroscopy, Dynamic NMR, Mass spectrometry). Reactions involving various organometallic compounds - oxidative addition reactions, reductive elimination reactions, migratory insertion reactions, 1,1-type and 1,2-type insertion reactions, elimination reactions, β-hydride elimination reactions. Conditions for organometallic

compounds to exhibit above reactions, cyclo-metalation and ortho-metalation reactions, agostic interactions.

Unit 5: Organometallic Catalysis

Alkene hydrogenation using Wilkinson's catalyst, water-gas shift reaction, Mosanto process, Cativa Process. Reaction steps in the above catalytic processes. Hydro-formylation reactions, catalytic addition of molecular oxygen to alkenes (Wacker process), Ziegler-Natta polymerization of alkenes, Fischer-Tropsch process, olefin-metathesis (types of Grubbs catalysts and Hoveyda–Grubbs catalysts), oligomerization of alkynes, aluminum alkyls in polymerization of olefins. Palladium based reactions such as Heck, Stille, Suzuki, Sonogashira, Buchwald-Hartwig couplings; Tsuji-Trost C-C bond formations. Homogeneous vs. heterogeneous organometallic catalysis (principles, mechanism and their applications). Organometallics - in industry, in medicine, in agriculture and in environmental science.

TEXTBOOKS:

1. J.E. Huheey, R.A. Keiter, R.L. Keiter, 'Inorganic Chemistry-Principles of Structure and Reactivity', 4thEdn., Prentice Hall, 1997.
2. P. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong,' Shriver and Atkins Inorganic Chemistry', 4thEdn., Oxford University Press, 2006.
3. F.A. Cotton, G. Wilkinson, C.A. Murillo, M. Bochmann, 'Advanced Inorganic Chemistry', 6thEdn.,Wiley-Interscience, 1999.
4. Anil Elias, Gupta B.D., "Basic Organometallic Chemistry", Universities Press; 2ndEdition 2013
5. J.D. Atwood, 'Inorganic and Organometallic Reaction Mechanism', 2nd Edn., Wiley-

REFERENCES:

1. R. H. Crabtree, 'Organometallic Chemistry of the Transition Metals', John Wiley & Sons, 6th Ed.
2. VCH, 1997.
3. J. Tsuji, 'Transition metal reagents and catalyst innovations in organic synthesis', John-Wiley- & Sons, Ltd, New York, 2000
4. B.E. Douglas, D.H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rdEdn., Wiley-India, 2007.
5. M. Bochmann, Orgaonometallics: Complexes with Transition Metal-Carbon Sigma Bonds, Oxford University Press, 1994.
6. J. P. Collman, R G Finke and and J R Norton "Principles and Applications of Organo-transition metal Chemistry" University Science Books, 1987.
7. W.K. Li, G.D. Zhou, T. Mak, Advanced Structural Inorganic Chemistry, Oxford University Press, 2008.
8. K. C. Nicolaou, 'Classics in Total Synthesis', Vols I-III, Wiley-VCH, 1996; 2003; 2011

Learning Outcomes: In this course students learn about the concepts of organometallic chemistry, theories and concepts, synthesis, bonding, structure, charecterizations, functional properties and the applications of coordination compounds in various fields, like, medicine and catalysis. This knowledge is essential for the students to pursue their higher studies in inorganic chemistry, organometallic chemistry or catalysis and to seek a profession related to catalysis or medicinal chemistry.

Evaluation Pattern – R.13 & R.16

18CHY581 INORGANIC SEMI-MICRO QUALITATIVE ANALYSIS LAB. 0 0 6 2

Course Outcomes

After the course, the students will be in a position

CO 1: To understand the distinction between qualitative and quantitative chemical analyses

CO 2: To acquire theoretical knowledge on quantification of an analyte present in a sample through volumetrically and gravimetrically

CO 3: To perform volumetric and gravimetric experiments using conventional equipment/apparatus, instrumentation and techniques

CO 4: To attain skills in laboratory data collection, formal documentation and interpretation of the collected data

Course contents

Semi micro analysis of mixtures
The mixture will include 4 cations including two common (eg. Cations of metals like Cu, Mn, Zn, Ni, Ca, Ba, Mg etc) and two less common cations (eg. Cations of metals like Ti, Zr, V, W, Li, Ce, Th etc).

(The student has to successfully analyze a minimum of 10 mixtures).

TEXTBOOKS:

1. *A. I. Vogel, 'A text book of Qualitative Analyses', 4th edition, Longmans publications, 1985.*
2. *V.V. Ramanujam, 'Inorganic Semi-Micro Qualitative Analysis', 3rd edition, The National Publishing Company, 1974.*

REFERENCES:

1. *G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney, 'Vogel's Text Book of Qualitative Chemical Analysis', 5th edition, John Wiley & Sons Inc, 1989.*
2. *G.W. Parshall, 'Inorganic Synthesis', Vol. 15, Tata McGraw-Hill Education, 1974.*

Learning Outcomes: The methods used in analysing the different inorganic cations and their chemistry. It is very useful in the various applications like food safety and pharmaceuticals.

Evaluation Pattern – R.13 & R.16

18CHY582 ORGANIC QUANTITATIVE ANALYSIS LAB. 0 0 6 2

Course Outcomes

After the course, the students will gain

CO1: Impeccable understanding to calculate a limiting reagent, yield, and percent yield. Also, ability to summarize findings in a clear and concise manner

CO 2: Knowledge of safe laboratory practices handling laboratory glassware, equipment, and chemical reagents including how to perform common laboratory techniques, including reflux,

distillation, steam distillation, recrystallization, vacuum filtration, aqueous extraction, thin layer chromatography, column chromatography.

CO 3: Wide knowledge in prediction of outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups.

CO 4: Basic knowledge in characterizing organic molecules by physical and spectroscopic means, including melting point, boiling point, Infrared red spectroscopy and NMR.

Course contents

A. Estimations:

Estimation of equivalent weight of an acid
Estimation of glucose
Estimation of phenol
Estimation of acetone
Estimation of acid value of an oil
Estimation of iodine value and sap value of an oil
Estimation of Nitrogen – Kjeldahl method
Estimation of formaldehyde
Estimation of aniline
Estimation of ester

B. Preparations of Organic Compounds

Double stage preparations

(a) m-nitro benzoic acid from ethyl benzoate
(b) p-bromobenzanilide from aniline
(c) p-nitro acetanilide from aniline

Single stage preparations

(a) Benzimidazole
(b) Benzophenone oxime
(c) Dibenzilidene acetone (chalcone)
(d) Benzalacetophenone
(e) Benzanilide
(f) Acetanilide
(g) Acetyl salicylic acid (aspirin)

Name Reactions

(a) Benzil-Benzilic acid rearrangement
(b) Cannizaro reaction
(c) Claisen condensation

For all preparations

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

REFERENCES:

1. *P.W.G. Smith, A.J.Hannaford, B.S.Furnis and A.R. Tatchell, "Vogel's Textbook of Practical Organic Chemistry", ELBS/Logman, 1989.*
2. *Ralph L. Shriner, Christine K. F. Hermann, Terence C. Morrill, David Y. Curtin, Reynold C. Fuson, 'Systematic Identification of Organic Compounds', John Wiley & Sons, 2003.*
3. *Mann and Saunders, 'Practical Organic Chemistry', Pearson edition, 2009.*

Learning Outcomes: In this course students get the training on synthesis, extraction, purification and charectrization of some important organic compounds. They also perform some named reactions of synthetic importance. Students also get the information about elemental estimation techniques. This knowledge is essential for the students to continue their studies in synthetic chemistry, to take part in research and development and to seek a profession related to synthetic chemistry.

Evaluation Pattern – R.13 & R.16

18CHY583 ADVANCED PHYSICAL CHEMISTRY LAB. 0 0 5 2

Course Outcomes

After the course, students will gain

CO 1: Skill to evaluate the kinetics of different chemical reactions and to determine the activation energy for reactions.

CO 2: Ability to analyse the thermodynamic parameters in phase equilibrium

CO 3: Knowledge of optical properties of materials and apply this for analytical applications

CO 4: Knowledge to create experiments to evaluate physical chemistry concepts

Course contents

1. Construction of phase diagram for three component system.
2. Determination of equivalent conductance at infinite dilution of weak electrolytes.
3. Determination of order of reaction for ion exchange reaction.
4. Extraction efficiency of solute from a solution by immiscible solvent method.
5. Determination of calorific value using Bomb calorimeter.
6. Kinematic viscosity of lubricants using Bomb calorimeter.
7. Determination of the formation constant of silver-ammonia complex and stoichiome try of the complex potentiometerically.
8. Determination of flash point, fire point of a lubricant.
9. Determination of cloud point and pour point of a lubricant.

TEXTBOOKS:

1. *Alexander Findly, 'Practical physical chemistry', 9th edition, Wiley, 1972.*
2. *R.C.Das and B.Behera, 'Experimental Physical Chemistry', Tata McGraw-Hill, 1983.*

REFERENCE BOOKS:

1. *J.B.Yadav, 'Advanced Practical Physical Chemistry', Krishna Prakashan Media, 29th edition, 2010.*

2. *Francis William Gray, 'A Manual of Practical Physical Chemistry' Macmillan and Co., Limited, 1914.*

Learning Outcomes: In this course students get the training on advanced techniques and methods used in the determination of various parameters of chemical compounds and their reactions. This knowledge is essential for the students to continue their studies in chemistry, to take part in research and development and to seek a profession related to analytical and industrial chemistry.

Evaluation Pattern – R.13 & R.16

18CHY584 INORGANIC QUANTITATIVE ANALYSIS LAB. 0 0 6 2

Course Outcomes

This course will help students

CO 1: To understand the distinction between qualitative and quantitative chemical analyses

CO 2: To acquire theoretical knowledge on quantification of an analyte present in a sample through volumetrically and gravimetrically

CO 3: To perform volumetric and gravimetric experiments using conventional equipment/apparatus, instrumentation and techniques

CO 4: To attain skills in laboratory data collection, formal documentation and interpretation of the collected data

Course contents

1. Estimation of Calcium (Permanganometry)
2. Estimation of Barium (Iodometry)
3. Estimation of Calcium as Calcium Carbonate (Gravimetry)
4. Estimation of Zinc using oxine (Gravimetry)
5. Estimation of Iron as Ferric Oxide (Gravimetry)
6. Analysis of Brass
7. Estimation of Copper and Nickel in a Mixture
8. Estimation of Copper and Iron in a Mixture
9. Preparation and Determination of Ferrous Oxalate
10. Estimation of Different Types of Hardness in the Given Water Sample
11. Estimation of Different Types of Alkalinities in the Given Water Sample
12. Estimation of Dissolved Oxygen in the Given Water Sample
13. Complexometric Estimations

TEXTBOOKS:

1. G. Svehla, 'Vogel's Qualitative Inorganic Analysis', 7th Edition', Prentice Hall, 1996.
2. D. A. Skoog and D. M. West,'Analytical Chemistry - An Introduction', 4th Edition, CBS Publishing Japan Ltd., 1986.

REFERENCES

1. E.J.Meehan, S.Bruckenstein and I.M.Kolthoff and E.B.Sandell, 'Quantitative Chemical Analysis', 4th Edition, The Macmillan Company, 1969.

2. R.A.Day (Jr) and A.L.Underwood, 'Quantitative Analysis', 6th Edition, Prentice Hall of India, 1991.

Learning Outcomes: In this course students get the training of various methods used in the quantitative estimation several metal ions or mixture of metal ions. They also learn the methods for estimation of hardness, alkalinity and dissolved oxygen of water. This knowledge is essential for the students to continue their studies in chemistry, to take part in research and development and to seek a profession related to analytical and environmental chemistry.

Evaluation Pattern – R.13 & R.16

18CHY601 Electrochemistry Kinetics and Surface Chemistry 3 1 0 4

Course Outcomes

After completion of the course, the students will be able to

CO 1: Compute physical quantities based on equations

CO 2: Analyse the behaviour of solutions of electrolytes

CO 3: Deduce the mechanism of chemical reactions

CO 4: Deduce the kinetics of chemical reactions

CO 5: Have a thorough knowledge about the laws and theory

CO 6: Understand the applications of the laws and theory

CO 7: Predict and understand about the mechanism

CO 8: Gain knowledge about the instruments used for various analytical work

CO 9: Gain knowledge on batteries and fuel cells

Course contents

Unit 1 Surface Chemistry

Different types of interfaces, molecular and atomic surface structure, surface chemical reactions, surface tension of solutions, surface excess, thermodynamics of surfaces, Gibbs equation and its derivation, surface films, surface potential, adsorption by solids, Langmuir isotherm - its kinetic and statistical derivation, Freundlich equation, multilayer adsorption, BET isotherm - its kinetic derivation, measurement of surface area.

Colloids - their preparation, purification, stability & electro kinetic phenomena, Donnan membrane equilibrium, micro and nano emulsions.

Surface analysis using photoelectron spectroscopy, surface imaging techniques like SEM, TEM, AFM etc., sputter coating, ion beam principles, design of surfaces with novel properties.

Unit 2 Electrochemistry I

Review of Faraday's laws, conductivity of electrolytes, ionic mobility, transference number, Kohlrausch law, pH of acids, bases and buffers, solubility product and salt hydrolysis and Ostwald dilution law. Deviations from the Ostwald law, activity and activity coefficients in electrolytic solution, Modern theory of conductance of strong electrolytes and its tests and improvements, Debye-Huckel-Onsager equation – theory of mean activity coefficients of strong electrolyte – Debye-Huckel Limiting Law and its testing and improvement.

Unit 3 Electrochemistry II

Electrochemical cells, standard electrode potentials, reversible cell, concentration cells with and without transference, standard electrode potentials, reversible cell, cell notation and calculation of emf – variation of potential with concentration, pressure and temperature, Liquid Junction Potential – its calculation and elimination - Thermodynamics of cell reactions and equilibrium constant - applications of e.m.f. measurements, potentiometric measurement of pH –reference electrodes - glass and quin-hydrone electrodes and their performance and limitations, – ion selective electrodes – biomembranes, Interfacial region – electrical double layers and their structure – Helmholtz-Perrin, Gouy-Chapman and Stern models - charge transfer across interfaces, mass transport – diffusion and convection controlled transport – irreversible electrode processes - activation, concentration and IR polarisation, decomposition potential, Butler-Vohmer equation - over potential (hydrogen, oxygen and metal decomposition over voltage), theories of over voltage, Tafel equation, and Tafel plots – corrosion and its rate from Tafel equation.

Unit 4 Chemical Kinetics I

Reaction rates and order of reactions, determination of order of reactions, complex reactions, reversible, consecutive and concurrent reactions, reactions of variable order, steady state treatment, reaction mechanism and molecularity, theories of unimolecular reactions and termolecular reactions, Arrhenius equation, collision theory and transition state theory, comparative study of the theories of reaction rates, free energy of activation, effect of solvent on rate of reactions, ionic reactions and effect of ionic strength - salt effect, effect of pressure on velocity of gas reactions.

Unit 5 Chemical Kinetics II

Reaction dynamics, fast reactions, flash photolysis and relaxation methods, catalysis and inhibition, homogeneous catalysis, acid, base and enzyme catalysis, kinetics of enzyme catalyzed reaction - the Michaelis-Menten equation. Photochemical kinetics, steady state treatment of photochemical reactions, Semenov-Hinshelwood theory of chain reactions and explosions, free radical reactions - the Rice-Herzfeld mechanism.

TEXTBOOKS:

1. *Gilbert W. Castellan, "Physical Chemistry", 3rd Edition, Narosa Publishing House, 2004.*
2. *K. J. Laiddler, 'Chemical-Kinetics', 3rd Edition, McGraw Hill, New York, 2004.*
3. *An introduction to Electrochemistry, Samuel Glassstone (*2007)

REFERENCES:

1. *W. J. Moore and R. G. Pearson, 'Kinetics and Mechanism', 2nd edition, Wiley, 1981.*
2. *Physical Chemsitry, Peter Atkins, Julio D Paula, OUP Oxford; 9 edition (19 November (2009)*
3. *Textbook of Physical Chemistry, Samuel Glassstone,* D. Van Nostrand company, inc; 2nd edition (1946)
4. John O'M. Bockris, Amulya K.N. Reddy,Modern Electrochemistry 1: Ionics, 2nd Edition, Springer, 1998
5. John O'M. Bockris, Amulya K.N. Reddy, Maria E. Gamboa-Aldeco, Modern Electrochemistry 2A: Fundamentals of Electrodics 2nd Edition, Springer, 2001

Learning Outcomes: This course gives detailed basic and concise advanced knowledge of the fields, Surface chemistry, chemical kinetics and electrochemistry, which is essential for the better understanding of chemistry and advancement.

Evaluation Pattern – R.13 & R.16

18CHY602 Synthetic Strategies and Reagents 3 1 0 4

Course Outcomes

After the completion of the course the students will have an understanding of

CO 1: Pericyclic reactions, principle of conservation of orbital symmetry, thermal and photochemical reactions, selection rules, electrocyclic reactions, cycloadditions, sigmatropic rearrangements

CO 2: Retrosynthetic analysis-ways to synthesize organic molecules from simple starting materials

CO 3: Organometallic reagents, methods of preparing them and the reactions carried out using them

CO 4: Various oxidation and reduction reactions and the reagents that are used for such reactions.

CO 5: Base catalyzed reactions and an in-depth knowledge on various name reactions using different type of bases.

Course contents

Unit 1 Synthetic Strategies
Synthetic strategies: Functional group inter-conversion – conversion of one functional group to other. Nitrogen, oxygen, sulphur protection and deprotection – utilization of protection groups in organic synthesis. Retro synthetic analysis, functional group equivalents, use of retrosynthesis in organic synthesis. Reversal of reactivity (Umpolung), Introduction to combinatorial chemistry. Application of phase transfer catalysts.

Unit 2 Oxidation and reduction:
PCC, DDQ, DMSO, Dess-Martin Reagent, TEMPO, osmium tetroxide, ruthenium tetroxide, selenium dioxide, peracids, hydrogen peroxide, singlet oxygen, aluminum isopropoxide, periodic acid, lead tetraacetate. Swern, Jones, Oppeneur oxidation, Woodward and Prevost hydroxylation, Sharpless asymmetric epoxidation, catalytic hydrogenations (heterogeneous and homogeneous), Clemmenson, Wolff Kishner, Rosenmund and MPV reductions, metal hydrides as reagents (aluminium/boron hydrides and hydroboration reaction), Birch reduction, Borche Reduction, hydrazine and diimide reduction.

Unit 3 Organometallic reagents: Preparation, properties and reactions of organo lithium, organosilicon, organozinc (Reformatsky reaction) and organomagnesium reagents (Barbier and Grignard), organocadmium, organo mercury reagents based organometallic reactions involving C-C bond formation. Selected functional group transformations in organic synthesis. Preparation and reactions of Organo copper, organopalladium,- Wacker process – Heck reaction, cross coupling, carbonylation reaction, organonickel, organo cobalt and organo rhodium reagents – Olefin metathesis reaction. Reactions and applications of Organoboron, organo silicon and organotin compounds.

Unit 4 C-C, bond formation

C-C bond formation – aldol, Arndt-Eistert, Bardhan-Sengupta, Baker-Venkataraman,Barbier, Baylis-Hillman, Benzoin, Heck, Fukuyama, Dieckmann, Friedel–Crafts, Michael, Perkin, Claisen, Robinson annulations, Vilsmeier, Wittig, Knoevnagel, Michael additions.

Unit 5 C-N, C-O bond formations

C-O bond formation – barton, Fischer esterification, Prins, Darzen, Baeyer-Villiger, Mitsunobu, Williamson's ether synthesis, Ullman Coupling with Boronic Acids.

C-N bond formation – Mannich, Fukuyama, Mitsunobu, Ritter, Gabriel Synthesis, Ugi, Doebner Reaction, Buchwald-Hartwig, Stork-enamine, formation of azides and hydrazines, formation of amides and peptides, coupling reactions.

TEXT BOOKS

1. Modern Organic Synthesis, Dale L. Boger, The Scripps Research Institute, Rush Press, San Diego, California, 2001
2. Francis A.Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part B: Reactions and Synthesis", 5th Edition, Springer, 2008.
3. R.O.C. Norman and J.M. Coxon, "Principles of organic synthesis", CRC press, 2014

REFERENCES

1. Stuart Waren, Designing Organic Synthesis: A programmed introduction to the synthon approach, JOHN WILEY & SONS, 2nd edition, 2008
2. Name Reactions: A collection of detailed Mechanisms and synthetic applications, Jie Jack Li, Springer, fourth edition (expanded edition), 2009.
3. Michael B Smith, "March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure", 7th edition, Wiley (2015).
4. Francis A.Carey and Richard J. Sundberg, "Advanced Organic Chemistry - Part A: Structure and Mechanisms", 5th Edition, Springer, 2008

Learning Outcomes: This course gives advanced knowledge about the various synthetic strategies, importance of redox-steps, C-C, C-N and C-O bond formation and usage of organomettalic reagents. This knowledge is essential for the students to continue their studies in synthetic chemistry and catalysis to take part in research and development and to seek a profession in polymer, pharmaceutical or other related industries.

Evaluation Pattern – R.13 & R.16

18CHY603 Solid State Chemistry and Materials Science 3 0 0 3

Course Outcomes

After completing the course a student will have

CO 1: In-depth understanding of the fundamental concepts of crystallographic systems and their symmetries.

CO 2: Ability to comprehend the different types of solid structures: Ionic solids, spinels, rutile, fluorite, etc.

CO 3: Ability to understand the basics of bonding in different types of solids and their theories.

CO 4: In-depth understanding of Band theory and its application in explaining the properties of solids (photoconductivity, electrical conductivity, etc.)

CO 5: An understanding of the basics of magnetic properties (ferro and anti-ferro magnetic, super exchange) of solid materials.

CO 6: Thorough understanding of the contribution of crystal defects in to various properties of solids: Schottky defects, Frenkel defects, doping in crystals and colour features, ruby, diamond.

CO 7: Knowledge of the importance of solid materials and their structure property relationships: Band-gap properties of semiconductors; photo-catalytic properties of ZnO and TiO_2; inorganic-organic hybrid materials; high Tc superconductors.

CO 8: Knowledge about metal-organic framework (MOF) materials and their special features (gas storage, emission properties and sensors).

CO 9: Deep understanding about sol-gel processes, characterization of processed materials by PXRD, IR, Raman, UV-visible and solid state NMR spectral techniques, understanding morphological features through, SEM, EDAX and TEM methods.

CO 10: An understanding of chemical vapour deposition (CVD) method for solid state synthesis and synthesis of inorganic-organic hybrid materials; solvo-thermal and high pressure synthesis.

Course contents

Unit 1 Introduction to Crystal Systems

Introduction to solids - solid state chemistry, close packing, hcp, fcc, density, coordination numbers, tetrahedral and octahedral holes, body centered and primitive structures, symmetry, proper rotation, mirror planes, inversion, improper axis symmetry elements, symmetry in crystals, Schoenflies and Hermann-Mauguin notations, unit cells, glide plane, screw axis, atom occupancy in cubic unit cells, seven crystal systems/classes, space groups, Miller indices, Bravais lattices, reciprocal lattice, inter-planar spacing in different crystal systems, fractional coordinates, ionic solids, structures of CsCl, NaCl, NiAs, zinc blende and wutzite structures, MX_2 type solids, fluorite and antfluorite structures, $CdCl_2$ and CdI_2 structures, rutile and anti-rutile, ReO_3, spinel and inverse spinel, pervoskite structures, ionic radii, crystal radii, radius ratio, Extended covalent array, diamond, graphite.

Unit 2 Bonding in Solids and Electronic properties

Bonding in crystals, metallic bonding, ionic bonding, covalent bonding, silicates, Born-Haber cycle, Hess's law, lattice energy (L) and calculation of L, free electron theory, density of states, electronic conductivity, molecular orbital theory, overlap and bonding, linear chain of H atoms, LCAO, Fermi Level, conductors, insulators and semiconductors, n- and p-type semiconductors, bands in compounds, band-gap energy, direct and indirect band gaps in semiconductors, band-gap measurements, electrical conductivity, photo-conductivity.

Unit 3 Magnetic and Optical Properties of Solids

Behaviour of substances in magnetic field, magnetic moments, para magnetism, diamagnetism, ferro- and anti-ferromagnetism, ferri-magnetism, effects of temperature of magnetism, Curie & Curie-Weiss laws; mechanism of ferro- and anti-ferromagnetic ordering, super exchange. Luminescence and phosphorescence of solid materials, phosphors, lasers, non-stoichiometry and its effect in properties of solids, electronic properties of non-stoichiometric oxides. Defects in solids, Schottky defects, Frenkel defects, doping in crystals and colour features, ruby, diamond, organic conductors, preparation, mechanism of conduction in organic semiconductors, photoconductivity of polymers.

Unit 4 Materials Science-Structure and properties

Solid materials of importance. Structure and properties of SiO_2, ZrO_2, SiC, BN, ZnO, TiO_2, CdS, CdTe, GaAs, MoS_2. Band-gap properties of semiconductors like ZnO, TiO_2, CdS, CdSe, CdTe, GaAs, MoS_2 and $(CH_3NH_3)[PbX_3]$-type perovskites. Photo-catalytic properties

of ZnO and TiO_2 – principle and applications. Inorganic-organic hybrid materials. High Tc superconductors (HTS) like Bi-Sr-Ca-Cu oxide based HTS (BSCCO) and Y-Ba-Cu-oxide (YBCO), their structure and properties. Metal-organic framework (MOF) materials, special features of MOF materials. Synthesis, special features and properties of MOF materials like HKUST-1 and MOF-8. Gas storage and emission properties of MOF materials. MOFs as sensors. Zeolites, their special features and properties.

Unit 5 Materials Science-Synthesis, processing and characterization

Sol and gel, their properties, xerogels. Sol-gel synthesis - synthesis of SiO_2 and TiO_2 through sol-gel process. Calcination and sintering. Characterization of processed materials, PXRD, IR, Raman, Uv-visible and solid-state NMR spectral techniques. Understanding morphological features through, SEM, EDAX and TEM methods. Chemical vapour deposition (CVD) method. Solid state synthesis, synthesis of High Tc superconducting materials like YBCO and BSCCO. Synthesis of inorganic-organic hybrid materials. Solvo-thermal and high-pressure synthesis.

TEXTBOOKS:

1. *L V Azroff* , *'Introduction to Solids' , Tata McGraw-Hill publishing company*
2. L. E. Smart and E. A. Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2016.
3. A. R. West, Solid State Chemistry and its Applications, Wiley, 2014
4. C N R Rao, K Biswas, Essentials of Inorganic Materials Synthesis, John Wiley, 2014
5. C N R Rao Chemical Approaches to Synthesis of Materials, Wiley, 1994

REFERENCES

1. D. Jiles, "Magnetism and Magnetic Materials", Chapman and Hall, London, 1991.
2. R. E. Hummel, "Electronic Properties of Materials", 3rd ed., Springer-Verlag, New York, 2001.
3. Schubert, U. and Hüsing, N, Synthesis of Inorganic Materials, 3rd edn, VCH-Wiley Verlag GmbH, Weinheim, 2012
4. W.D. Kingery, H.K. Dowen and R.D. Uhlman, Introduction to Ceramics, John Wiley.
5. F.H. Norton, Elements of Ceramics,.
6. M.W. Barsoum, Fundamentals of Ceramics, McGraw Hill.
7. Material Science and Engineering, S.K. Hajra Choudhury, Indian Book Dist.
8. B D Fahlman, Materials Chemistry, 2nd Edition, Springer, 2011
9. Stefan Kaskel, The Chemistry of Metal–Organic Frameworks: Synthesis, Characterization, and Applications, Wiley-VCH Verlag GmbH, 2016

Learning Outcomes: This course gives advanced knowledge about the solid materials, bonding and structure, electronic, optical and magnetic properties and their applications in various fields. This knowledge is essential for the students to continue their studies in chemistry, material science and catalysis to take part in research and development and to seek a profession in polymer, fuel, paint or other related industries.

Evaluation Pattern – R.13 & R.16

18CHY604 Bioinorganic Chemistry 3 0 0 3

Course Outcomes

After completion of the course a student will

CO 1: Understand the basics of metal ions in biology (including photosynthesis, PS-I and

PS–II) and electron transport systems in biology.

CO 2: Gain knowledge on reactive oxygen species (ROS) and role of antioxidants in biology.

CO 3: Understand the theory and mechanistic action of hemoglobin and myoglobin and their model compounds; structure and functions of haemerythrin (Hr) and haemocyanin (Hc).

CO 4: Gain knowledge about different types of cytochromes and their role in biology; Fe-S and other non-heme iron proteins.

CO 5: Understand the structural basics of metallo-enzymes such as catalases, peroxidases, copper enzymes, superoxide dismutase (SOD), Zn-containing enzymes, nitrogenase enzyme.

CO 6: Master the structures of Fe-S clusters, Fe-protein structure, Mo-Fe protein structure, P-cluster and M-centre and their model compounds.

CO 7: Understand about role of Zn, Ca, Mn, Ni, Mo and Cr in biological systems and metal toxicity.

CO 8: Understand I depth about the basics of metal ion based (Pt, V, Au) drugs, anticancer agents, DNA intercalators, MRI imaging and contrast agents.

CO 9: Have knowledge on biomimetic compounds of Fe(II), Co(II) and Cu(II) for Mb and Hc.

CO 10: Understand photodynamic therapy (PDT), principles and applications; natural and synthetic ionophores, crown ethers, cryptands and cryptates, calixarenes, cyclo-dextrins and their special properties.

Course contents

Unit 1: Basics in bio-inorganic chemistry

Essential elements in biological systems, transport of ions across biological membranes, active and passive transport, metal transport and metallochaperons, Na^+/K^+ pump and active transport. Metal complexation with biological molecules. Electron transport in biology, electron transport chain (ETC), role of ETC in biological systems. Amino acids, peptides and proteins, primary and secondary structure of proteins, α-helix and β-sheets forms of proteins and their special features; tertiary and quaternary structures of proteins the type of molecular interactions involved in them. Reactive oxygen species (ROS), generation and function of organic free radicals, action of ROS in biological systems, oxidative stress, antioxidants. Photosynthesis, PS-I and PS–II.

Unit 2: Oxygen take-up, transport and storage proteins

Porphine, corrin, corrole, chlorin and bacteriochlorin. Myoglobin (Mb) and hemoglobin (Hb), their prosthetic groups and functions, mechanism for reversible binding of O_2 in Mb and Hb. Cooperative effect in Hb and its consequence. Behaviour of bound O_2 to Fe(II). Difference between O_2 and CO binding to Hb and Mb, CN^- poisoning. Structure and functions of haemerythrin (Hr) and haemocyanin (Hc), O_2 binding nature in Hr and Hc, electron transfer processes in them. Cytochromes and their role in biology, cytochrome P-450, cytochrome C-oxidase and oxygen transfer from O_2 to non-activated substrates, monooxygenases, methane monooxygenase (MMO). Fe-S and other non-heme iron proteins, ferredoxins-their structure and special properties, transferrin, ferritin, siderophores, enterobactin, uptake, transport and storage of iron. Sickle-cell anemia.

Unit 3: Metallo-enzymes

Catalases – structure and properties reaction mechanism. Peroxidases- glutathione peroxidase, HRP, structure and properties and enzyme reaction mechanism. Cytochrome c peroxidase and lignin peroxidase. Copper enzymes-structure and function, azurin, plastocyanin. Type I, II and III copper proteins. Superoxide dismutase (SOD) - structure and enzymatic reaction mechanisms. Tyrosinase, reaction mechanism. Zn-containing enzymes, carbonic anhydrase and carboxy-peptidases-structure and enzymatic reactions. N_2 fixation, nitrogenase enzyme, Fe-S clusters, Fe-protein structure, Mo-Fe protein structure, P-cluster and M-centre, their model compounds.

Unit 4: Other functional roles of metal ions

Zn in biological systems, Zn-finger proteins – structural features and properties, classifications and their roles in biological systems. Ca^{2+} binding proteins, calmodulins. Metal ion based (Pt, V, Au) drugs, anticancer agents. Cis-platin and its properties. Chelation therapy, macrocyclic antibiotics. Role of Mn, Ni, Mo and Cr in biological systems, metal toxicity and homeostasis, therapeutic complexes. Diseases caused by both excess and deficiency of metal ions, thalassaemia, Wilson disease. DNA intercalators, diagnostic agents, MRI imaging and contrast agents, the role of Gd^{3+} and other metal ions as contrast agents.

Unit 5: Biomimetic compounds, metals in medicine

Porphyrins (H_2P) and metalloporphyrins (MP), spectral, fluorescence and redox properties of H_2P and MP. Biomimetic compounds. Fe(II), Co(II) and Cu(II) based model compounds model compounds of Mb and Hc –. 'picket-fence' porphyrin and its special features. Photodynamic therapy (PDT), principles and applications. Natural and synthetic ionophores, crown ethers, interaction and uptake of alkali metal and alkaline earth metal ions with crown ethers, cryptands and cryptates, calixarenes and their special properties, cyclo-dextrins and their special properties.

TEXTBOOKS:

1. J.E. Huheey, R.A. Keiter, R.L. Keiter, Inorganic Chemistry-Principles of Structure and Reactivity, 4th Edn., Prentice Hall, 1997.
2. F.A. Cotton, G. Wilkinson, C.A. Murillo, M. Bochmann, Advanced Inorganic Chemistry, 6th Edn., Wiley-Interscience, 1999.
3. P. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, Shriver and Atkins Inorganic Chemistry, 4th Edn., Oxford University Press, 2006.

REFERENCES

1. S. J. Lippard, J. M. Berg, Principles of Bioinorganic Chemistry, University Science Books, 1994.
2. J. D. Atwood, Inorganic and Organometallic Reaction Mechanism, 2nd Edn., Wiley-VCH, 1997.
3. B.E. Douglas, D.H. McDaniel, J. J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Edn., Wiley-India, 2007.
4. W. Kaim, B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John Wiley & Sons, 1994.
5. M. N. Hughes, The Inorganic Chemistry in Biological Processes, Wiley (1981)

Learning Outcomes: In this course students get the detailed knowledge about the concepts of bionorganic chemistry. Structure and activity profiles of various biomolecules will be familariezd. This course provides all the essential knowledge needed for the students to purse higher studies, research activites or jobs related to bioinorganic chemistry and pharma.

18CHY631 Applied Electrochemistry 3 0 0 3

Course Outcomes

The course is intended

CO 1: To make students familiar with basic notions of electrochemistry: oxidation-reduction, potential, overvoltage.

CO 2: To give students an understanding of the electric double layer theory.

CO 3: To ensure that students know fundamental principles of Faraday's law and able to use it for engineering calculations

CO 4: to describe and understand the operation of electrochemical systems for the production of electric energy, i.e. batteries and fuel cells.

CO 5: provide students with, both an understanding of the basic concepts of biosensing technology, and an appreciation of the state of the art and future directions.

Course contents

Unit 1 – Electrodics: Electron transfer under an interfacial electric field, A two way traffic across the interference: equilibrium and exchange current density. Dependence of the electrochemical reaction rate on over potential-Quantitative version of the Butler Volmer equation. Electrode kinetics involving the semiconductor/solution interface. Techniques of electrode kinetics-preparation of electrode surface. Microelectrodes-applications.

Unit 2: Industrial Cathodic process - Electrodeposition of copper, nickel and chromium over mild steel – zinc plating on MS – decorative plating of silver and cold – nano plating and microstructure of deposits - Tests for adhesion, hardness, thickness, uniformity and corrosion resistance of the electro deposits-post plating passivation processes-barrel plating of small components - Electroless deposition of nickel, copper, gold on metal components – making of waveguides and plated through hole boards.

Unit 3: Industrial Anodic Processes: Anodising of aluminium and its alloys – baths used, operating conditions and sequence determination of thickness – industrial applications- nano anodizing of titaniuim, and tantalum – application to sensor field

Electropolishing of ferrous and non-ferrous metals and alloys - mechanism of electropolishing –Electrochemical etching of ferrous and non-ferrous metals –

Special processes: Electrolysis of water – electrowinning of aluminium and sodium – electrolysis of brine-photoelectrochemistry

Unit4 - Electrochemical energy systems: Primary batteries: Zinc-carbon (Leclanche type), zinc alkaline (Duracell),; lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account) Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries. Reserve batteries

thermally activated batteries - remote activation - pyrotechnic materials: Fuel Cells: Principle, proton exchange membrane (PEM), direct methanol(DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.

Unit5 - Electro chemical sensors: Potentiometric sensors, solid state Potentiometric chemical sensors, polymeric membrane sensors, ion selective field effect transistor, application, Hydrovolumetric technique-hydrodynamic voltammetric-application, voltammetric sensors-electrode modification application, optical sensors, bioamperometric titration. Methods involving forced convection-hydrodynamic methods.

Text books

1. Allen J. Bard and Larry R. Faulkner, 'Text book for Electrochemical Methods',2nd edition, Wiley, 2000.

2. Derek Pletcher and Frank C. Walsh, 'Industrial Electrochemistry', Blackie Academic and Professional, (1993).

References

1. *Christopher M A, Brett, 'Electrochemistry – Principles, Methods and Applications', Oxford University, (2004).*
2. *Watanabe T, 'Nano-plating: microstructure control theory of plated film and data base of plated film microstructure', Elsevier, Oxford, UK (2004).*
3. *Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Curtis, 'Electroforming', London, (2004).*
5. *Rumyantsev E and Davydov A, 'Electrochemical machining of metals', Mir, Moscow, (1989).*
6. *Peter G Sheasby 'Basics of aluminium anodising', Banbury, Oxon (2001)*
7. *Robert Brugger 'Nickel Plating' Robert Draper Ltd, Teddington, (1970)*
8. *J. K. Dennis, T. E. Such, 'Nickel and Chromium Plating, Third Edition' Woodhead Publishing Series in Metals and Surface Engineering, 3rd Edition,(1993)*

Learning Outcomes: This course enables the students to understand principles and applications of electrodics, industrial cathodic and aniodic processes, electrochemical energy systems (batteries) and electrochemical sensors. This knowledge will enable them to seek advanced courses and professions related to battery technology and energy.

Evaluation Pattern – R.13 & R.16

18CHY632 BIOANALYTICAL CHEMISTRY 3 0 0 3

Course contents

Unit 1 Enzymes

Enzyme nomenclature, Enzyme commission numbers, Enzymes in bioanalytical chemistry, Enzyme kinetics - Enzyme activators, Enzyme inhibitors.

Unit 2 Quantification of Enzymes and their substrates

Instrumental methods, Optical detection - Absorbance, Fluorescence, Luminescence,

Nephlometry Electrochemical detection -Amperometry, Potentiometry, Conductometry, Other Detection Methods - Radiochemical, Manometry, Calorimetry.

Unit 3 Immobilized enzymes
Immobilization methods - nanopolymerizing covalent immobilization, Crosslinking with bifunctional reagents. Properties of immobilized enzymes, immobilized enzyme reactions, theoretical treatment of packed bed enzyme reactors.

Unit 4 Antibodies
Structural and functional properties of antibodies, Polyclonal and monoclonal antibodies Antibody-antigen interactions, analyrtical application of secondary antibody-antigen.

Unit 5 Biosensors
Response of Enzyme-based Biosensors, Examples of Biosensor Configuration, Ferrocene-mediated Amperometric Glucose Sensor, Potentiometric Biosensor for Phenyl Acetate, Potentiometric Immunosensor for Digoxin, Optical Biosensor for Glucose Based on Fluorescence Energy Transfer, Piezoelectric Sensor for Nucleic Acid Detection, Enzyme Thermistors.

TEXTBOOKS:

1. Susan R. Mikkelsen, and Eduardo Corto´n 'Bioanalytical Chemistry', 1st edition, Wiley Interscience, 2003.
2. Andres Manz, Nicole Pamme and Dimitri Lossifidis, 'Bioanalytical Chemistry', World Scientific Publishing Company, 2004.

REFERENCE:

1. Robert W. Cattrall, 'Chemical Sensors', Oxford University Press, 1997.

Learning Outcomes: This course provides the detailed information about the qualitative and quantitative analysis of various biomolecules, including enzymes, antibodies and biosensors. This knowledge will enable them to seek advanced courses and professions related to pharmacology and bioanalytical chemistry.

Evaluation Pattern – R.13 & R.16

18CHY633 CHEMISTRY OF BIOMOLECULES 3 0 0 3

Course Outcomes

The course enables the students to

CO 1: Understand the role of aminoacids, proteins and peptides in biology along with their application.

CO 2: Describe the basic properties, mechanisms of action and applications of enzymes

CO 3: Gain knowledge in nucleic acids, antibodies, recombtinant DNAand gene analyses.

Course contents

Unit 1 Amino acids, Proteins and Peptides
Classification, Stereochemical aspects, physical properties, Ionic properties, spectral

properties, essential and non essential amino acids, chemical reactions of amino acids, Industrial preparation and chemical synthesis of amino acids. Ionic properties of proteins, protein structure, protein purification, protein structure determination, proteomics and protein function, solid phase peptide synthesis, biologically important peptides.

Unit 2 Enzymes
Introduction to Enzymes, Classification of enzymes, mechanism of enzyme action, immobilized enzymes and enzyme technology, enzyme analog built polymers, design of molecular clefts, enzymes in synthetic organic chemistry. Enzymes in biological systems

Unit 3 Molecular biology and bioinformatics
Structure of nucleic acids, genes and genome complexity, functions of nucleic acids, isolation and separation of nucleic acids, molecular analysis of nucleic acid sequences, nucleotide sequencing of DNA.

Unit 4 Immunochemical techniques
Production of antibpodies, purification and fragmentation of immunoglobulins, immunoprecipitatipon, labeling antibodies, immunoblotting, immunoassays, immunohisto/cytochemistry.

Unit 5 Recombinant DNA and genetic analysis
Constructing gene libraries, cloning vectors, hybridization and gene probes, application of gene cloning, expression of foreign genes, pharmacogenomics.

REFERENCES:

1. *Hermann Dugas, 'Bioorganic Chemistry - A Chemical Approach to Enzyme Action', 3rd edition, Springer.*
2. *Keith Wilson and John Walker, 'Principles and Techniques of Biochemistry and Molecular Biology', 6th edition, Cambridge University Press.*

Learning Outcomes: This course provides the students with detailed information about the chemistry enzymes, protiens and peptides. It also familarieses students with immumochemical techniques, genetic analysis and bioinformatics. This knowledge will enable them to seek advanced courses and professions related fields.

Evaluation Pattern – R.13 & R.16

18CHY634 INDUSTRIAL CHEMISTRY 3 0 0 3

Course Outcomes

The enables the students

CO 1: To gain knowledge about various water treatment processes adopted in industries

CO 2: To get an in-depth overview on production, refining and processing of various types of fuels

CO 3: To understand the importance and preparative methods of explosives and chemical weapons

CO 4: To learn the manufacturing process of paints and pigments and to develop ability to scale up the products prepared in the laboratory to the industrial level

CO 5: To obtain a comprehensive knowledge of various energy resources used commercially

CO 6: To calculate, analyse and execute different types of industrial processes

Course contents

Unit 1 Water treatment
Softening of water, Ion exchange process, Lime soda process, Modified Lime soda process, Zeolite process, Chemical and physical method of sterilization, Desalination, Boiler problems. Corrosion of boiler units, industrial water treatment, water analysis.

Unit 2 Fuels
Calorific value, determination of Calorific value, classification of fuels, Solid fuels, Properties of fuels, classification of coal, coking and non-coking coals, advantages and disadvantages of solid fuels. Liquid fuels, gaseous fuels, analysis of fuel gases, Distillation of petroleum. Processing & purification of petroleum and petroleum products, Flash point, Fire point, Knocking, antiknocking, Cetane number, octane number, natural gasoline, cracking, polymerization, alkylation, isomerisation, rocket fules, fossil fules, nuclear fuels.

Unit 3 Energy resources
Renewable and non-renewable sources of energy, conventional and non conventional sources of energy, solar energy, solar technology, solar photovoltaic cell - application, PV lantern system, Radiotelephone system, Application of solar energy, Environmental implication, Nuclear energy, nuclear fuel cycle in India, Energy conservation and waste heat boilers, Fuel cells, hydrogen cells.

Unit 4 Paints and Pigments
White pigment, blue, green, yellow, black and red pigments - manufacture, physical properties, characteristics, Manufacture of paints, setting of paints, requirement for good paints, emulsion paint, latex paint, luminescent paint, fire retardant paints, heat resistant paints, varnishes, manufacture of varnishes, enamels, lacquers.

Unit 5 Explosives and Toxic Chemical Weapons
Introduction, Classification. Deflagrating or low explosives. Characteristics of explosives, nitrocellulose, PETN, DNB, TNB, TNT, Picric Acid, Nitroglkycerine, Dynamite, Cirdite, Gun powder, RDX, EDNA, HMX,Tetryl, Pentryl, Hexyl, Dinol. Toxic chemical weapons, screening smokes, Incendiaries, Pyrotechniques, Explosives in India.

TEXTBOOKS:

1. *B. K. Sharma, 'Industrial Chemistry', Goel publishing.*
2. *James A Kent, 'Riegels Hand book of Industrial chemistry', 10th edition, Kluwer Academic/Plenum publishers, 2003.*

REFERENCES

1. *Alan Heaton, 'An Introduction to Industrial chemistry', 3rd edition, Blackie Academic and professional, 1996.*
2. *Chris A Clausen and Guy Mattson, 'Principles of industrial chemistry', 2nd edition Wiley, 1978.*
3. *Jonathan Steed, 'Core Concepts on supramolecular chemistry and nanochemistry', Wiley Eastern Publishers, 2006.*

Learning Outcomes: This course familarises the students with the various industrial processes and products, including energy storage materials, paints, explosives. The detailed understanding of these things is necessary to secure a career in the chemical industries.

Evaluation Pattern – R.13 & R.16

18CHY635 INDUSTRIAL STOICHIOMETRY 3 0 0 3

Course contents

Unit 1 Introduction to process calculation - dimensions and systems of units - fundamental quantities of units, derived quantities, definition and units of force, volume, pressure, work, energy, power, heat-unit conversions in FPS, MKS and SI systems.

Unit 2 Mixtures and solutions - methods of expressing compositions of mixture and solutions, wet and dry basis concept. Ideal and real gas laws – Gas constant – normal molal volume, calculations of pressure, volume and temperature using ideal gas law. Gas mixtures – Use of partial pressure and pure component volume in gas calculations. Dissociating gases. Relation between mole%, volume% and pressure% of ideal gases calculation of average molecular weight, density, mole%, weight% in gas mixture in SI/MKS systems – applications of real gas relationship in gas calculation.

Unit 3 Description and simple material balance calculation of physical processes such as drying, distillation, absorption, mixing, crystallization, Evaporation.

Unit 4 Single stage material balance calculation of leaching and extraction, calculations involving recycling and bypassing operation - limiting reactant, excess reactant, conversion, yield and selectivity - simple numerical for finding yield, conversion and composition.

Unit 5 Calculation of material and energy balance based on reactions involving heat capacity and specific heat - mean heat capacity of gases - heat capacity of gas mixture and liquid mixture. Calculations of heat capacity by integral equation up to three terms - sensible and latent heats of fusion, sublimation, vaporization. Calculations of standard heat of formation from heat of combustion data. Calculations for heat of reaction from heat of formation and heat of combustion data – Fuels - calorific values proximate and ultimate analysis - air requirement and composition of flue gases.

TEXTBOOKS:

1. *Bhatt, B. L. Vora,S. M., "Stoichiometry", 3rd Edition, Tata McGraw-Hill (1996).*
2. *Felder, R. M. and Rousseau ,R. R. "Elementary Principles of Chemical Processes" 3rd Edn., John Wiley & Sons, New York 2000.*

REFERENCE BOOKS:

1. *Hougen O.A., Watson K.M. and Ragatz R.A., "Chemical Process Principles" Part I, CBS Publishers (1973).*
2. *Warren. K Lewis, Arthur H. Radash & H. Clay Lewis, "Industrial Stiochiometry", McGraw Hill Book C., NY 1995.*

Learning Outcomes: This course re-introduces the concepts of stoichiometry with respect to the important industrial processes. The knowledge and understanding of industrial stoichiometry are necessary to secure a career in the chemical industries.

Evaluation Pattern – R.13 & R.16

18CHY636 MATERIAL SCIENCE AND NANOCHEMISTRY 3 0 0 3

Course Outcomes

After completing the course, students gain a

CO 1: Perfect understanding of nanomaterials, their preparation and properties.

CO 2: Basic knowledge in classification and quantum confinement

CO 3: A sound understanding of characterization techniques

CO 4: Wide knowledge in the application of nanomaterials in different arenas.

CO 5: a thorough knowledge of the fate of nanomaterials in the environment as well as living organisms and the ethical use of nanomaterials

Course contents

Unit 1 Introduction to NanomaterialsIntroduction to Material Science, Interdisciplinary nature, Structure of nanomaterials, Length scales, de-Broglie wavelength & exciton Bohr radius, Foundations of Quantum Mechanics: wave function, Schrödinger equation, ucertainty principle, quantum wells, quantum wires, quantum dots, articles.

Unit 2 Nanomaterials: Synthesis, PropertiesSize effect and properties of Nanoparticles - Particle size - Particle shape - Particle density, Specific surface area and pore - Composite structure, Crystal structure - Functionality of nanostructures and their characteristic evaluation - Optical properties - Catalytic property; Synthesis - Methods and Strategies, Top-down and bottom-up approaches, Chemical vapor deposition, Laser ablation, Electric-arc, Sol-Gel Processing, Lithography - Surface modification of inorganic nanoparticles by organic functional groups.

Unit 3 Surface Science and Characterization of NanomaterialsElectron Microscopy, MFM, SNOM, SEM, TEM, EDAX, X-ray Diffraction and Electron diffraction, Atomic Force Microscopy, Scanning Tunneling Microscopy, Spectroscopy: UV-Visible spectroscopy, Photoluminescence spectroscopy, IR spectroscopy, FTIR and ATR, Raman spectroscopy, Self-Assembled Monolayers.

Unit 4 Nanotechnology: Applications and DevicesNanoscale materials, Nano transfer printing, Biomaterials applications, MEMS and NEMS, selforganisation, nanoscale (opto) electronics, Fullerenes, Devices - Actuators and motors for nanodisplacements, Nanosensors, development of optical memory using semiconductor nanoparticles - Nozzle-free inkjet technology - Dendrimers and their application to organic electronics devices - Nanomedicines, Bio-imaging with quantum dots.

Unit 5 Environmental Issues in NanotechnologyNanoparticles and environment - Nanoparticles in atmosphere - Ground water, exhaust gases – wastewater and Indoor environments; Safety of nanoparticles - Problems caused by nanoparticles, Safety assessment for the nanoparticles; Removal of nanoparticles.

TEXTBOOKS:

1. T. Pradeep, 'Nano - The Essentials Understanding Nanoscience and Technology', McGraw-Hill Professional Publishing, 2008.
2. Charles P. Pool and Frank J. Ovens, 'Introduction to Nanotechnology', John Wiley and sons, 2006.

REFERENCES:

1. Ozin, Geoffrey Alan, Arsenault, 'Nanochemistry: A Chemical Approach to Nanomaterials', Royal Society of Chemistry, 2008.
2. C.N.R. Rao, A.Muller, A.K.Cheetham, 'The Chemistry of Nanomaterials: Synthesis, Properties and Applications', Wiley-Vch Verlag Gmbh & Co., 2004.
3. Alexei Nabok, 'Organic and Inorganic Nanostructures', Artech House, 2005.
4. C. Richard Brundle, Charles A. Evans Jr., and Shaun Wilson, 'Encyclopedia of Materials Characterization', Butterworth-Heinemann Publishers, 1992.
5. Masuo Hosokawa, Kiyoshi Nogi, Makio Naito and Toyokazu Yokoyama, 'Nanoparticle Technology Handbook', Elsevier Publishers, 2007.

Learning Outcomes: This course provides the students with complete knowledge of nanaomaterials, synthesis, structures, their charecterizations and specific applications. This knowledge is essential for the students to continue their studies or research in the nanochemistry and nanotechnology, it will also be very useful in seeking a profession in related sector.

Evaluation Pattern – R.13 & R.16

18CHY637 MEDICINAL CHEMISTRY 3 0 0 3

Course Outcomes

The course helps the students

CO 1: To understand the physicochemical properties of drug and its metabolic pathways, adverse effect and therapeutic value of drugs.

CO 2: To know the role of enzymes and vitamins in biological action.

CO 3: To understand the chemistry of various drugs with respect to their pharmacological activity

Course contents

Unit 1 Medicinal chemistry: Introduction, drugs – classification of drugs – mechanism of drug action. Drug-receptor complex, nomenclature – agonist.

Unit 2 Physicochemical properties of drugs in relation to biological action: solubility**,** Partition coefficient, dissociation constant, hydrogen bonding, ionization, drug shape, surface activity, complexation, protein binding, molar refractivity, bioisosterism – stereo chemical aspects of drug action.

Enzymes, hormones and Vitamins - representative cases, nomenclature, classification and characteristics of enzymes, mechanism of enzyme action, factors affecting enzyme action, co-factors and co-enzymes, enzymes in organic synthesis, mechanism of enzyme catalysis, enzyme inhibition. Hormones and vitamins – representative cases.

Unit 3 Essentials of drug design

Molecular mimetics, drug-lead modification, drug design using QSAR and computer assisted design, assessment of drug activity, receptors and drug action, mechanism of drug action, drug metabolism pathways, Drug potentiation, drug antagonism and drug resistance

Unit 4 Medicinal agents from natural products

History of the use of natural products as therapeutic agents, medicinal plants, active principle, Isolation methods of alkaloids, terpenes, antioxidants, natural oils from plants.

Unit 5 Medicinal agents

Medicinal agents belonging to alkaloids, steroids, polypeptides, modified nucleic acid bases, sulphonamide and sulpha drugs, antibacterials - sulpha drugs, substituted sulphonamides, anticonvulsants, anticoagulants, antiamoebic agents, antihelmintic agents, anti-malarial agents, diuretics and cardio vascular agents, , medicinal agents affecting CNS, analgesics, antipyretics, antiseptics and disinfectants, Histamine and anti-histaminic agents.

Infectious and non-infectious diseases (malaria, AIDS, Cancer) introduction, mechanism of action types of cure.

TEXTBOOKS:

1. *John M beak and John H Block, 'T Wilson, O. Gisvold and R. F. Deorge - Text book of Organic, Medicinal and Pharmaceutical Chemistry', 7th edition, J.B. Lippincott Williams and Wilkons Company, 1977.*
2. *A.Burger, 'Medicinal Chemistry', 3rd edition, Wiley Interscience, 1970.*
3. *V.K.Ahluwalia and Madhu Chopra, 'Medicinal Chemistry', Ane Books pvt Ltd, 2008.*

REFERENCES

1. *V.Kothekar, 'Essentials of Drug Designing', 14th edition, Dhruv publications, 2005.*
2. *V.K.Ahluwalia, Lalita S.Kumar and Sanjiv Kumar, 'Chemistry of Natural Products', Ane Books India.*
3. *L.P.Graham 'An introduction to Medicinal Chemistry', 3rd edition, Oxford University Press, 2005.*

Learning Outcomes: This course provides the detailed information about the medicinal drugs, physicochemical properties of drugs in relation to biological action, drug design, and extraction of medicinal agents from natural products. This knowledge is essential for the candidates who wants to continue in medicinal chemistry or pharmacology for higher studies, reaserch or a career.

Evaluation Pattern – R.13 & R.16

18CHY638 SUPRAMOLECULAR CHEMISTRY 3 0 0 3

Course Outcomes

The course enables the students

CO 1: To understand the basic concepts of molecular and supramolecular chemistry. Understand the bottom-up and top-down approach used for the synthesis of supramolecular assemblies.

CO 2: To learn about fundamental principles of photoinduced charge transfer and energy

transfer,molecular electronics, molecular photonics etc.

CO 3: To understand the underlying principles of molecular recognition, semiochemistry , get to know various receptors like crown ethers, cyclophanes, cyclodextrins etc

CO 4: To familarise with electrochemically controllable molecular switchable systems

CO 5: To familarise with molecular scale mechanical devices, molecular motors, allosteric movements , tweezers, harpoons , molecular rotaxanes, catenanes and threading and dethreading movements associated with them

Course contents

Unit 1 Introduction to Supramolecular Chemistry
From molecular to supramolecular chemistry: Factors leading to strong binding, hydrogen bonding and stacking interactions, Bottom-up approach, Top-Down Approach, Energy and Signals Semiochemistry, photo switching devices, electro switching devices, mechanical switching processes.

Unit 2 Processing of Energy and Signals by Molecular and Supramolecular system
Fundamental principles of photo induced electron and energy transfer, Molecular electronics, Molecular photonics, Molecular Chemionics, Molecular electro photonics, Molecular Photochemionics.

Unit 3 Molecular Recognition
Molecular receptors: crown ethers, siderophores, cyclophanes, cyclodextrin and their application in specific recognition processes. Metal guided self assembly reactions, molecular knot with double helical complexes, Self assembly of polynuclear metal complexes.

Unit 4 Electrochemistry of Supramolecular Systems
Electroluminescent systems as sensors and devices, Redox controlled molecular switches, Biohybrid electrochemical devices, Dendrimers as multielectron storage devices, Redox-active Metal-Polypyridinedendrimers as light harvesting antennae.

Unit 5 Molecular Scale Mechanical Devices Introduction to mechanical devices, Spontaneous mechanical like motions, Allosteric movements, Tweezers and Harpoons, A natural proton pump, Twisters, Tweezers, Threading-Dethreading movements, Ring switching processes in Rotaxanes and Catenanes, Molecular valves, Molecular Muscles.

TEXTBOOKS:

1. *VincezoBalzani, 'Supermolecular Chemistry', Kluwer Academic, 1992*
2. *Vincenzo Balzani, Alberto Credi and MargheritaVenturi, 'Molecular Devices and Machines: A Journey Into the Nanoworld', Wiley, 2006.*
3. *Paola Ceroni, Alberto Credi and MargheritaVenturi, 'Electrochemistry of Functional Supramolecular Systems', Wiley, 2010.*

REFERENCES:

1. *Jonathan W. Steed Atwood, Jerry L. Chich, 'Supramolecular Chemistry', 2nd edition, Wiley, 2009.*
2. *Fritz Vögtle and F. Alfter 'Supramolecular Chemistry: An Introduction', John Wiley & Sons, 1999.*
3. *Jean-Marie Lehn, 'Supramolecular Chemistry', RCS pubs., 2005*

4. *Jonathan Steed, David Turner and Carl Wallace, 'Core concepts in Supramolecular Chemistry and nanochemistry', John Wiley & Sons, 2007*
5. *Katsuhiko Ariga and ToyokiKunitake, 'Supramolecular chemistry – Fundamentals and applications advanced textbook', Springer-Verlag, 2000.*

Learning Outcomes: This course provides detailed information about the theories and concepts of supramolecular chemistry. Students get to learn about the processing of energy and signals by molecular and supramolecular systems, molecular recognition, electrochemistry of supramolecular systems, and molecular scale mechanical devices. This knowledge is useful for the students to understand and advance in the area of supramolecular chemistry.

Evaluation Pattern – R.13 & R.16

18CHY639 Nanomaterials for Biomedical Applications 3 0 0 3

Course contents

Unit 1: Introduction to Nanomaterials: Size dependence of properties – Surface to volume ratio and Quantum confinement. Microscopic techniques to study nano structures - SEM, AFM – TEM and STM. Spectroscopic techniques to characterize nanostructures - Raman, XPS, Auger, EDAX.

Unit 2: Synthetic approaches: Colloidal, Self-Assembly (Self assembled monolayers-SAMs) and electrostatic self-assembly, electrochemical methods (cathodic and anodic processes), sol-gel, Langmuir-Blodgett (LB) technique, chemical vapour deposition, plasma arcing and ball milling, lithography.
Unit 3: Electrical, optical, mechanical, chemical and magnetic properties of nanomaterials. Surface Plasmon resonance – Fluorescence Resonance energy transfer (FRET).

Unit 4: Carbon Clusters: Synthesis, properties and biomedical applications of Fullerenes, Carbon nanotubes and Graphenes. Quantum Dots, wells and wires (metallic and semiconducting) - Preparation, properties and biomedical applications. Dendrimeric structures and their applications.

Unit 5: Biofunctionalisation of nanomaterials - Noncovalent Assembly - Covalent assembly - Biofunctional Nanomaterials - Semiconductor Nanoparticles - Magnetic Nanoparticles. Applications of Biofunctional nanomaterials – Optical and Electrochemical Sensing.

REFERENCES:

1. Alexei Nabok, "Organic and Inorganic Nanostructures", Artech House, Inc., 2005
2. Huangxian Ju, Xueji Zhang and Joseph Wang, "NanoBiosensing, Principles, Development and Application", Springer, 2011.
3. M. Reza Mozafari (Editor), "Nanomaterialsand Nanosystems for Biomedical Applications", Springer 2007.
4. Zhong Lin Wang (Editor), "Characterisation of Nanophase Materials", Wiley VCH,

2000.

Learning Outcomes: This course provides the detailed information about the nanomaterials that have versatile biomedical applications. The students learn about the synthesis, properties, characterization and biofunctionalization of nanomaterials. This knowledge is essential for the students to go for the advanced courses or career related to nanotechnology and non-medicine.

Evaluation Pattern – R.13 & R.16

18CHY640 INDUSTRIAL METAL FINISHING PROCESSES 3 0 0 3

Course contents

Unit 1 Background Theory: Review of reversible and irreversible processes - electrodes, indicator and reference - Nernst and Butler-Vohmer equation - phenomenon of polarization - factors influencing - Tafel experiment and Tafel plot - Significance.

Unit 2 Electrodeposition: Industrial plating of copper-nickel (dull and bright) - chromium on mild steel – operating conditions and sequence – pre-treatment processes - plant layout – electroplating of zinc on MS and post plating chromating, yellow and blue passivation processes – decorative plating of silver and gold on non-ferrous metals – brief discussion on nano plating of metals and micro structure of the deposition.
Properties of deposits: Tests for adhesion, hardness, thickness, uniformity and corrosion resistance of the electro deposits.
Electroless deposition: Nickel, copper, gold on metal components – bath composition and operating conditions - immersion plating - plating on plastics – pre-treatment processes – long duration plating – electroforming, operating conditions and sequence.

Unit 3 Anodising: Industrial anodizing of aluminium and its alloys – baths used, operating conditions and sequence – plant layout – effect of temperature and current density on the thickness of anodic film – determination of thickness – industrial applications.
Nano anodizing of titaniuim, aluminium and tantalum – application to sensor field.
Plasma electrolytic oxidation: power supply requirements – baths used – process sequence for aluminium, magnesium and titanium – properties of the coating and industrial applications.

Unit 4 Electropolishing: Mechanism of electropolishing – electropolishing of ferrous and non-ferrous metals – industrial baths used – operating conditions and sequence - industrial applications.
Unit 5 Electrochemical etching: Etching of ferrous and non-ferrous metals – special properties of matt and satin finish – DC and AC processes – operating conditions and sequence.
Special Topics: Electrochemical and chemical metal colouring of ferrous and non-ferrous metals.
Black nickel coating – Hard chromium deposition – Hard anodizing of aluminium – Electrochemical machining of hard steels – Electro-winning process – Barrel plating – Electrodeposition of paint.

TEXTBOOK:

1. *Derek Pletcher and Frank C. Walsh, 'Industrial Electrochemistry', Blackie Academic*

and Professional, (1993).
REFERENCES:
1. *Christopher M A, Brett, 'Electrochemistry – Principles, Methods and Applications', Oxford University, (2004).*
2. *Watanabe T, 'Nano-plating: microstructure control theory of plated film and data base of plated film microstructure', Elsevier, Oxford, UK (2004).*
3. *Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Curtis, 'Electroforming', London, (2004).*
5. *Rumyantsev E and Davydov A, 'Electrochemical machining of metals', Mir, Moscow, (1989).*
6. *Peter G Sheasby 'Basics of aluminium anodising', Banbury, Oxon (2001)*
7. *Robert Brugger 'Nickel Plating' Robert Draper Ltd, Teddington, (1970)*
8. *J.K.Dennis, T.E.Such, 'Nickel and Chromium Plating, Third Edition' Woodhead Publishing Series in Metals and Surface Engineering, 3rd Edition, (1993)*

Learning Outcomes: The wide and indepth knowledge the students get in this course about the industrial metal finishing processes is very useful for them to secure a job in the related industries.

Evaluation Pattern – R.13 & R.16

18CHY641 Biosensors: Fundamentals and Applications 3 0 0 3

Course contents

Unit 1: Introduction to biosensor – classification based on the signal transduction and biorecognition element. Enzymatic and non-enzymatic sensors, DNA and protein based sensors-immunosensors.

Unit 2: Biosensing using nanomaterials: Concepts of surface to volume ratio, quantum confinement, surface plasmon resonance, fluorescence, chemiluminescense and electroluminescence and FRET in biosensing. Application of metal, semiconducting quantum dots, carbon nanotubes, graphene and carbon dots in biosensing.

Unit 3: Electrochemical principle in biosensing: Principles of potentiometry, voltammetry, amperometry and impedimentary in biosensing. Principle, fabrication and working of optical, electrochemical biosensors. Construction and working of potentiometric, amperometric and impedemetric sensors. Development and applications of piezoelectric sensors.

Unit 4: Optical and electrochemical sensors for glucose, vitamins, cholesterol, dopamine, nitric oxide, nitrates, and pesticides. Biocompatibility of sensors.

Unit 5: Biochips and wearable devices: lab-on-a-chip - fabrication of microfluidics-lithography, wearable sensors, epidermal electronic system, lab-on-skin-devices.

REFERENCES

1. Xueji Zhang, Huangxian Ju, Joseph Wang, “Electrochemical Sensors, Biosensors and Their Biomedical Applications”, Elsevier, 2008
2. Joseph Wang, "Analytical Electrochemistry", Wiley, 2006
3. Huangxian Ju, Xueji Zhang, Joseph Wang, "NanoBiosensing: Principles, Development and Application", Springer, 2011.
4. Peter Grundler, “Chemical Sensors – An Introduction for Scientists and Engineers”, Springer-Verlag, Berlin Heidelberg, 2007
5. Arben Merkoci, “Biosensing using nanomaterials” Wiley, 2009.

Learning Outcomes: This course deals with the fundamentals and applications of biosensors, students get to learn about the electrochemical and optical biosensors, biochips and wearable devices. This knowledge will help the students to advance further into the biosensor field either for R&D or production career.

Evaluation Pattern – R.13 & R.16

18CHY642 Computational Chemistry 3 0 0 3

Course Outcomes

This course helps students to gain

CO 1: Knowledge on approximation methods

CO 2: Ability to apply approximation methods

CO 3: Knowledge on potential energy surface

CO 4: Ability to apply potential energy surface

CO 5: Theoretical knowledge on the various tools or methods of Computational Chemistry

CO 6: Knowledge of application of various tools or methods of Computational Chemistry

CO 7: Knowledge on basis sets

CO 8: Knowledge on orbitals

Course contents

Unit 1 - Introduction

Introduction to computational chemistry (molecular modelling), questions commonly investigated computationally, principle and application of methods (tools) of computational chemistry - molecular mechanics, ab initio method, semiempirical methods, density functional theory and molecular dynamics, STOs, GTOs, basis sets, specification of molecular geometry using Cartesian coordinates and internal coordinates, Z-matrix, Z-matrix of simple molecules (water, ethanol), potential energy surface (PES), potential energy surface of diatomic molecules and triatomic molecules (H_2O and HOF) - hypersurface and process of “slicing”, stationary points on apotential energy surface -potential energy surface of the isomerization reaction of ozone to isoozone, stationary points (ozone, isoozone and transition state), intrinsic reaction coordinate, minimum, relative minimum, saddle-shaped surface,

saddle point, higher-order saddle point and mathematical treatment of stationary points, Born-Oppenheimer approximation and its significance and frozen-nuclei energy.

Unit 2 - Molecular Mechanics

Introduction to molecular mechanics, forcefield, developing a force field - expression for potential energy of a molecule, bond stretching term, angle bending term, torsional term and nonbonded interaction term,parameterizing a forcefield -parameterizingbond stretching term, angle bending term, torsional term and nonbonded interaction term, calculation using forcefield - compare the energies of two 2, 2, 3, 3-tetramethylbutane geometries, illustration of application (use) ofmolecular mechanics - calculation of geometries and energies of small-sized and medium-sized molecules, polymers and transition states (transition state for the Diels-Alder reaction of butadiene with ethene to form cyclohexene), in organic synthesis for predicting the more suitable path for carrying out the synthesis and calculation of normal-mode vibrational frequencies for characterizing a species as a minimum or a transition state or higher-order saddle point, for obtaining zero-point energies to correct frozen-nuclei energies and for interpreting or predicting IR spectra, strength (merit) and weakness (demerit) of molecular mechanics.

Unit 3 - Semiempirical methods - Part 1

Introduction to semiempirical (SE) methods, Simple Huckel Method (SHM) - theory - expression for calculating energy of a molecular species, expression for molecular wave function based on LCAO approximation, secular equations and the single matrix equation, H, C, S and ε matrices and their interpretation, the values of H_{ij} as zero, coulomb integral α and bond integral β and their physical significance, the H matrix in terms of α, β and zero for ethene system(ethene neutral molecule, ethene radical cation and ethene radical anion), propenyl system (propenyl cation, propenyl neutral radical and propenyl anion) and cyclobutadiene system (square cyclobutadiene dication, square cyclobutadiene neutral molecule and square cyclobutadiene dianion), the H matrix in terms of zero, α = 0 and β **=–** 1for ethene systems (ethene neutral molecule, ethene radical cation and ethene radical anion), propenyl system (propenyl cation, propenyl neutral radical and propenyl anion) and cyclobutadiene system (square cyclobutadiene dication, square cyclobutadiene neutral molecule and square cyclobutadiene dianion), result of diagonalization of the H matrices written for ethene system, propenyl system and cyclobutadiene system, molecular orbital energy level diagrams and expressions for energy and molecular wave functionsfor ethene system, propenyl system and cyclobutadiene system based on the result of diagonalization of the H matrices, and molecular orbital energy level diagrams for ethene system, propenyl system and cyclobutadiene system showing ground state and excited state electronic configurations.

Unit 4 - Semiempirical methods - Part 2

Application of SHM - nodal properties of molecular orbitals and Woodward-Hoffmann orbital symmetry rule, stability towards oxidation and reduction of various species in ethene system, propenyl system and cyclobutadiene system, geometry of cyclobutadiene molecule as predicted by SHM and its Jahn-Teller distortion, aromaticity and Huckel's (4n + 2) π electron rule,and calculation of resonance (stabilizing) energy, bond order and atomic charges of various species in ethene system, propenyl system and cyclobutadiene system, strength of SHM, weakness of SHM (detailed explanation) - basis set is limited to p orbitals (p_z orbitals), it treats only π electrons, and the overlap integrals, Fock matrix elements, electron spin and electron-electron repulsion are not calculated/accounted properly, Extended Huckel Method (EHM) - minimal valence basis set, calculation of Fock matrix elements, and calculation of overlap integrals by Lowdin orthogonalization, EHM procedure, EHM calculation on protonated helium molecule, application of EHM - an overall idea, strength and weakness of

EHM, SCF SE methods - Pariser-Parr-Pople (PPP) method and Complete Neglect of Differential Overlap (CNDO) method - basic principle (an exhaustive treatment is **not** expected).

Unit 5 - Density Functional theory and ab initio method

(An exhaustive treatment is **not** expected)

Introduction to Density Functional theory and calculations, Kohn-Sham approach - the first and the second Hohenberg-Kohn theorems, introduction to ab initio method and calculation, basis sets for H, He and first, second and third row elements used in ab initio calculations - STO-3G, 3-21G, 3-21G$^{(*)}$ and 6-31G*, these basis sets for a few molecular species (water, methane and carbene), basic principles of ab initio method (an idea only).

Text Book

1. Computational Chemistry-Introduction to the Theory and Applications of Molecular and Quantum Mechanics - Errol Lewars

Learning Outcomes: This course introduces the students with the concepts of computational chemistry. Students will learn about the molecular mechanics, semi-empirical methods, Density functional theory and ab initio method. This theory knowledge is essential for to students to advance in the chemistry related fields either for research or a job.

Evaluation Pattern – R.13 & R.16

18CHY643 Sustainable Chemical Science 3 0 0 3

Course contents

Unit 1 Green Chemistry and Sustainability

History of green chemistry, Chemical composition of the, environment (Air, water & soil-Role of organic and inorganic molecules in pollution), the twelve principles of green chemistry (detailed description with examples), green chemistry as an expression of environmental ethics (Thrift Chemistry),the concept of sustainability, from green to sustainable chemistry, sustainable use of chemical feedstock, water and energy, quantifying greenness of a chemical reaction, green chemistry metrics- mass based, energy and environmental metrics, designing greener process, life cycle assessment (introduction and scope),Green toxicology- the need, principles of toxicology, Disposition of Toxicants in Organisms, Non-Organ System Toxicity, Mechanistic Toxicology, Quantitative Structure–Activity Relationships, (Environmental Toxicology-Persistence and bioaccumulation), Non-Cancer risk assessment, Cancer risk assessment, stakeholders in sustainable policy implementation.

Unit 2 Chemistry in water

Definition and attributes of a green solvent, the principle and reasons for use of water in green chemistry- hydrophobicity- cyclodextrin chemistry, Lewis acids in aqueous media, Michael addition in water using triflates, green processes with base in water, green oxidations and reduction in water, on water conditions, use of water in microwave and ultrasonic technology.

Unit 3 Green solvents

Ionic liquids as green solvents- definitionand notation- properties, synthesis and use in

organic reactions, oxidation, oxidative carbonylation of aniline,Friedel–crafts reaction, Michael addition, Fischer Indole synthesis, Benzoin condensation, dimethyl carbonates synthesis in ionic liquids. Super critical fluids- super critical water and carbondioxide-properties and organic transformations.(Diels Alder, Clasen rearrangement, Fisher Indole, Friedel–crafts reaction, oxidation and hydrogenation. Properties and application in organic transformation of green solvents like polyethylene glycol, glycerol, cyclopentyl methyl ether, 2-methyltetrahydro furan, Perfluorinated (Fluorous) Solvents- FluorousBiphase Concept and dimethyl carbonate.

Unit 4 Green Chemistry and Catalysis

Importance of catalysis, turn over number and frequency, the basis of catalysis-kinetic phenomenon, basics of homogeneous, heterogeneous and biocatalysis, sabatier's principle, catalyst -deactivation, sintering, thermal degradation, inhibition and poisoning, catalyst promoters, modifiers, supported catalysts and reagents for green chemistry- heterogenized reactions for green chemistry, preparation of solid catalyst-slurry and co-precipitation, impregnation, hydrothermal synthesis- drying, calcination, activation and forming, selecting the right support, catalyst characterization- surface characterization methods, temperature programmed techniques, spectroscopy and microscopy.Common mechanism in enzyme catalysis immobilized enzymes, developing biocatalyst- rational design and directed evolution, non-enzymatic biocatalysts.

Unit 5 Green Chemistry Technologies and Alternate Energy Sources

Design for Energy Efficiency, Photochemical Reactions Advantages of and Challenges Faced by Photochemical Processes (Examples). Microwaves as energy source in chemistry-properties of microwaves, microwave heating (Effects), Approaches to Microwave-assisted Organic Chemistry- solvent free methods, MORE chemistry, continuous microwave reactor (CMR)-microwave batch reactor (MBR), examples of organic transformations. Sonochemistry and Green Chemistry-Theoretical Basis- Cavitation Inception, Nucleation-Bubble Dynamics- examples of organic transformations, Sono-chemical synthesis of nano-structured materials, Electrochemical Synthesis- materials manufactured using the process, organic electrosynthesis- 3-bromothiophen from thiophene. Renewable Sources of Energy, Solar Energy, Wind Power, Geothermal Solution, Hydropower (Sources, Merits and Difficulties in widespread applications), Indian Energy scenario- Energy Conservation act (2001)- features.

Reference

1. Green chemistry and engineering A Pathway to Sustainability, Anne E. Marteel-Parrish, Martin A. Abraham, American Institute of Chemical Engineers, Inc, John Wiley & Sons, Inc 2014.
2. Synthetic organic Sonochemistry, Jean-Louis luche, Springer Science+Business Media New York, 1998
3. New Methodologies and Techniques for a Sustainable Organic Chemistry, Alessandro Mordini and FerencFaigl, Springer, 2008.
4. Green chemistry, Fundamentals and Applications, Suresh C. Ameta and RakshitAmeta, CRC press, Taylor & Francis Group, 2013
5. Handbook of Green Chemistry, Vol5 Green Solvents- Reactions in Water, PualT Anastas, Chao Jun Li
6. Sonochemistry: theory, reactions, syntheses, and applications, Filip M. Nowak, Nova Science Publishers, Inc, 2010.
7. Green Chemistry Metrics, A Guide to Determining and Evaluating Process Greenness, Dicks, Andrew, Hent, Andrei, SpringerBriefs in Green Chemistry for

Sustainability, 2015
8. Catalysis: concepts and applications, Gadi Rothenberg, Wiley-VCH Verlag& Co. KGaA, Weinheim, Germany, 2008

Learning Outcomes: In this course, the students learn about green chemistry and sustainability, green solvents, green chemistry and catalysis, green chemistry technologies and alternate energy sources. The knowledge and they get in this course will be useful for them to continue their studies in the related fields or to land a profession.

Evaluation Pattern – R.13 & R.16

18CHY644 Sustainable Techniques in Chemical Sciences 3 0 0 3

Course contents

Unit 1 From Industrial to Sustainable Chemistry
IndustrialSustainable Chemistry- Managing Intraorganizational Sustainability, Managing Horizontal Interorganizational Sustainability, Managing Vertical Inter organizational Sustainability. Integrated Pollution Prevention and Control- Best Available Techniques reference documents(BREFs), From Industrial Emissions Directive (IED) to Voluntary Systems, Policy Drivers for Sustainable Chemistry (Transition Concept), Development of a CSR Management System Framework. Sustainability Assessment Methods and Tools- Sustainability Assessment Framework, Impact Indicators and Assessment Methodologies, Environmental Impact Assessment, Economic Impact Assessment, Social Impact Indicators, Understanding Industrial Symbiosis-Cluster Management. Sustainability of Logistics in the Chemical Sector, Basic Principles of Chemical Leasing (ChL), Differences between Chemical Leasing and Other Alternative Business Models for Chemicals, Sustainable Chemical Warehousing- Risk Management in the Chemical Warehouse, F^3-Factory concept, Indian energy security scenarios (IESS) 2047.

Unit 2 Process Intensification I
Opportunities and Perspectives for a Sustainable Process Design Definition and Concept, Reaction Engineering, Mixing Principles, Transport Processes, Enhanced Transport Processes, Integrating Process Steps. Moving from Batch to Continuous Processing, Spinning Disc Reactor (Design, Operating Features and Characteristics of SDRs- Green Synthesis of Nanoparticles using SDR), Micro Process Technology-Transport Intensification, Chemical Intensification, Process Design Intensification. Oscillatory Baffled Reactors- Design and operations. Monolith Reactors for Intensified Processing- Design, Hydrodynamics, Advantages and Applications- Cleaner Production of Fuels and Removal of Toxic Emissions. Cavitational Reactors, Mechanism, Reactor Configurations, Transesterification of Vegetable Oils Using Alcohol using Cavitation

Unit 2 Process Intensification II
Membrane Technology- Definitions, functions and operations, Biocatalytic Membrane Reactors (Entrapment, Gelification and Chemical Attachment), Biofuel Production Using Enzymatic Transesterification. Membrane Technology in Metal Ion Removal fromWaste Water, Membrane Operations for the Production of Optically Pure Enantiomers, Integrated Membrane Processes for Water Desalination. Reactive Distillation Technology and Reactive Extraction Technology- Principles, control design and applications. Reactive Absorption Technology in Carbon Dioxide Capture, removal of Nitrogen Oxides, Desulfurization, and in

Sulfuric and Nitric Acid production

Unit 4 Computer Applications in Catalytic Research
Computers as research tools in catalysis- a brief overview, a short over view of modelling methods, Data-mining methods in catalysis (PCA, PLS and Artificial Neural networks)

Unit 5 Successful Example of Sustainable Industrial Chemistry
Detailed Process Chemistry of the current technologies and routes for the following chemicals in industry. Industrial Propene Oxide Production (CHPO (Chlorohydrin) Technology, PO/TBA Technology, PO/SM Technology, PO-only Routes). Synthesis of Adipic Acid (Current Technologies for AA Production- Two-Step Transformation of Cyclohexane, Alternatives for AA Production). Ecofining- New Process for Green Diesel Production from Vegetable Oil. Direct Oxidation of Benzene to Phenol, Friedel–Crafts Acylation of Aromatic Ethers Using Zeolites, Sustainable Chemistry in the Production of Nicotinates. Homogeneous catalysis: The Shell higher olefin process (SHOP) and Du Pont synthesis of Adiponitrile. Heterogeneous catalysis: The BP AVADA ethyl acetate process

Reference

1. Management Principles of Sustainable Industrial Chemistry, Genserik L.L. Reniers, Kenneth Sorensen, ¨ and Karl Vrancken (Eds), Wiley-VCH Verlag& Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2013
2. Sustainable Development in Practice, Azapagic, A., Perdan, S. (eds.), Wiley-VCH Verlag& Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2011
3. The Art of Process Chemistry, Yasuda, N. (ed.), Wiley-VCH Verlag& Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2011
4. Sustainable Industrial Chemistry, Centi, G., Trifiro, F., Perathoner, S., Cavani, F. (eds.), Wiley-VCH Verlag& Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2009
5. Green chemistry, Fundamentals and Applications, Suresh C. Ameta and RakshitAmeta, CRC Press, Apple Academic Press, Inc, Taylor & Francis Group, 2013
6. Catalysis: concepts and applications, Gadi Rothenberg,Wiley-VCH Verlag& Co. KGaA, Weinheim, Germany, 2008

Learning Outcomes: In this course students learn about sustainable industrial processes, process intensification methods and computer applications in industrial catalysis. This knowledge is essential for the students to seek a profession in chemical industries.

Evaluation Pattern – R.13 & R.16

18CHY681 ORGANIC QUALITATIVE ANALYSIS LAB 0 0 6 2

Course Outcomes

After completion of the course, a student has

CO 1: Ability to engage in safe laboratory practices handling laboratory glassware, equipments, and chemical reagents

CO 2: Capacity in predicting the outcome of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups.

Course contents

1. Separation of binary mixtures

Includes separation, preliminary investigations, determinations of saturation/unsaturation, detection of elements by Lassaigne's test, functional group identification, derivative preparation, determination of melting points of the derivatives and calculation of Rf values from TLC

The following mixtures can be given:
(a) Acid and hydrocarbon
(b) Phenol and aldehyde
(c) Phenol and acid
(d) Phenol and amine
(e) Acid and ester
(f) Halo compound and aldehyde
(g) Acid and aldehyde
(h) Amine and aldehyde
(i) Amine and ketone
(j) Alcohol and hydrocarbon

2. Thin layer chromatography to determine Rf values of compounds
(a) 2-nitroaniline
(b) 4-nitroaniline
(c) Cinnamic acid and 2-nitroaniline
(d) Acetophenone
(e) Ethyl benzoate

3. Simple column chromatography to separate the components of binary mixtures
(a) Hydrocarbon and ester
(b) Aldehyde and amine

REFERENCES:
1. P.W.G. Smith, A.J. Hannaford, B.S.Furnis and A.R. Tatchell, "Vogel's Textbook of Practical Organic Chemistry", ELBS/Longman, 1989.
2. Ralph L. Shriner, Christine K.F. Hermann, Terence C. Morrill, David Y. Curtin, Reynold C. Fuson, 'Systematic Identification of Organic Compounds', John Wiley & Sons, 2003.
3. Mann and Saunders, 'Practical Organic Chemistry', Pearson edition, 2009.

Learning Outcomes: After the completion of course students will be able to separate organic binary mixture using ether as solvent and determine whether the components are saturated/unsaturated. They willbe able to identify functional groups present in each component, detect the elements present and prepare derivatives of the specific compounds and report the observations in a systematic manner. Qualitative testing of organic compound will be helpful in seeking job to pharma, plastics and R & D in chemical companies.

Evaluation Pattern – R.13 & R.16

18CHY682 INSTRUMENTAL METHODS OF ANALYSIS LAB. 0 0 5 2

Course Outcomes

The course helps a student to

CO 1: Develop skill to analyze the effect of electrochemical parameters for industrial anodisation.

CO 2: Acquire the knowledge to apply the principles of electrolyte conductance and electrode potential for analytical applications.

CO 3: Attain the skill to evaluate the optical properties of chemical species for analytical applications.

CO 4: Understand the rate of electrochemical reactions and applying it for industrial corrosion.

Course contents

1. Determination of strengths of halides in a mixture potentiometrically.
2. To find the redox potential of the given sample using cyclic voltametry.
3. Determination of half wave potential of Cd & Zn by polarography.
4. Determination of pKa of an indicator in aqueous and micellar medium using UV-Vis spectroscopy.
5. Determination of stoichiometry and stability constant of inorganic (ferric-salicylic acid) and organic (amineiodine) complexes using UV–Vis spectroscopy.
6. Determination of copper and cadmium in a mixture by electrogravimetry.
7. Determination of rate constant for enzyme kinetics-inversion of sucrose.
8. Determination of molecular weight of a polymer by Viscometry.
9. Determination of a molecular weight of a solute using Beckmann thermometer.
10. Refractrometric determination of composition of solutions.

TEXTBOOKS:

1. Alexander Findly, 'Practical physical chemistry', 9th edition, Wiley, 1972.

2. R.C. Das and B. Behera, 'Experimental Physical Chemistry', Tata McGraw-Hill, 1983.

REFERENCE BOOKS:

1. J. B. Yadav, 'Advanced Practical Physical Chemisty', Krishna Prakashan Media, 29th edition, 2010.

2. Francis William Gray, 'A Manual of Practical Physical Chemistry' Macmillan and Co., Limited, 1914.

Learning Outcomes: In this lab course, students learn to use various analytical instruments for the analyses of different paramaters of the chemical compounds. The training they get here is very useful for their further studies with advanced chemistry courses as well as for seeking analytical chemistry related jobs.

Evaluation Pattern – R.13 & R.16

18CSA100 PROBLEM SOLVING AND COMPUTER PROGRAMMING 3 0 0 3

Course Outcomes

This course helps the students to

CO 1: understand basics of computer programming

CO 2: learn C programming

CO 3: Equip themselves with minimum programming skills to be applied in future

Course contents

Unit 1
Introduction to problem solving: algorithm development and flowchart. Introduction to Computer terminologies and computer languages.

Unit 2
C Fundamentals: structure of C program: directives, functions, statements, printing strings, comments; compilation and execution, programming errors and debugging. Variables and assignment, reading input; data types, constants, identifiers, keywords, operators - arithmetic, logical, relational, assignment; expressions - precedence and associativity, type cast-implicit and explicit.

Unit 3
Selection statements: if, if else, nested if, if else ladder, switch. Case. Iterative structures: entry controlled and exit controlled loop, exiting from a loop: break, continue, goto; nested loops.

Unit 4
Functions: library functions, user defined functions: defining and calling functions, function declaration, passing arguments to a function, returning values from function. Storage classes - auto, extern, static, register variables, scope of a variable. Recursion. Number systems: binary, octal and hexadecimal. Bitwise operators and enumeration.

Unit 5
Arrays: one dimensional numeric arrays, initialization, accessing and usage, two dimensional numeric arrays, initialization, accessing and usage. Introduction to multidimensional arrays. Strings: literal, variables: initialization, reading, writing and accessing. String handling functions. Array of strings. Passing arrays and strings to functions.

TEXTBOOK:

Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

***REFERENCE**:*

Reema Thareja, "Computer Fundamentals and programming in C", Oxford University Press, 2012.

Evaluation Pattern – R.13 & R.16

18CSA116 ADVANCED COMPUTER PROGRAMMING 3 0 0 3

Course contents

Unit 1
Structures: structures variables - declaration, bit fields, initialization and operation on structures, typedef, nested arrays and structures: arrays in structures, nested structures, arrays of structures.

Unit2
Pointers– Declarations, Passing arguments by call by reference, Functions returning pointer, Pointer Arithmetic. Pointer to pointer, Pointers and Arrays – pointer to array, array of pointers, Dynamic memory allocation – malloc(), calloc(), deallocation: free(), dangling pointers.

Unit 3
Pointers and structures, structures and functions: passing structure as argument and returning structure from functions, self-referential structure, unions.

Unit 4
Files - file pointers, standard streams and redirection, text files, binary files, file operations: open, mode, close; Input and output - character I/O, line I/O, formatted I/O. Random file access, Command line arguments.

Unit 5
Preprocessor – Macros. User defined libraries and headers, introduction to the graphics library.

TEXTBOOK:
Jeri Hanly and Elliot Koffman, "Problem solving and program design in C", Fifth Edition, Addison Wesley (Pearson), 2007.

***REFERENCE**:*
Reema Thareja, "Computer Fundamentals and programming in C", Oxford University Press, 2012.

Evaluation Pattern – R.13 & R.16

18CSA180 PROBLEM SOLVING AND COMPUTER PROGRAMMING LAB 0 0 2 1

Course contents

Basic Linux commands, programs using input/output statements, operators, control structures and loops. Programs using functions and recursions. Programs using numeric one dimensional array, two-dimensional array. Programs using strings, string handling functions and string arrays. Programs using passing arrays and strings to functions.

Evaluation Pattern – R.13 & R.16

18CSA181 ADVANCED COMPUTER PROGRAMMING LAB 0 0 2 1

Course contents

Programs to demonstrate functions call by reference and returning values by reference. Programs using pointer arithmetic operations and handling pointers. Programs to demonstrate dynamic memory allocation and de-allocation. Programs to show structure and union operations. Programs using files, command line arguments and macros. Programs using user defined libraries and graphics library.

Evaluation Pattern – R.13 & R.16

18CUL101 CULTURAL EDUCATION I 2 0 0 2

Description

The student will be introduced to the foundational concepts of Indian culture and heritage.

Course Outcomes: After the completion of the course the student will be able to

CO 1: Gain a positive appreciation of Indian culture, traditions, customs and practices

CO 2: Understand the foundational concepts of Indian civilization like purusharthas, law of karma, etc, which contributes towards personality growth.

CO 3: Understand the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma's life and vision of holistic education

CO 4: Imbibe spirit of living in harmony with nature

CO 5: Get guidelines for healthy and happy living from the great spiritual masters.

Course contents

Unit 1

Introduction to Indian Culture - Introduction to Amma's life and Teachings - Symbols of Indian Culture.

Unit 2

Science and Technology in Ancient India - Education in Ancient India - Goals of Life – Purusharthas - Introduction to Vedanta and Bhagavad Gita.

Unit 3

Introduction to Yoga - Nature and Indian Culture - Values from Indian History - Life and work of Great Seers of India.

TEXTBOOKS:

1. The Glory of India (in-house publication)
2. The Mother of Sweet Bliss, (Amma's Life & Teachings)

Evaluation Pattern – R.13 & R.16

18CUL111 CULTURAL EDUCATION II 2 0 0 2

Description
The students will be able to deepen their understanding and further their knowledge about the different aspects of Indian culture and heritage.

Course Outcomes: After the completion of the course the student will be able to

CO 1: Get an overview of India and her contribution to the world in the field of science and literature

CO 2: Understand the foundational concepts of ancient Indian education system and practices associated with them

CO 3: Learn the important concepts of Vedas, Bhagavad-Gita and Yogasutras and their relevance to daily life

CO 4: Familiarize themselves with the inspirational characters and anecdotes from the epics and Indian history

CO 5: Gain a rational understanding of the underlying principles of Indian spirituality.

Course contents

Unit 1
1. Relevance of Sri Rama and Sri Krishna in this Scientific Age
2. Lessons from the Epics of India
3. Ramayana & Mahabharata

Unit 2
4. Who is a Wise Man?
5. A Ruler's Dharma
6. The Story of King Shibi

Unit 3
7. Introduction to the Bhagavad Gita
8. Bhagavad Gita – Action without Desire

Unit 4
9. Role and Position of Women in India
10. The Awakening of Universal Motherhood

Unit 5
11. Patanjali'sAstanga - Yoga System for Personality Refinement
12. Examples of Heroism and Patriotism in Modern India

TEXTBOOKS:
Common Resource Material II (in-house publication)
Sanatana Dharma - The Eternal Truth (A compilation of Amma's teachings on Indian

Culture).

Evaluation Pattern – R.13 & R.16

18ENG101 Communicative English 2-0-2-3

Objectives:

To help students obtain an ability to communicate fluently in English; to enable and enhance the students skills in reading, writing, listening and speaking; to impart an aesthetic sense and enhance creativity. By the end of the course, the students will be able to:

CO 1: Demonstrate competency in all the four linguistic skills, viz. listening, speaking, reading and writing.

CO 2: Apply different styles of communication in professional context.

CO 3: Participate in different planned & extempore communicative activities.

CO4: Interpret and discuss facts and information in a given context.

CO5: Develop an appreciation for human values.

Course contents

Unit I

Kinds of sentences, usage of preposition, use of adjectives, adverbs for description, Tenses, Determiners- Agreement (Subject – Verb, Pronoun- Antecedent) collocation, Phrasal Verbs, Modifiers, Linkers/ Discourse Markers, Question Tags

Unit II

Paragraph writing – Cohesion - Development: definition, comparison, classification, contrast, cause and effect - Essay writing: Descriptive and Narrative

Unit III

Letter Writing - Personal (congratulation, invitation, felicitation, gratitude, condolence etc.) Official (Principal / Head of the department/ College authorities, Bank Manager, Editors of newspapers and magazines)

Unit IV

Reading Comprehension – Skimming and scanning- inference and deduction – Reading different kinds of material –Speaking**:** Narration of incidents / stories/ anecdotes- Current News Awareness

Unit V

Prose: John Halt's 'Three Kinds of Discipline*'* [**Detailed**]
Max Beerbohm's 'The Golden Drugget' [**Detailed**]
Poems: Ogden Nash- *'*This is Going to Hurt Just a Little Bit' [**Detailed**]
Robert Kroetsch– *'*I am Getting Old Now', Langston Hughes-'I, Too'[**Detailed**]
Wole Soyinka- 'Telephone Conversation' **[Non-Detailed**]

Kamala Das- 'The Dance of the Eunuchs'[**Non-Detailed**]
Short Stories:Edgar Allan Poe's 'The Black Cat*',* Ruskin Bond's 'The Time Stops at Shamili*'* **[Non-Detailed**]

CORE READING:

1. *Ruskin Bond, Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989*
2. *Syamala, V. Speak English in Four Easy Steps, Improve English Foundation Trivandrum: 2006*
3. *Beerbohm, Max, The Prince of Minor Writers: The Selected Essays of Max Beerbohm (NYRB Classics), Phillip Lopate (Introduction, Editor), The New York Review of Book Publishers.*
4. *Edger Allan Poe. The Selected Works of Edger Allan Poe. A Running Press, 2014.*
5. *Online sources*

References:

6. *Ruskin Bond, Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989*
7. *Martinet, Thomson, A Practical English Grammar, IV Ed. OUP, 1986.*
8. *Murphy, Raymond, Murphy's English Grammar, CUP, 2004*
9. *Online sources*

Learning Outcomes: This course will help students to obtain an ability to communicate fluently in English; and enhance the students' skills in reading, writing, listening and speaking; and helps to impart an aesthetic sense and enhance creativity

Evaluation Pattern – R.13 & R.16

18ENG121 Professional Communication 1- 0-2-2

Objectives:
To convey and document information in a formal environment; to acquire the skill of self-projection in professional circles; to inculcate critical and analytical thinking. By the end of the course, the students will be able to:

CO 1: Demonstrate competency in oral and written communication.

CO 2: Apply different styles of communication in professional context.

CO 3: Participate in different planned & extempore communicative activities

CO 4: Interpret and discuss facts and information in a given context

CO 5: Develop critical and analytical thinking.

Course contents

Unit I
Vocabulary Building: Prefixes and Suffixes; One word substitutes, Modal auxiliaries,Error Analysis: Position of Adverbs, Redundancy, misplaced modifiers**,**Dangling modifiers –

Reported Speech

Unit II

Instruction, Suggestion & Recommendation - Sounds of English: Stress, Intonation - Essay writing: Analytical and Argumentative

Unit III

Circulars, Memos – Business Letters - e - mails

Unit IV

Reports: Trip report, incident report, event report - Situational Dialogue - Group Discussion

Unit V

Listening and Reading Practice - Book Review

References

1. *FelixaEskey. Tech Talk, University of Michigan. 2005*
2. *Michael Swan. Practical English Usage, Oxford University Press. 2005*
3. *Anderson, Paul. Technical Communication: A Reader Centered Approach, V Edition, Hercourt, 2003.*
4. *Raymond V. Lesikar and Marie E. Flatley. Basic Business Communication, Tata Mc Graw Hill Pub. Co. New Delhi. 2005. Tenth Edition.*
5. *Thampi, G. Balamohan. Meeting the World: Writings on Contemporary Issues. Pearson, 2013.*
6. *Lynch, Tony. Study Listening. New Delhi: CUP, 2008.*
7. *Kenneth, Anderson, Tony Lynch, Joan Mac Lean. Study Speaking. New Delhi: CUP, 2008.*
8. *Marks, Jonathan. English Pronunciation in Use. New Delhi: CUP, 2007.*
9. *Syamala, V. Effective English Communication For You (Functional Grammar, Oral and Written Communication): Emerald, 2002.*

Learning Outcomes: This course will help the students to convey and document information in a formal environment; to acquire the skill of self projection in professional circles; to inculcate critical and analytical thinking.

Evaluation Pattern – R.13 & R.16

18ENV300 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY 3 0 0 3

Course outcomes

After completion of the course, students will be able to

CO 1: Integrate facts and concepts from ecological, physical and social sciences to characterize some common socio-environmental problems.

CO 2: Develop simple integrated systems and frameworks for solving common interconnected socio-environmental problems.

CO 3: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

CO 4: Identify the ethical underpinnings of socio-environmental issues in general.

Course contents

Unit 1
State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.
Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.
Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action.
Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/ land degradation/ pollution

Unit 2
Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.
Discuss the interrelation of environmental issues with social issues such as:
Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3
Common goods and public goods, natural capital/ tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment (EIA), Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes/ Green buildings, Sustainable communities, Sustainable Cities.
Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

TEXTBOOKS/ REFERENCES:

1. *R. Rajagopalan, Environmental Studies: From Crisis to Cure. Oxford University Press, 2011, 358 pages. ISBN: 9780198072089.*
2. *Daniel D. Chiras, Environmental Science. Jones & Bartlett Publishers, 01-Feb-2012, 669 pages. ISBN: 9781449645311.*
3. *Andy Jones, Michel Pimbert and Janice Jiggins, 2011. Virtuous Circles: Values, Sys tems, Sustainability. IIED and IUCN CEESP, London.*

URL:http://pubs.iied.org/pdfs/G03177.pdf

4. *Annenberg Learner, The Habitable Planet, Annenberg Foundation 2015. URL: http://www.learner.org/courses/envsci/unit/pdfs/textbook.pdf*

Evaluation Pattern – R.13 & R.16

18HIN101 HINDI I 1 0 2

2

Objectives:

To teach Hindi for effective communication in different spheres of life:- Social context , Education, Research & Media.

Course Outcomes

By the end of the course, the students will be able to:

CO 1: To understand the nature & culture of the language

CO 2: Ability to understand the structure of the language in different context.

CO 3: To understand the functional skills of the language

CO 4: Enhance the social contribution of modern literature

CO 5: Develop research and secondary reading ability

Course contents

Unit-1

a) Introduction to Hindi Language, -other Indian Language's, Official Language, link Language Technical terminology.
b) Hindi alphabet: ParibhashaAurBhed.
c) Shabda: ParibhashaAurBhed, RoopantharkiDrishti se
d) Sangya -Paribhasha Aur Bhed, Sangyake Roopanthar-ling, vachan, karak
e) Sarvanaam- ParibhashaAurBhed.

Unit-2

a) Common errors and error corrections in Parts of Speech –with emphasis on use of pronouns, Adjective and verb in different tenses –gender & number
b) Conversations, Interviews, Short speeches.

Unit -3

a) Letter writing –Paribhasha Aur Bhed, Avedanpatra (request letter) & Practice
b) Translation-Paribhasha Aur Bhed, English to Hindi

Unit- 4

Peom :

a) Maithilisharangupth: sakhivemujsekahakarjaate
b) Suryakanthtripatinirala :Priyatam
c) Mahadevivarma- adhikaar
d) Shiyaramsharangupth:ekphoolkichah

Unit- 5

Kahani

a) Kafan - Premchand ,
b) Rajasthan ki Ek Gaav kee theerthyatra - Beeshmasahni
c) Raychandrabhai :By Mahathma Gandhi - Sathya ke prayog
d) Rajani - Mannu Bhandari

Textbooks

1. Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi
2. Vyavaharik Hindi Vyakaran, Anuvad thaha Rachana: Dr. H. Parameswaran, Radhakrisna publishing House, New Delhi.
3. Kamtha Prasad Guru: Hindi Vyakaran, Best Book pub House, New Delhi
4. Poetry: Kavya Ras - Ed: T. V. Basker - Pachouri Press; Mathura

Learning Outcomes: This course teaches Hindi to the students for effective communication in different spheres of life: Social context, Education, governance, Media, Business, Profession and Mass communication.

Evaluation Pattern – R.13 & R.16

18HIN111 HINDI II 1 0 2 2

Objectives:

Appreciation and assimilation of Hindi Literature through Oral & visual technique.

Course Outcomes

By the end of the course, the students will be able to:

CO 1: Develop the creativity & language competence.

CO 2: To improve the writing and analytical skills

CO 3: Enhancing critical thinking.

CO4: A good exposure with the different styles of literary writing.

CO5: To understand the post-modern trends of literature.

Course contents

Unit -1

a) Visheshan- Paribhasha Aur Bhed. special usage of adverbs, changing voice and conjunct tions in sentences.

b) Kriya- Paribhasha Aur Bhed, rupantharkidrushti se-kaal
c) Padhparichay.
d) Vigyapan Lekhan (Advertisement writing), Saar Lekhan (Precise writing).

Unit -2

Communicative Hindi – MoukhikAbhivyakthi –understanding proper pronunciation, Haptics..etc in Interviews, short speeches.

Unit -3

Film review, Audio–Visual-Media in Hindi – Movies appreciation and evaluation, News reading and presentations in Radio and TV channels in Hindi, Samvaadhlekhan.

Unit -4

a) Harishankarparasaiyi- SadacharkaThavis
b) Jayashankarprasadh – Mamata
c) Mannubandari- Akeli
d) Habibtanvir- Karthus

Unit -5

Kavya Tarang

a) Himadri thung shrung se (poet- Jayasankar prasad)
b) Dhabba (poet- kedarnath sing) ,
c) Proxy (poet- Venugopal),
d) Machis(poet –Suneeta Jain) ,
e) Vakth. (poet – Arun kamal)
f) Fasal (poet- Sarveshwar Dayal Saxena)

Reference:

Kavay Tarang: Dr. Nirnjan, Jawahar Pusthakalay Mathura.
Gadya Manjusha: Edotior Govind, Jawahar Pusthakalay Mathura.

Learning Outcomes: This course enables students to use Hindi for effective communication in different spheres of life: Social context, Education, governance, Media, Business, Profession and Mass communi cation.

Evaluation Pattern – R.13 & R.16

18KAN101 **KANNADA I** **1 0 2 2**

Course Outcomes

The course is meant

CO 1: To enable the students to acquire basic skills in functional language.

CO 2: To develop independent reading skills and reading for appreciating literary works.

CO 3: To analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech

Course contents

UNIT – 1

- Railway Nildanadalli – K. S. Narasimha Swamy
- Amma, Aachara Mattu Naanu – K. S. Nisar Ahamad
- Kerege Haara – Janapada
- Simhaavalokana – H.S. Shivaprakash

UNIT – 2

- Dhanwantri Chikitse - Kuvempu
- Mouni - Sethuram
- Meenakshi Maneya Mestru - Kuvempu

UNIT – 3

- Sukha –H. G. Sannaguddayya
- Mobile Thenkara Jen Nonagala Jhenkara – Nagesh Hegade
- Namma Yemmege Maatu Tiliyitu – Goruru Ramaswamy Iyangar

UNIT – 4
Language structure

- Usage of punctuation marks
- Introduction to words (right usage)
- Reading skills
- Sentence formation (simple & complex)
- Translation- English to Kannada

References:

1. Kannada Samskruti Kosha – Dr. Chi. C Linganna
2. Kannada Sanna Kathegalu – G H Nayak
3. Lekhana Kale – N. Prahlad Rao
4. Kannada Sahithya Charithre – R. Sri Mugali

Learning Outcomes: This course enable the students to acquire basic skills in Kannada language, helps to develop independent reading skills and reading for appreciating literary works. Further it helps to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.

Evaluation Pattern – R.13 & R.16

18KAN111 KANNADA II 1 0 2 2

Course Outcomes

CO 1: To enable the students to acquire basic skills in functional language.

CO 2: To develop independent reading skills and reading for appreciating literary works.

CO 3: To develop functional and creative skills in language.

CO 4: To enable the students to plan, draft, edit & present a piece of writing.

Course contents

UNIT – 1

- Bettada Melondu Maneya Maadi – Akka Mahadevi
- Thallanisadiru Kandya – Kanakadasa
- Avva – P. Lankesh
- Neevallave – K. S. Narasimha Swamy

UNIT – 2

Gunamukha – Drama by P. Lankesh

UNIT – 3

Karvalo – Novel by Poornachandra Thejaswi

UNIT – 4

Letter Writing –

Personal (congratulation, invitation, condolence etc.)

- Official (To Principal, Officials of various departments, etc.,)
- Report writing
- Essay writing
- Precise writing

Prescribed text:

1. Gunamukha by P. Lankesh (Lankesh Prakashana)
2. Karvalo by Poornachandra Thejaswi (Mehtha publishing house)

Reference

1. Saamanyanige Sahithya Charitre (chapter 1 to 10) – Bangalore University Publication
2. Hosa Kannada Saahithya Charithre – L.S Sheshagiri Rao
3. Kacheri Kaipidi – Kannada Adhyayana Samsthe (Mysuru University)
4. Kannada Sahithya Charithre – R. Sri Mugali
5. H.S. Krishna Swami Iyangar – *Adalitha Kannada – Chetana Publication, Mysuru*

Learning Outcomes: This course enables the students to develop functional and creative skills in Kannada language and helps the students to plan, draft, edit & present a piece of writing.

Evaluation Pattern – R.13 & R.16

18MAL101 Malayalam I 1 0 2

By the end of the course, the students will be able to:

CO 1: Inculcate philosophical thoughts and practice.

CO 2: To understand the post modern trends of literature.

CO 3: To understand the literary cultural era of a particular region

CO 4: Familiarise with the Malayalam literary maestro.

CO 5: Expansion of ideas in writing.

Course contents

Unit 1

Ancient poet trio: *Adhyatmaramayanam*, *LakshmanaSwanthanam (Lines: valsasoumitre… mungikidakayal),* Ezhuthachan -Medieval period classics – *Jnanappana (Lines:201 to 298*), Poonthanam.

Unit 2

Modern Poet trio: *EnteGurunathan,* VallatholNarayanaMenon- Critical analysis of the poem.

Unit 3

Short stories from period 1/2/3: *Poovanpazham*-VaikaomMuhammedBasheer-Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: *BharathaParyadanam-VyasanteChiri*–Ithihasa studies-KuttikrishnaMararu-Outline of literary Criticism in Malayalam Literature-Introduction to KuttikrishnaMararu& his outlook towards literature &life.

Unit 5

Error-freeMalayalam: **1.** Language; **2**. Clarity of expression; **3**. Punctuation-Thettillatha Malayalam – Writing-**a**. Expansion of ideas; **b**. Precis Writing; **c**. Essay Writing; **d**. Letter writing; **e.** RadioSpeech; **f**. Script/Feature/ScriptWring; **g**. NewsEditing; **h**. Advertising; **i.** Editing; j. Editorial Writing; **k**. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. P. K. Balakrishnan, Thunjan padhanangal, D. C. Books, 2007.
2. G. Balakrishnan Nair, Jnanappanayum Harinama Keerthanavum, N.B.S, 2005.
3. M. N. Karasseri, Basheerinte Poonkavanam, D. C. Books, 2008.
4 M. N. Vijayan, Marubhoomikal Pookkumbol, D. C. Books, 2010.
5. M.Thomas Mathew, Lavanyanubhavathinte Yukthisasthram, National Book Stall, 2009.
6. M.Leelavathy, Kavitha Sahityacharitram, National Book Stall, 1998.

7. Thayattu Sankaran, Vallathol Kavithapadhanam, D. C. Books, 2004.

Learning Outcomes: This course helps the students to appreciate the aesthetics & cultural implications; to enhance creative thinking in Malayalam language. It equips students to read & write correct Malayalam, and to correct the mistakes in pronunciation.

Evaluation Pattern – R.13 & R.16

18MAL111 Malayalam II 1 0 2

Course Outcomes:

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

CO 1; To understand the different cultural influence of linguistic translation.

CO 2: To identify the romantic elements of modern literature.

CO 3: To analyse the autobiographical aspects.

CO 4: To create awareness of the historical, political and socio-cultural aspects of literature.

CO 5: Expansion of ideas in writing.

Course contents

Unit1
Ancient poet trio: *Kalayanasougandhikam (Lines: kallum marangalum… namukkennarika vrikodara),* KunjanNambiar - Critical analysis of his poetry-Ancient Drama: *Kerala Sakunthalam* (Act 1), Kalidasan (Transilated by Attor Krishna Pisharody).

Unit 2
Modern/romantic/contemporary poetry: *Chandanakkattil* –G.Sankara kurupu-Romanticism – modernism.

Unit 3
Memoirs from Modern Poets: *Theeppathi*, Balachandran Chullikkadu-literary contributions of his time.

Unit 4
Partof an autobiography/travelogue: *Kannerum Kinavum*, Chapter: Valarnnu Varunnoratmavu, V.T. Bhattathirippadu-Socio-cultural literature-historical importance.

Unit 5
Error-free Malayalam-**1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha Malayalam-Writing-**a**.Expansion of ideas;**b**.PrécisWriting;**c.** Essay Writing; **d**.Letter writing;**e**.RadioSpeech;**f**.Script/Feature/ScriptWriting;**g**.NewsEditing;**h.**Advertising;**i**.Editing; **j**.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. Narayana Pillai,P.K, Sahitya Panchanan. Vimarsanathrayam, Kerala Sahitya Academy, 2000

2.Sankunni Nair, M.P, Chathravum Chamaravum, D. C. Books, 2010.
3. Gupthan Nair,S, Asthiyude Pookkal, D. C Books.2005
4. Panmana Ramachandran Nair, Thettillatha Malayalam, Sariyum thettum etc., D. C. Book, 2006.
5.M.Achuthan, Cherukatha-Innale, innu, National Book Stall, 1998.
6. N. Krishna Pillai, Kairaliyude Katha, National Book Stall, 2001.

Learning Outcomes: This course helps the students to appreciate the aesthetics & cultural implications; to enhance creative thinking in Malayalam language. It equips students to read & write correct Malayalam, and to correct the mistakes in pronunciation.

Evaluation Pattern – R.13 & R.16

18MAT105 INTRODUCTION TO CALCULUS AND MATRIX THEORY 3 1 0 4

Course Outcomes

CO 1: Learn calculus which are relevant to Chemistry for application to Chemistry.

CO 2: The basics are expected to make quantum Chemistry and other Physical Chemistry topics understandable.

Course contents

Unit 1
Calculus on a Single variable (Based on Textbook 1) Graphs Functions and their graphs. Shifting and scaling of graphs. Limit and Continuity - Limit of Functions, One sided limits and limits at infinity.

Unit 2
Continuous Functions, Discontinuities. Applications of Derivative - Extreme values of functions, Concavity and Curve Sketching.

Unit 3
Integration - Definite Integrals, Properties of definite integrals. Integration techniques. Fundamental theorem of Calculus. Numerical Methods - Trapezoidal and Simpson's rules. (Sections: 1.3, 1.5, 2.3, 2.4, 2.5, 2.6, 4.1, 4.4, 5.3, 5.4, 8.7).

Unit 4
Matrix Eigen Value problems (Based on Text book 2) Linear Independence and rank of a matrix, Eigen values and Eigen vectors- Definitions and properties.

Unit 5
Some applications of eigenvalue problems, Symmetric, Skew Symmetric and Orthogonal matrices, Eigenbases, Diagonalization, Quadratic forms. (Sections: 8.1-8.4) Numerical Methods - Power Method for Eigen Values and Eigen Vectors. (Sections: 20.8)

TEXTBOOKS:

1. Calculus, G. B. Thomas, Pearson, 2009, Eleventh Edition.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley India, Tenth Edition, 2015.

REFERENCE BOOKS;

1. George Turrell, Mathematics for Chemistry and Physics, Academic Press, 2002.

2. Herbert S. Wilf, Applied Mathematics for Physical Chemistry, 2nd Edition, Prentice Hall, 1998.

Evaluation Pattern – R.13 & R.16

18MAT114 Ordinary Differential Equations and Vector Calculus 3 1 0 4

Course Outcomes

This course gives the necessary mathematical background for solving Physical Chemistry numericals and derivations

Course contents

Unit 1
Ordinary Differential Equations: First Order Differential Equations - Basic concepts, Exact ODEs and Integrating factor, Orthogonal trajectories. (Sections 1.1, 1.4, 1.6).

Unit 2
Second Order Differential Equations - Review of linear homogeneous ODE of second order with constant coefficients. Euler-Cauchy Equations. Solution of second order linear non-homogeneous ODE by method of Undetermined Coefficients and by method of Variation of Parameters. (Sections 2.1, 2.2, 2.5, 2.7, 2.10).

Unit 3
System of ODEs - Homogeneous and Non-homogeneous systems with Constant Coefficients. (Sections 4.1, 4.2, 4.6) Numerical Methods - Euler's methods, Runge-Kutta method (Sec: 21.1).

Unit 4
Vector Calculus: Vector and Scalar Functions, fields, derivatives, Curves, Tangent and normal vectors, Arc Length, gradient, divergence and curl (Sections: 9.4, 9.5, 9.7, 9.8, 9.9).

Unit 5
Line Integral, Line Integrals Independent of Path, Double integrals, Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem. (Sections: 10.1 - 10.7 and 10.9).

TEXTBOOK:
Advanced Engineering Mathematics, Erwin Kreyszig, Wiley India, Tenth Edition, 2015.

REFERENCE BOOKS:
1. George Turrell, Mathematics for Chemistry and Physics, Academic Press, 2002.
2. Robert G. Mortimer, Mathematics for Physical Chemistry, 3rd Edition, Elsevier, 2005.

Evaluation Pattern – R.13 & R.16

18MAT207 INTRODUCTION TO PROBABILITY AND STATISTICS 3 1 0 4

Course Outcomes

After completing the course the student will be able to

CO 1: Apply Probability concepts in different areas of chemistry.

CO 2: Identify discrete distributions and continuous distributions.

CO 3: Understand that different chemical variables are random variables and which follow which type of distributions.

CO 4: Identify which type of chemical variable follow uniform distributions, Poisson distributions and normal distributions

CO 5: Explain the difference between solubility and dissociation in water and apply this knowledge to acids, bases and salts and understand whether they are correlated

CO 6: Apply the theoretical concepts of hypothesis testing for decision making.

CO 7 : Interpreting the results from a one–way ANOVA test

Course contents

Unit 1
Probability Concepts: Review of probability concepts - conditional probability - Bayes theorem. Random Variable and Distributions: Introduction to random variable – discrete and continuous random variables and its distribution functions – mathematical expectations – moment generating function and characteristic function.

Unit 2
Binomial, Poisson, Geometric, Uniform, Exponential. Normal distribution functions (moment generating function, mean, variance and simple problems) – Chebyshev's theorem. Correlation and Regression: Scatter diagram, simple correlation and simple regression for data.

Unit 3
Theory of Estimation: Population and sample – sampling distributions – determination of sample size – t, F and Chi-square distributions – theory of estimation – types of estimation - point estimation and properties of point estimator - interval estimation methods based on normal, t, F and chi-square distributions.

Unit 4
Testing of Hypothesis: Central limit theorem, large sample tests for mean, variance and proportions - small sample tests for mean and variances – tests based on Chi-square distribution (tests for independence of attributes and goodness-of-fit).

Unit 5
Analysis of Variance (ANOVA): Introduction - analysis of variance – one-way analysis of variance – two way analysis of variance - Latin square design – Two factor factorial design.

TEXTBOOKS:

1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers,
(2005) John Wiley and Sons Inc.
2. J. Ravichandran, "Probability and Statistics for Engineers", Revised Edition 2012, Wiley India.

REFERENCE BOOKS:

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and

Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.
1. Sheldon M Ross, Introduction to Probability and Statistical Inference, 3rd Edition, Academic Press.

Evaluation Pattern – R.13 & R.16

18MAT219 INTEGRAL TRANSFORMS 3 1 0 4

Course Outcomes

Basic knowledge for application to problems in Chemistry

Course contents

Unit 1
Laplace Transform: Laplace Transforms, Inverse Transforms, Linearity, Shifting, Transforms of Derivatives and Integrals, Differential Equations, Unit Step Function, Second Shifting Theorem, Dirac's Delta Function.

Unit 2
Differentiation and Integration of Transforms. Convolution, Integral Equations, Partial Fractions, Differential Equations, Systems of Differential Equations. (Sections: 6.1 to 6.7).

Unit 3
Fourier Series and Fourier Transform: Fourier series, Half range Expansions, Parseval's Identity, Fourier Integrals, Fourier integral theorem. Sine and Cosine Integrals.

Unit 4
Fourier Transforms, Sine and Cosine Transforms, Properties, Convolution theorem. (Text book-1, Sections: 11.1-11.3, 11.7-11.9).

Unit 5
Applications of Partial Differential Equations: Basic Concepts, Modeling; VibratingString, Wave Equation, Separation of Variables, Use of Fourier Series, Heat Equation; Solution by Fourier Series. (Sections: 12.1, 12.2, 12.3, 12.4).

TEXTBOOK:

1. Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2015.

REFERENCE BOOKS:

1. George Turrell, Mathematics for Chemistry and Physics, Academic Press, 2002.
2. Donald Allan McQuarrie, Mathematics for Physical Chemistry, University Science books, 2008.

Evaluation Pattern – R.13 & R.16

18PHY103 MECHANICS 3 1 0 4

Course Outcomes

Basic knowledge of mechanics and physics required for thorough understanding of concepts in Chemistry

Course contents

Unit 1 Motion
Motion in 1D; vectors, motion in 2D & 3D, projectile and uniform circular motion; relative motion and relative velocity.

Unit 2 Forces and dynamics
Force, mass, Newton's laws, inertial mass, examples of forces, free body diagram analysis for simple applications; friction and contact forces, drag force and terminal speed, uniform circular motion.

Unit 3 Work, Energy, Collisions
Work, kinetic energy, work-kinetic energy theorem, work done by gravitational and spring forces, power; Work and potential energy, conservative forces, conservation of mechanical energy, potential energy curve; Center of mass, Newton's law for system of particles, linear momentum and its conservation, Impulse forces, collisions - elastic and inelastic collisions in 1D and 2D; systems with variable mass - rockets.

Unit 4 Rotational Motion
Rotational variables, linear and angular variables, rotational kinetic energy, rotational inertia; torque, Newton's law for rotation, work, rolling – combined translation and rotation, angular momentum, Newton's law in angular form, system of particles, conservation of angular momentum.

Unit 5 Oscillatory motion
Small oscillations in physical systems; determination of frequency; simple harmonic motion; damped oscillations, resonance.

TEXTBOOK:
Halliday, Resnick, and Walker, Fundamentals of Physics, 8th Extended Ed., Wiley Indian Reprint, 2008, Chap. 1-12, 15

REFERENCES:
1. Young and Freedman, University Physics, 11th Ed, Dorling Kindersley India, 2006
2. Halliday, Resnick, and Krane, Physics, Vol. 1, 5th Ed., Wiley Indian Reprint, 2007
3. Feynamn, Leighton and Sands, "The Feynman Lectures on Physics", Narosa, 1E, 2008.

Evaluation Pattern – R.13 & R.16

18PHY114 ELECTRICITY AND MAGNETISM 3 1 0 4

Course Outcomes

Required for understanding concepts in Inorganic and Physical Chemistry

Course contents

Unit 1 Electric forces and fields
Electric forces, charges, conservation of charge, superposition of electric forces; electric

fields, calculation of electric fields of static discrete and continuous charge distributions; Gauss' law and determination of electric fields of simple symmetric charge distributions.

Unit 2 Electric potential and Capacitors
Electrical potential energy and electric potential of discrete and continuous distributions of charges; calculating electric field from potential; potential energy of system of point charges; capacitors and dielectrics.

Unit 3 Magnetostatics
Force due to magnetic fields, Hall effect, circular and helical orbits, magnetic force on a current carrying wire, torque on a current loop, magnetic dipole moment; calculation of magnetic field from current sources using Biot-Savart's law and Ampere's law; solenoids and toroids.

Unit 4 Changing magnetic fields
Faraday's law, Electromagnetic Induction, Self & mutual inductance; Magnetism in matter and Maxwell's equations.

Unit 5 DC and AC Circuits
Electric current, resistance, resistivity, microscopic view; DC circuits involving resistance and capacitance; AC Circuits, RLC circuits, transformers.

TEXTBOOK:

1. *Halliday, Resnick, and Walker, Fundamentals of Physics, 8th Ed., Wiley Indian Reprint, 2008, Chapters 22-33.*

REFERENCES:

1. Halliday, Resnick, and Krane, Physics, Vol. 1, 5th Ed., Wiley Indian Reprint, 2007
2. Young and Freedman, University Physics, 11th Ed, Dorling Kindersley India, 2006
3. Edward Purcell, Electricity and Magnetism, 2e, Tata-McGraw Hill, 2011.
4. Feynamn, Leighton and Sands, "The Feynman Lectures on Physics", Narosa, 1E, 2008

Evaluation Pattern – R.13 & R.16

18PHY181 PHYSICS LAB. I 0 0 2 1

Course contents

List of experiments:
1. Surface Tension – Capillary Rise Method.
2. Coefficient of Viscosity - Stoke's Method.
3. The Torsion Pendulum.
a. Moment of Inertia of the Disc.
b. The Rigidity Modules of the Material of Wire.
4. Young's Modulus – Uniform Bending.
5. Spectrometer – Dispersive Power.
6. Liquid Lens – Refractive index of liquid.
7. Laser - Wave length of Laser beam.
8. Laser - Slit Width of the given slit.
9. Magnetometer – Measurement of magnetic flux.

Evaluation Pattern – R.13 & R.16

18PHY182 PHYSICS LAB. II 0 0 2 1

Course contents

List of experiments:
1. Lee's disc – Thermal Conductivity of a bad conductor.
2. Solar cell characteristics.
3. Potentio meter – Comparison of emfs.
4. Conversion of galvanometer to Voltmeter.
5. Field along the axis of a coil.
6. Measurement of Laser beam divergence.
7. Spectrometer - i – d – curve.
8. Newton's rings.
9. Meter bridge - Resistance measurement.
10. Ref. index of a Transport bar.
11. Elective field distribution.

Evaluation Pattern – R.13 & R.16

18PHY208 BASIC ELECTRONICS 3 1 0 4

Course contents

Unit 1
Voltage and current - resistors, voltage dividers, voltage and current sources, Thevenin's theorem, sinusoidal signals, signal amplitudes and decibels, other signals, logic levels, signal sources.

Unit 2
Conduction in metals, semiconductors and insulators, intrinsic semiconductors, n and p materials, conduction by drift and diffusion, The p-n junction, Fermi level ofpn junction, diode equation, Hall effect, diode characteristics, capacitance of a p-n junction, rectification, rectifier configurations for power supplies, circuit applications of a diode-as a switch, clipping, clamping, different types of diodes - Zener diodes, LEDs, diode lasers, photodiodes, etc.

Unit 3
Transistors - npn and pnp, transistor characteristics - CB, CE and CC configurations, relation between a, b and g, transistor switch, transistor biasing. Feedback circuits. Transistor action, emitter follower, Transistor applications as amplifier. RC coupled amplifier.

Unit 4
Transistor as an oscillator, FET, JFET, MOSFET, etc. Operational amplifiers; differential amplifier, inverting and non-inverting amplifiers ers. Op-amp applications-integrator, differentiator, adder etc. ICs – examples.

Unit 5

Digital electronics: Digital versus analog, logic gates, truth table, discrete circuits for gates, logic identities, minimization and Karnaugh maps.

TEXTBOOK:

1. Bernar Grob and Mitchel E. Schultz, Basic Electronics (9th Edition), Tata McGraw Hill, New Delhi (2003)

REFERENCES:

1. John D. Ryder, Electronic Fundamentals and Applications, Prentice Hall of India Pvt.Ltd. New Delhi (1983).
2. Albert Paul Malvino, Digital Computer Electronics Tata McGraw Hill Pub. Co. Ltd New Delhi (1983).
3. Horowitz and Hill, The art of Electronics (Cambridge University press).

Evaluation Pattern – R.13 & R.16

18PHY214 WAVES AND OPTICS 3 1 0 4

Course contents

Unit 1

Review of Geometrical Optics: Fermat's principle, laws of reflection and refraction from Fermat's principle. Refraction at a spherical surface, Linear and lateral magnifications, Refraction through a thick lens. Focal lengths of thick and thin lenses. Combination of two lenses. Cardinal points.

Unit 2

Wavemotion: Simple Harmonic Oscillation (SHO), differential equation for SHO and its general solution, super position of two or more SHOs, Damped and forced oscillators, resonance. Wave equation, travelling and standing waves in one dimension, energy density and energy transmission in waves, Group velocity and phase velocity.

Unit 3

Interference: Wave nature of light, Spatial and temporal coherence, coherent sources, interference of light by division of wave front: Fresnel's biprism, interference of light by division of amplitude: interference in thin films, fringes of equal inclination, airwedge, Newton's rings and Michelson's interferometer. Multiple beam Interference -
Fabry-Perot interferometer, multilayer thinfilms: AR and HR coatings.Diffraction: Fresnel and fraunhoffer diffraction, diffraction grating, Rayleigh criterionand resolving power.
Polarisation: linear, circular and Elliptic polarization, double refraction and optical rotation. Propagation of light through matter, dispersion and absorption, Nonlinear optics, second harmonic generation, integrated optics (qualitative only).

Unit 5

Fiber optics: Introduction to optical fiber, the numerical aperture, coherent bundle, pulse dispersion in step index fiber, graded index fiber, single mode fiber, multimode fiber, fiber optic sensors - examples - fiber optic communication (qualitative), Advantages of fiber optic

communication system.

REFERENCES:

1. E. Hecht & A.R. Ganesan, Optics, Pearson, 2008
2. Jenkins and White, Fundamentals of Optics, TMH India, 4E, 2011
3. A K Ghatak, Introduction to Modern Optics, Tata-McGraw Hill, 4E, 2008
4. G R Fowles, Introduction to Modern Optics, Dover, 2E, 1989

Evaluation Pattern – R.13 & R.16

18SAN101 SANSKRIT I 1 0 2 2

Course Outcomes

CO 1: To familiarize students with Sanskrit language and literature.

CO 2: To read and understand Sanskrit verses and sentences.

CO 3: Self-study of Sanskrit texts and to practice communication in Sanskrit.

CO 4: To help the students imbibe values of life and Indian traditions propounded by the scriptures.

CO 5: To be able to speak in Sanskrit.

Course contents

Unit I

Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunctconsonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit.

Unit II

Verbs- Singular, Dual and plural — First person, Second person, Third person.
Tenses – Past, Present and future – Atmanepadi and parasmaipadi-kartharipraYoga.

Unit III

Words for communication and moral stories.

Unit IV

Chanakya Neethi first chapter (first 15 Shlokas)

Unit V

Translation of simple sentences from Sanskrit to English and vice versa.

REFERENCES

1. Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore-560 085

2. Sanskrit Reader I, II and III, R. S. Vadhyar and Sons, Kalpathi, Palakkad
3. Prakriya Bhashyam written and published by Fr. John Kunnappally
4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5, Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7. Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar press

Learning Outcomes: This course familiarize students with Sanskrit language and literature. It will help them to speak, read and understand Sanskrit verses and sentences and thus help them to imbibe values of life and Indian traditions propounded by the scriptures.

Evaluation Pattern – R.13 & R.16

18SAN111 SANSKRIT II 1 0 2

Course Outcomes:

CO 1: To familiarize students with Sanskrit language and literature.

CO 2: To read and understand Sanskrit verses and sentences.

CO 3: Self-study of Sanskrit texts and to practice communication in Sanskrit.

CO 4: To help the students imbibe values of life and Indian traditions propounded by the scriptures.

CO 5: To be able to speak in Sanskrit.

Course contents

Unit I

Seven cases, Avyayas, sentence making with Avyayas, Saptha kakaras.

Unit II

Kthavathu' Prathyayam, Upasargas, Kthvatha, Thumunnantha, Lyabantha Prathyayam. Three Lakaras – brief introduction, Lot lakara.

Unit III

New words and sentences for the communication, Slokas, moral stories(panchathanthra) Subhashithas, riddles (Selected from the Pravesha Book).

Unit IV

Introduction to classical literature, classification of Kavyas, classification of Dramas - Important five Maha kavyas.

Unit V

Translation of paragraphs from Sanskrit to English and vice-versa.

Unit VI

Bhagavad - Geeta fourteenth chapter (all 27 Shlokas).

Essential Reading

1, Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085

2, Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad

3, PrakriyaBhashyamwritten and published by Fr. John Kunnappally

4, Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston

5, Sabdamanjari, R.S. Vadyar and Sons, Kalpathi, Palakkad

6, Namalinganusasanam by Amarasimha published by Travancore Sanskrit series

7, SubhashitaRatnaBhandakara by Kashinath Sharma, published by Nirnayasagarpress

Learning Outcomes: This course familiarize students with Sanskrit language and literature. It will help them to speak, read and understand Sanskrit verses and sentences and thus help them to imbibe values of life and Indian traditions propounded by the scriptures.

Evaluation Pattern – R.13 & R.16

18SSK201 LIFE SKILLS I 1 0 2 2

Course Outcomes: After successful completion of the course, students

CO 1: will have develop self-confidence and positive attitude necessary to compete and challenge themselves, analyse and manage their emotions to face real life situations (Soft Skill**)**

CO 2: will have honed their presentation skills by understanding the nuances of content creation, effective delivery, use of appropriate body language and the art of overcoming nervousness to create an impact in the minds of a target audience. (Soft Skill)

CO 3: will have acquired the ability to analyse, understand and classify questions under arithmetic, algebra and logical reasoning and solve them employing the most suitable methods; will be able to analyse, compare and arrive at conclusions for data analysis questions. (Aptitude**)**

CO 4: will have the ability to dissect polysyllabic words, infer the meaning, inspect, classify, contextualise and use them effectively (Verbal**).**

CO 5: will have the ability to understand the nuances of English grammar and apply them effectively (Verbal).

CO 6: will have the ability to identify, analyse and interpret relationship between words and use the process of elimination to arrive at the answer (Verbal).

Course contents

Soft skills and its importance: Pleasure and pains of transition from an academic

environment to work-environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, self-motivation and continuous knowledge upgradation.

Self Confidence: Characteristics of the person perceived, characteristics of the situation, Characteristics of the Perceiver. Attitude, Values, Motivation, Emotion Management, Steps to like yourself, Positive Mental Attitude, Assertiveness.

Presentations: Preparations, Outlining, Hints for efficient practice, Last minute tasks, means of effective presentation, language, Gestures, Posture, Facial expressions, Professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words.

Listening Skills: The importance of listening in communication and how to listen actively.

Prepositions and Articles: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving: Number System; LCM &HCF; Divisibility Test; Surds and Indices; Logarithms; Ratio, Proportions and Variations; Partnership; Time speed and distance; work time problems;

Data Interpretation: Numerical Data Tables; Line Graphs; Bar Charts and Pie charts; Caselet Forms; Mix Diagrams; Geometrical Diagrams and other forms of Data Representation.

Logical Reasoning: Family Tree; Linear Arrangements; Circular and Complex Arrangement; Conditionalities and Grouping; Sequencing and Scheduling; Selections; Networks; Codes; Cubes; Venn Diagram in Logical Reasoning.

TEXTBOOKS:

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
2. Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3. Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa& Co.
4. The Hard Truth about Soft Skills, by Amazone Publication.

REFERENCES:

1. Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
2. Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.
3. Data Interpretation, R S Aggarwal, S Chand Publ.
4. Nova GRE, KAPAL GRE, Barrons GRE books;
5. Quantitative Aptitude, The Institute of Chartered Accountants of India.
6. More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
7. The BBC and British Council online resources
8. Owl Purdue University online teaching resources
9. www.thegrammarbook.com online teaching resources
10. www.englishpage.com online teaching resources and other useful websites.

18SSK211 LIFE SKILLS II 1 0 2 2

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

CO 1: communicate convincingly and negotiate diplomatically while working in a team to arrive at a win-win situation, would further develop their inter-personal and leadership skills (Soft Skill).

CO 2: examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arrive at a consensus (Soft Skills).

CO 3: identify, recall and arrive at appropriate strategies to solve questions on geometry; will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability and combinatorics (Aptitude).

CO 4: relate, choose, conclude and determine the usage of right vocabulary (Verbal).

CO 5: utilise prior knowledge of grammar to recognise structural instabilities and modify them (Verbal).

CO 6: comprehend, interpret, deduce and logically categorise words, phrases and sentences; will also have the ability to theorise, discuss, elaborate, criticise and defend their ideas (Verbal).

Course contents

Professional Grooming and Practices: Basics of Corporate culture, Key pillars of Business Etiquette. Basics of Etiquette: Etiquette – Socially acceptable ways of behaviour, Personal hygiene, Professional attire, Cultural Adaptability. Introductions and Greetings: Rules of the handshake, Earning respect, Business manners. Telephone Etiquette: activities during the conversation, Conclude the call, To take a message. Body Language: Components, Undesirable body language, Desirable body language. Adapting to Corporate life: Dealing with people.

Group Discussions: Advantages of Group Discussions, Structured GD – Roles, Negative roles to be avoided, Personality traits to do well in a GD, Initiation techniques, How to perform in a group discussion, Summarization techniques.
Listening Comprehension advanced: Exercise on improving listening skills, Grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading Comprehension advanced: A course on how to approach middle level reading comprehension passages.
Problem solving – Money Related problems; Mixtures; Symbol Based problems; Clocks and Calendars; Simple, Linear, Quadratic and Polynomial Equations; Special Equations; Inequalities; Functions and Graphs; Sequence and Series; Set Theory; Permutations and Combinations; Probability; Statistics.
Data Sufficiency: Concepts and Problem Solving.
Non-Verbal Reasoning and Simple Engineering Aptitude: Mirror Image; Water Image; Paper Folding; Paper Cutting; Grouping Of Figures; Figure Formation and Analysis; Completion of

Incomplete Pattern; Figure Matrix; Miscellaneous.
Special Aptitude: Cloth, Leather, 2D and 3D Objects, Coin, Match Sticks, Stubs, Chalk, Chess Board, Land and geodesic problems etc., Related Problems

TEXTBOOKS:

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
2. Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3. Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa& Co.
4. The Hard Truth about Soft Skills, by Amazone Publication.

REFERENCES:

1. Quantitative Aptitude, by R S Aggarwal, S Chand Publ.
2. Verbal and Non-verbal Reasoning, R S Aggarwal, S Chand Publ.
3. Quantitative Aptitude by AbjithGuha, Tata McGraw hill Publ.
4. More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
5. The BBC and British Council online resources
6. Owl Purdue University online teaching resources
7. www.thegrammarbook.com online teaching resources
8. www.englishpage.com online teaching resources and other useful websites.

Evaluation Pattern – R.13 & R.16

18SSK301 LIFE SKILLS III 1 0 2 2

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

CO 1: prepare a suitable resume (including video resume), present themselves confidently, introduce themselves and face interviews in a sure-footed manner (Soft Skills).

CO 2: analyse every question asked by the interviewer, compose correct responses and respond in the right manner to justify and convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication (Soft Skills).

CO 3: interpret, critically analyse and solve logical reasoning questions; manage time while applying methods to solve questions on arithmetic, algebra, logical reasoning, and statistics and data analysis and arrive at appropriate conclusions (Aptitude).

CO 4: understand and use words, idioms and phrases, interpret the meaning of standard expressions and compose sentences using the same (Verbal).

CO 5: decide, conclude, identify and choose the right grammatical construction (Verbal)..

CO 6: examine, interpret and investigate arguments, use inductive and deductive reasoning to support, defend, prove or disprove them; create, generate and relate facts / ideas / opinions and share / express the same convincingly to the audience / recipient using their communication skills in English (Verbal).

Course contents

Team Work: Value of Team work in organisations, Definition of a Team, Why Team, Elements of leadership, Disadvantages of a team, Stages of Team formation. Group Development Activities: Orientation, Internal Problem Solving, Growth and Productivity,

Evaluation and Control. Effective Team Building: Basics of Team Building, Teamwork Parameters, Roles, Empowerment, Communication, Effective Team working, Team Effectiveness Criteria, Common characteristics of Effective Teams, Factors affecting Team Effectiveness, Personal characteristics of members, Team Structure, Team Process, Team Outcomes.

Facing an Interview: Foundation in core subject, Industry Orientation/ Knowledge about the company, Professional Personality, Communication Skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced Grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, Critical reasoning: A course on verbal reasoning. Listening Comprehension advanced: An exercise on improving listening skills.

Reading Comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Specific Training: Solving campus recruitment papers, National level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In Mathematics). Lateral Thinking problems. Quick checking of answers techniques; Techniques on elimination of options, Estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

TEXTBOOKS:

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
2. Adair J (1986) - "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3. Gulati S (2006) - "Corporate Soft Skills", New Delhi, India: Rupa& Co.
4. The Hard Truth about Soft Skills, by Amazon Publication.

REFERENCES:

1. Speed Mathematics, Secrets of Lightning Mental Calculations, by Bill Handley, Master Mind books;
2. The Trachtenberg Speed System of Basic Mathematics, Rupa& Co., Publishers;
3. Vedic Mathematics, by Jagadguru Swami Sri BharatiKrsnaTirthayi Maharaja, MotilalBanarsidass Publ.;
4. How to Ace the Brainteaser Interview, by John Kador, Mc Graw Hill Publishers.
5. Quick Arithmetics, by Ashish Agarwal, S Chand Publ.;
6. Quicker Maths, by M tyra& K Kundan, BSC Publishing Co. Pvt. Ltd., Delhi;
7. More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.
8. The BBC and British Council online resources
9. Owl Purdue University online teaching resources
10. www.thegrammarbook.com online teaching resources
11. www.englishpage.com online teaching resources and other useful websites.

Evaluation Pattern – R.13 & R.16

OPEN ELECTIVES

18OEL231 Advertising 3 0 0 3

Course contents

Unit 1
Evolution of advertising; Social and economic effects of advertising; Advertising agency system; advertising budget; Legal and ethical aspects of advertising;

Unit 2
Marketing; Market segmentation; Social marketing; Consumer behaviour; Factors influencing consumer behaviour, buying behaviour, buying decision process;

Unit 3
Planning advertising campaigns; Advertising copy, visualization, illustration, layout, headline, body, colour, trademarks, slogans; Television and Radio commercials; Media selection, newspaper, magazines, radio, television, Internet, outdoor, direct mail;

Unit 4
Industrial advertising; Retail adverting; corporate advertising; Public service a vertising;

Unit 5
Evaluation of advertising effectiveness, methods of measurement. Pre-testing and post – testing methods.

BOOKS RECOMMENDED:

1. *B.S. Rathor; Advertising management*
2. *Chunnawala: Advertising theory and Practice*
3. *Sandage and others: Advertising: Theory and Practice*
4. *Thomas Russell and Glenn Verrill: Otto cleppner's advertising Procedure*
5. *Manendra Mohan: Advertising Management: Concepts and cases*
6. *Philip Kotler: Marketing Management*
7. *David Aaker and George day: Marketing Research*
8. *Mahendra Mohan: Advertising Management; Concepts and Cases*
9. *Frank Jefkins: Advertising Made Simple*

Evaluation Pattern – R.13 & R.16

18OEL232 Basic Statistics

3 0 0 3

Course contents

Unit 1

Introduction to Statistics: Meaning and scope of statistics, limitations of statistics, purpose and scope of inquiry.

Unit 2

Methods of collecting data - primary and secondary data, classification of data, tabulation of data, frequency table.

Unit 3

Presenting data by diagrams and graphs - bar diagram - simple, multiple, component and percentage bar diagram, pie diagram, histogram, frequency polygon and frequency curve, less than ogive and greater than ogive.

Unit 4

Measures of central tendency: Arithmetic mean, median, mode.

Unit 5

Dispersion: Quartile deviation, standard deviation, coefficient of variation.

REFERENCES:

1. *P.R Vittal - Business mathematics and statistics, Margham Publications, Chennai.*
2. *Dr.C Satyadevi - Quantitative Techniques, S. Chand & Company Pvt. Ltd., New Delhi.*
3. *Dr. S.P Gupta - Statistical Methods, Sultan Chand & Sons, New Delhi.*

Evaluation Pattern – R.13 & R.16

18OEL233 Citizen Journalism 1 0 2 3

Objective: *The course is aimed at encouraging young educated rural men and women tohighlight local issues and imparting the required skills to articulate them in the media.*

Course contents

Unit 1

Introduction: Highlighting development problems of rural areas; pathetic condition of infrastructure in rural areas.

Unit 2

Lack of connectivity – bad roads or lack of roads.

Unit 3

Lack of potable water – women having to trek distances to fetch drinking water for the family.

Unit 4

The story of electrification of villages – Official claims and reality, Schools without teachers, primary health centres without doctors.

Unit 5

Farmers caught in between labour shortage, high wages, rising cost of inputs and indebtedness due to crop failure and middlemen taking the profit from farm products.

REFERENCES:

1. *Allan, S. (2009). Citizen journalism: Global perspectives (Vol. 1). Peter Lang.*
2. *Thorsen, E., & Allan, S. (2014). Citizen Journalism: Global Perspectives - Volume 2. Peter Lang International Academic Publishers.*
3. *Wall, M. (2012). Citizen Journalism: Valuable, Useless, Or Dangerous? International Debate Education Association.*
4. *Allan, S. (2013). Citizen witnessing: Revisioning journalism in times of crisis. John Wiley & Sons.*

Learning Outcomes: This course will help to develop an understanding of problem solving methods, to understand the basic concepts of statistics and to apply the results to real life problems.

Evaluation Pattern – R.13 & R.16

18OEL234 Creative Writing For Beginners 1 0 2 3

Course contents

Unit 1

Introduction to Creative Writing – meaning and context of using creative writing, Difference between creative writing and functional writing.

Importance of reading – Reading practice for closer observation of the elements of creative writing.

Unit 2

Imaginative writing – idiomatic expression, use of imagery, figurative language, playing with words.

Reading from poetry and short stories – illustration of the use of imagery, allusion, figures

of speech, allegory and fables.

Unit 3

Narrating anecdotes, blog writing, and discussion through SMS / Whats App.

Unit 4

Short story writing – Narration and description – setting the plot, rising action, climax, falling action, resolution.

Unit 5

Poetry writing – rhythm and rhyme, Types of poems – Narrative, Dramatic, Lyric.

REFERENCE BOOKS:

1. *Janet Burroway, Imaginative Writing: The Elements of Craft, Longman, 1st Ed. ISBN: 0321081919*
2. *Anjana Neira Dev, Anuradha Marwah Swati Pal, Creative writing : A Beginner's Manual, Delhi, Pearson Longman, 2009*
3. *Robert Scholes, Nancy R Comely, Carl H. Klaus, Michael Silverman, Elements of Literature : Essay, Fiction, Poetry, Drama Film, Delhi, OUP, 2007*
4. *Write from the Heart: Unkenling the power of your creativity, Hal Zina Bennet, California Wew World Library, 2001*

Learning Outcomes: This course focuses on those elements of writing that enhances thevivid and effective writing skill among students across genres like fiction, poetry, essay and drama drawing their attention to significant details, lyrical language and memorable images; inventive metaphor and simile; authentic voice, dialogue and characterization. This course will help the students to develop talent for creative writing in English in order to enable them touse language effectively; to introduce the concept of creative writing; to acquaint students with the basic principles and techniques involved in writing poetry, fiction and drama.

Evaluation Pattern – R.13 & R.16

18OEL235 Desktop Support and Services 1 0 2 3

Course contents

Unit 1

Fundamentals of computers

Data & Information, Computer Architecture, CPU & Memory Organization, History of

Computer, Generation of Computer, I/O Devices, Number System, Logic Gates.

Unit 2

Internal devices - Study of PC ATATX System Pentium Core, Core 2 Cord, Core2 Duo, I3, I5, I7 Processor, Mother Board, MB Types, Expansion Slots, Processor, Memory, Hard Disk, CD-R, RW, DVD-RW. SMPS.

Unit 3

External Devices - Dot Matrix Printer, Inkjet Printer, Laser Printer, Modem, Portsand Connectors, Batteries, Power supply, Pen Drives. Scanner: Photo Scanner, Documents Scanner, Bar Cord Scanner Introduction of Expansion Card, Assembling of Personal Computer.

Unit 4

Operating System

Basics & Installation - Introduction to OS, Types of Operating systems, System files FAT and NTFS, Dos 6.22, Windows, XP, Windows Vista, Windows7 and Windows 8and RedHat Linux and Multi Boot Operating System.

Unit 5

Trouble shooting - Complete introduction & Troubleshooting, Antivirus free andpaid version, Downloading the Drivers from Internet, Installation of Drivers.

REFERENCES:

1. *PC AND CLONES Hardware, Troubleshooting and Maintenance B. Govindarajalu, Tata Mc-graw-Hill Publication*
2. *PC Troubleshooting and Repair Stephen J. Bigelow, Dream tech Press, New Delhi*

LAB Requirements

Required Accessories for Hardware Course

- *Basic Measuring Instruments Multi-meters*
- *Minimum two nos. Computer for Hardware Practice.*
- *All generations Motherboard, Processor, Ram.*
- *Expansion Card and Cables.*
- *All Ports, SMPS and UPS.'*
- *Hard disk, Floppy disk, Pen drive, CD ROM, DVD writer.*
- *Printer, Monitor, Speakers.*
- *Keyboard, Mouse, Modem.*
- *Installation Kit (Bootable CD, Windows CD, All Software CD.)*
- *Tool Kit.*
    - *Secure Driver with all bit.*
    - *Soldering with Solder and Paste.*
    - *De-soldering Pump.*
    - *Digital and Analog Multi-Meter.*

- *Screw driver set*
- *Internet connectivity.*

Learning Outcomes: This course creates an awareness in Non-computer science background students and provides them with the basic knowledge and understanding of computer, both software and hardware.

Evaluation Pattern – R.13 & R.16

18OEL236 Development Journalism 2 0 1 3

Course contents

Unit 1

Large-scale migration from rural to urban areas: causes and consequences. Stati tics, unemployment, education, health, insurgency (lack of security), lack of infrastructure.

Unit 2

'Pull' and 'Push' factors: Urban centres provide better scope for earning livelihood through employment in industries, transport, construction, trade, services etc. They act as magnets by offering modern facilities and 'pull' people from the rural areas, while unemployment, hunger and starvation and lack of means of livelihood "push" people out of villages into towns and cities.

Unit 3

Migration from rural areas and their impact on agricultural production due to shortage of labour in those areas.

Unit 4

Mass migration into metropolitan cities – Delhi, Kolkatta, Mumbai and Chennai – and their impact on civic amenities in the cities – increasing slums, decline in standard of living and environmental degradation.

Unit 5

Nuclear family - A side effect of urbanization - Changes in family system brought about by urbanization.

REFERENCES:

1. *Effects of internal Migration and Net Emigration on a City – Smriti Chand 4 Major causes of Migration in India – Smriti Chand Human Migration (Cause, Kinds and Theories) - Negi Mohita*
2. *UN state of the World Population Report – 2007*

Evaluation Pattern – R.13 & R.16

18OEL237 Digital Photography 1 0 2 3

Course contents

Unit 1

Introduction to photography, role of photographer, Types of cameras - Film camera, Digital Camera, image file types.

Unit 2

SLR - Camera functions and Types of Lenses.

Unit 3

Rules of composition, Types of shots.

Unit 4

Lighting, Natural lighting, flash, studio lights, creative lighting etc.

Unit 5

Types of photographers, Post processing, image editing.

TEXTBOOKS:

1. *The Basic Book of Photography by Tom Grimm and Michele Grimm, 4th Edition*
    1. *The Manual of Photography: Photographic and Digital Imaging by Ralph E Jacobson, Sidney F Ray, Geoffrey Attridge, Norman R Axford, 9th Edition*

REFERENCES:

- *The Basic Photography, 1973, Focal press*
- *Advanced Digital Photography by Tom Ang, Mitchell Beazley*

Learning Outcomes: This course introduces the students to different aspects of photography and enables them to understand their role as a photographer.

Evaluation Pattern – R.13 & R.16

18OEL238 Emotional Intelligence 1 0 2 3

Course contents

Unit 1

Emotional Intelligence: Intelligence Quotient - IQ, Concept of EmotionalIntelligence, History and origin of Emotional Intelligence, Science of Emotional Intelligence, Scope of Emotional Intelligence

Unit 2

Components of Emotional Intelligence: Importance of emotions, Self-awareness, Self-regulation, Self-motivation, Social awareness, Social skills.

Unit 3

Models of Emotional Intelligence: The Ability-based Model, The Trait Model ofEmotional Intelligence, Mixed Models of Emotional Intelligence.

Unit 4

Emotional Intelligence at Work place: Importance of Emotional Intelligence atWork place Cost –savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies

Unit 5

Measuring Emotional Intelligence: Emotional Intelligence Tests, Research onEmotional Intelligence, Developing Emotional Intelligence

REFERENCES:

1. *Daniel Goleman (1996). Emotional Intelligence - Why it can Matter More than IQ. Bantam Doubleday Dell Publishing Group*
2. *Geetu Bharwaney (2008) . Increase your Emotional Intelligence - Strategies for EI Living, Jaico Publishing House*
3. *Jyotsna Codaty (2012) . Understanding Emotional Intelligence - Pustak Mahal.*

Evaluation Pattern – R.13 & R.16

18OEL239 Essence of Spiritual Literature 3 0 0 3

Course contents

Unit 1

Indian Spirituality - Bhagvath Gita: Chapter 10; Upanishad – Isavasyopanishad; Vedic

Hymns.

Unit 2

Western Spirituality - The Bible.

Unit 3

Oriental Spirituality - Chinese: Confucianism - Japanese: Shinto-Buddhism.

Unit 4

Others - Jewish-Sufism – Zoroastrianism.

Unit 5

Yoga and Meditation - The Power of Meditative practices - How to Practise the power of transcendental awareness - Revising Negative trends into positive - Scientific nature of Sadhana - Spiritual Psychology - Human energy systems – Chakras.

REFERENCES:

1. *Max Muller, The Upanishad, Max Muller, Vedic Hymn*
2. *Swami Chinmayanada - Bhagavath Gita*
3. *The Gospel of Jesus Christ.*
4. *Legge James, Confusionism*
5. *Kushner, Lawerence, Jewish Mystical Spirituality*
6. *Rahula, Walpola, What the Buddha Taught*
7. *Lings Martin, What is Sufism*
8. *Iyenga B.K.S, Light on Yoga*
9. *Harish Johari, Chakras: Energy Centers of Transformation*

Learning Outcomess: This course helps to eradicate superstition and to establish moral and ethical values; to check unscrupulousexploitation of nature; bring to fruition Amma's dream of the world as one village; an overview of spirituality the world over.

Evaluation Pattern – R.13 & R.16

18OEL240 Film Theory 2 1 0 3

Course contents

Unit 1

Introduction - Basic stages of cinema production, Pre-production, Production, Post-production, Introduction to Lighting.

Unit 2

Indian Cinema - Early Indian cinema, History of Malayalam cinema, Key directors in Malayalam cinema, Key technicians in Malayalam cinema

Unit 3

Theoretical Perspective - Expressionism, Realism, neo-realism, new wave, Auteur theory, Narrative theory.

Unit 4

Different Genres in Cinema and its Features - westerns, musicals horror, fictions, historical, Documentary.

Unit 5

Film Screening - Citizen Kane, Nanook of the north, Children of heaven, Modern times, Psycho, Dreams, Home (Documentary), Samsara (Documentary).

TEXTBOOKS:

1. *Film Art: An Introduction - David Bordwell, Kristin Thompson*
2. *Malayala Cinemayude Katha – Vijayakrishnan*
3.

REFERENCES:

4. *The Art and Science of Cinema - Anwar Huda*
5. *Key Concepts in Cinema Studies - Susan Hayward*
6. *Film as Art - Rudolf Arnheim*
7. *Chalachithrathinte Porul - Vijayakrishnan*
8. *Movies and Meanings - Stephen Prince*

Learning Outcomes: This course helps student to have basic understanding ofcinema, study different aspects of cinema world thereby enabling him to develop the analyzing skill in visual world.

Evaluation Pattern – R.13 & R.16

18OEL241	**Fundamentals of Network Administration**	**2**	**0**	**1**	**3**

Course contents

Unit 1

Network Components:

Introduction of Network Cable like UTP, STP, Fiber Optics, Hub, Unmanageable Switch, Manageable Switch, Router, Modem, Wi-Fi, Access Point, PCI Wireless Card, USB Wireless Device, Print Server, USB Network Sharer, Backup Device, Server Hardware etc.

Unit 2

Basic Network Introduction & Installation - Introduction About Network, Installing Network Operating System - Windows Server versions, Cable Crimping, Network Sharing and user Permission, Internet Connection, E-Mail, Google Drive, Dropbox etc.

Unit 3

Transmission Media and Topologies - Media types: STP cable, UTP cable, Coaxial cable, Fiber cable, Base band and Broadband transmission, Cables and Connectors, Physical and logical topologies, Bus, Star, Ring and Mesh topologies.

Unit 4

Network protocols - HTTP, FTP and other Different types of protocols, OSI Model, Media Access Method, DNS services, DHCP services, web services, Proxy Services etc.

Unit 5

IP addressing - Introduction to TCP/IP and Sub-netting, configuring IP address and Network, Routing protocol basics.

REFERENCES:

1. *Networking Complete, BPB Publication*
2. *Computer Networking - Andrew S. Tanenbaum*

Learning Outcomes: This course enables the students to understand the basic networking components and installations; to have an indepth knowledge on network topologies; to understand the network layers and protocols implementation.

Evaluation Pattern – R.13 & R.16

18OEL242 **Gender Studies** **3 0 0 3**

Course contents

Unit 1

Women Writing in India 600 B.C. to the Present: Volume I: 600 B.C. to the Early Twentieth Century (Introduction) - Susie Tharu and K Lalitha

Unit 2 Fiction

Othappu: The Scent of the Other Side - Sara Joseph and Valsan Thampu.

Unit 3 Fiction

One Part Woman - Perumal Murugan

Unit 4 Drama

Dance like a Man - Mahesh Dattani

Unit 5 Short story

Quilt - Ismat Chugtai

Learning Outcomes: This course familiarizes the students with the contemporary discourses on gender with specialemphasis on India.

Evaluation Pattern – R.13 & R.16

18OEL243 Glimpses of Indian Economy and Polity 3 0 0 3

Course contents

Unit 1

General Introduction, Primitive Man and his modes of exchange – barter system, Prehistoric and proto-historic polity and social organization. Early India – the Vedic society – the Varnashramadharma – socio-political structure of the various institutions based on the four purusarthas.

Unit 2

The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala Socio-economic elements from the two great Epics – Ramayana and Mahabharata Sarasvati - Sindhu Civilization and India's trade links with other ancient civilizations - states and cities of the Indo-Gangetic plain

Unit 3

The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact. The emergence of the empire – the Mauryan Economy and Kautilya's Arthasastra. Of Politics and trade – the rise of the Mercantile Community. Elements from the age of the Kushanas and the Great Guptas. India's maritime trade. Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya. Glimpses into the South Indian Economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas. Medieval India – agrarian economy, non-agricultural production and urban economy, currency system.

Unit 4

The Indian Market and Economy before the arrival of the European traders. Colonisation – British attitude towards Indian trade, commerce and economy and the resultant ruining ofIndian economy and business – man-made famines – the signs of renaissance – the evolution of themodern banking system. Glimpses into British administration of India and

administrative models. The National Movement and nationalist undertakings in business and industry. Modern India: the growth of large-scale industry – Irrigation and Railways – Money and Credit – Foreign Trade. Towards Partition – birth of two new nations – division of property.

Unit 5

The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place. India since Independence – the saga of socio-political movements. Indian Economy since Independence – the Fiscal System – the Five Year Plans – Liberalisation – the GATT and after Globalisation and Indian Economy. Impact of science and (new/ emerging) technology on Indian economy. Histories of select Indian business houses and business entrepreneurship.

REFERENCES:

1. *The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.*
2. *Kautilya. Arthasastra.*
3. *Altekar, A.S. State and Government in Ancient India. New Delhi: Motilal Banarsidass.*
4. *Sircar, D.C. Studies in the Political and Administrative Systems in Ancient and Medieval Times. New Delhi: Motilal Banarsidass.*
5. *Dutt, R.C. The Economic History of India. London, 1902.*
6. *Dharampal. Collected Works (Volumes IV & V).*

Evaluation Pattern – R.13 & R.16

18OEL244 Graphics and Web Designing Tools 1 0 2 3

Course contents

Unit 1

Introduction to Computer Graphics Definition, Application, Pixel, Frame Buer, Raster and Random Scan display.

Unit 2

Images – Bitmaps and Grey Scale Images, Image Types – Color Graphics – Color Schemes – Palette Compositions.

Unit 3

Sound – Analog and Digital Sound – Quantization – Sampling – Sampling Rate – Sound Types.

Unit 4

Introduction to Adobe Photoshop – Image editing tools, Tracing, Static web page template designs creation – slicing – Various aspects of a static webpage.

Unit 5

Introduction to Dream viewer - tables and tools – Dynamic web page template design creation - Animations – 2D, 21/2 D and 3D perceptions with examples.

REFERENCES:

1. *Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, New Delhi.*
2. *Tay Vaughan, Multimedia: Making it Work, Ninth Edition. Tata McGraw-Hill, 2014.*
3. *Edward Angel, Interactive Computer Graphics: A top-down approach with OpenGL, Fifth Edition. Addison Wesley, 2008.*
4. *Alan Watt, 3D Computer Graphics, Third Edition, Addison-Wesley, 2000.*
5. *Foley, van Dam, Feiner, Hughes. Computer Graphics Principles and Practice, Second Edition in C. Addison Wesley, 1996.*

Learning Outcomes: This course helps the students to understand the basics of computer graphics, and the aspects ofimages and sound. It gives introductory knowledge on designing aspects and to design web pages.

Evaluation Pattern – R.13 & R.16

18OEL245 Green Marketing 3 0 0 3

Course contents

Unit 1 Introduction to Green Marketing

Meaning - Definition - Evolution of green marketing - Assumptions of green marketing - Reasons for adopting green marketing and benefits of green marketing.

Unit 2 Green Marketing Mix (GMM) and Sustainability

Meaning - concept of GMM – Strategies - Challenges. The concept of Sustainability and Green Marketing/ Consumers and pioneering efforts in India - Guiding principles of Sustainability and Green Marketing/ Consumers - Common assumptions and myths of green marketing.

Unit 3 Methods of implementation of Sustainability and Green Marketing

Method of bringing sustainability in green marketing in India and rest of the world.
Case study analysis.

Unit 4 Role of functional groups in Green Marketing

Functions within the market, Role of Wholesalers and Retailers, Role of banking institutions, funders and donors. Difference between general marketing and green

marketing.

Unit 5 Governance and Legal Institutions

Role of governance in sustaining green marketing, Implications of governance.

TEXTBOOKS AND REFERENCES:

1. *Green Marketing Strategies - Amitabha Ghose*
2. *Green Marketing in Indian Retail Sector - Tanushree Purohit and A.K Das Mohapatra*
3. *Green Marketing Management - Robert Dahlstrom*
4. *Green Marketing, Theory, Practise and Strategies - Robert Dahlstrom*
5. *Green Marketing Strategies and Consumer Behavior - Monica Loss*

Learning Outcomes: This course enables to students to understand and examine the core principles required to create competitive advantagein the marketplace by implementing innovative green marketing strategies.

Evaluation Pattern – R.13 & R.16

18OEL246 Healthcare and Technology 3 0 0 3

Course contents

Unit 1

Health information technology, Types of technology: Electronic Health Record, Personal health records (PHRs) Computerized provider order entry (CPOE), Application of HIT – case studies, Visualization of Medical Data.

Unit 2

Healthcare Improvement Using Analytics, Healthcare Transformation - Challenges and Opportunities, Fundamentals of Healthcare Analytics, Components of Healthcare Analytics, Advanced Analytics in Healthcare.

Unit 3

Foundations of Information Technology, Technological Innovations, Opportunities, and Challenges, Information Technology Assurance and Security.

Unit 4

Introduction to medical informatics, necessity of standards for e-health, security and cyber laws, ethical and medico legal issues in patient information exchange; Introduction to medical databases, electronic medical records, Decision Support Systems, Artificial

Intelligence.

Unit 5

Integrated Health information systems, cost effectiveness; Networks, PSTN, ISDN, VSAT, TI, information compression, storage and transmission standards, wireless telemetry, e-health and telemedicine and applications.

TEXTBOOKS/ REFERENCES:

1. *Shortlife E. H. and Cimino J J, Biomedical Informatics: Computer Applications in Health Care and Biomedicine, Third Edition, Springer-Verlag, 2006.*
2. *Norris A C, Essentials of Telemedicine and Telecare, John Wiley & Sons, 2002.*
3. *Diffusion and Value of Healthcare Information Technology, Bower, Anthony G. RAND Corporation 2005*
4. *Healthcare Analytics for Quality and Performance Improvement. Strome, T.L., John Wiley & Sons, 2013.*

Learning Outcomes: It provides students with a detailed understanding about technological applications inthe healthcare sector with an objective to promote better management of information regarding identification of biomedical and hospital technology planning, procurement and operation requirements.

Evaluation Pattern – R.13 & R.16

18OEL247 History of English Literature 3 0 0 3

Course contents

Unit 1

The Social and Literary context: Medieval and Renaissance (Evolution of English Language and Literature).

Unit 2

Restoration to the Romantic Age (Social Background and its influences).

Unit 3

The Victorian Society and Literature (features, effects on the globe).

Unit 4

Modernism and after (Social transformation, Science, World Wars).

Unit 5

Assignment, Seminar Discussion & Term Test

REFERENCES:

1. *William J Long - English Literature, FQ Books Publication*

2. *Pramod K Nayar - A Short History of English Literature, Cambridge University Press*
3. *Ifor Evans - A Short History of English Literature, Penguin Books*
4. *George Sampson - The Concise Cambridge History of English Literature, Cambridge University Press*

Learning Outcomes: This course introduces the students to the evolution of English as a language and culture; it helps students to acclimatize with the history of English Literature, and makes students aware of different movements and their effects on the society and literature.

Evaluation Pattern – R.13 & R.16

18OEL248 Indian Writing In English 3 0 0 3

Course contents

Unit 1
Introduction to Indian writing in English - development and growth of poetry, fiction and drama - trends of Indian writing in English.

Unit 2 Poetry
Nissim Ezekiel: Goodbye party for Miss Pushpa T.S;
Kamala Das: An Introduction
A.K. Ramanujan: A River

Unit 3 Short Stories
Rabindranath Tagore: My Boyhood Days
Khushwant Singh: The Portrait of a Lady

Unit 4 Fiction
R.K.Narayan: The Vendor of Sweets

Unit 5 Drama
Girish Karnad: Nagamandala – Play with a Cobra

REFERENCES:

1. *K.R.Sreenivasa Iyengar - Indian Writing in English, Sterling: Delhi.*
2. *Poetry down the Ages: Orient Blackswan.*
3. *Best of Rabindranath Tagore: Gitanjali, My boyhood days, The Post Office, The Gardner Mashi and Other Stories.*
4. *Khushwant Singh - The Portrait of a Lady: Collected Stories.*

Learning Outcomes: This course helps the students to trace the rise, growth and development of Indian poetry, fiction and drama in English; to provide an overview of the various phases of the evolution of Indian writing in English, to introduce the students to the rich and varied literature available in regional languages; to expose them to the Indian mind both ancient and modern; to inculcate a sense of appreciation for the literary genius; to understand the fabric of Indian society and the cultural unity of its people.

Evaluation Pattern – R.13 & R.16

18OEL249 Industrial Relations and Labour Welfare 3 0 0 3

Course contents

Unit 1

Industrial relations - industrial disputes - causes - handling and settling disputes - employee grievances - steps in grievance handling - causes for poor industrial relations - remedies.

Unit 2

Collective Bargaining: - Concept - Principles and forms of collective bargaining - Procedure - conditions for effective collective bargaining - worker's Participation in management.

Unit 3

Factories Act 1948 - The Workman's Compensation Act, 1923.

Unit 4

The Industrial Disputes Act 1947 - The Trade Union Act, 1926.

Unit 5

The Payment of Wages Act, 1936 - The Employee's State Insurance Act, 1948

REFERENCE BOOKS:

1. *P.C.Tripathi - Personnel Management & Industrial Relations, Sultan Chand*
2. *C.B.Mamoria - Dynamics of Personnel Management, Himalaya Publishing*
3. *N.G.Nair & Latha Nair - Human Resource Management, Sultan Chand & Sons.*
4. *P. Subbarao - Essentials of Human Resource Management and Industrial Relations, Himalaya Publishing.*

Learning Outcomes: On successful completion of this course, the students will have an understanding of theLegislations relating to Industrial Disputes and Labour welfare.

Evaluation Pattern – R.13 & R.16

18OEL250 Introduction to Ancient Indian Yogic and Vedic Wisdom 3 0 0 3

Course contents

Unit 1

Ayurvedic, Yogic and Vedic Lifestyle: Introduction to Ayurveda, Yoga and Veda, life and lifestyle, daily routine according to Ayurveda, Yoga and Veda like ablution and food system.

Unit 2

Over view of Indian Philosophy: Introduction to Indian Philosophies, difference between Indian Philosophies and western Philosophies, Basic idea on various Indian Philosophies.

Unit 3

Human mind: States of mind, virtues & vice, causes for distraction, ways to gain one pointed mind.

Unit 4

Eight Limbs of Yoga: Introduction to Yoga Philosophy, benefits of Yoga, goal of yoga, explanation on Eight Limbs of Yoga.

Unit 5

Bhagavadgita: Glory of the Bhagavadgita, Human life according to the Bhagavadgita, solution for sufferings, self management.

REFERENCE BOOKS:

1. *Bhagavad Gita – Commentary by Swami swarupananda, Advaita Ashrama*
2. *Paatanjala Yogasutra – Commentary by Swami Gambhirananda, Ramakrishna mission*
3. *Yogopanishath*
4. *Ayurvijnana Ratnakaraha – Yogendranath, Rashtriya Samkrita Samsthanam*

Learning Outcomess: This course helps the students to understand the importance of adapting a healthy lifestyle; to realize the significanceof ancient Indian wisdom; to help in understanding the goal of human life

Evaluation Pattern – R.13 & R.16

18OEL251 Introduction to Computer Hardware 2 0 1 3

Course contents

Unit 1

Hardware Basics – Generation of computers, Types of computers, Parts of a computer, and

Functions of System Modules, Front and rear panel view of system, Safety information while disassembling PC – Internal structure of PC.

Unit 2

Motherboards: Components and Architecture, features, components, form factor, processor support, BIOS, IDE and SATA Connectors, External interfaces and connectors, troubleshooting and maintenance of Mother Boards.

Unit 3

Popular CPU Chips and their Characteristics, Processor Architecture - Processor specifications - installing and uninstalling processor - CPU Overheating issues – common problems and solutions.

Unit 4

Memory and Storage: Memory features – Types of memory – working - Installing and uninstalling memory modules – maintenance and troubleshooting – common problems and solutions.

Storage devices – Hard disk details – Working and parts of hard disks – Installing hard disks – maintenance and troubleshooting.

Unit 5

Power supply – SMPS – features – types – installing SMPS – Specification for SMPS.

Maintenance and Troubleshooting: Preventive Maintenance and Safety Procedures - Managing Replaceable Components.

TEXTBOOKS/REFERENCE BOOKS

1. *James K L,"Computer Hardware: Installation, Interfacing Troubleshooting and maintenance", PHI Learning Press (Eastern Economy Edition, 2013)*
2. *Manahar Lotia, Pradeep Nair, Payal Lotia, "Computer Hardware Course", BPB Publications*

Learning Outcomes: This course provides a general understanding of the basic parts of computer and how a computer works.

Evaluation Pattern – R.13 & R.16

18OEL252 Introduction to Event Management 3 0 0 3

Course contents

Unit 1

Why Event Management, Requirement of Event Manager, Analyzing the events, Scope of the Event, Decision-makers, Technical Staff, Developing Record-Keeping Systems, Establishing Policies & Procedures.

Unit 2

Preparing a Planning Schedule, Organizing Tasks, Assigning Responsibility, and Communicating, Using the Schedule Properly, The Budget, Overall Planning tips, Checklists, Expert Resources, Computer Software Required.

Unit 3

Who are the people on the Event, Locating People, Clarifying Roles, Developing content Guidelines, Participant Tips, Reference Checks, Requirement Forms, Introduction, Fees & Honorariums, Expense Reimbursement, Travel Arrangements, Worksheets.

Unit 4

Types of Events, Roles & Responsibilities of Event Management in Different Events, Scope of the Work, Approach towards Events.

Unit 5

Introduction to PR – Concept, Nature, Importance, Steps, Limitations, Objectives Media – Types of Media, Media relations, Media Management PR strategy and planning – identifying right PR strategy, Brain Storming sessions, Event organization, writing for PR.

REFERENCES:

1. *Devesh Kishore, Ganga Sagar Singh - Event Management: A Blooming Industry and an Eventful Career, Har-anand Publications Pvt. Ltd.*
2. *Swarup K. Goyal - Event Management, Adhyayan Publisher – 2009.*

Evaluation Pattern – R.13 & R.16

18OEL253 Introduction to Media 3 0 0 3

Course contents

Unit 1

Introduction – Media Business - Media Classification - Mass Media – Niche Media - Addressable Media and Interactive Media - Media-Intrusiveness.

Unit 2

Print – Media – Newspaper - Principles of Newspaper Business - Classified Ads, Display Ad's Display Ad's – Coverage and Audience Measurement - Sales and Pricing – magazines. Directories.

Unit 3

Broadcast Media – Radio – Television - out of Home Media - out door Advertising - Cinema and Video Non-Traditional Media.

Unit 4

An overview of Media planning - problems of media planning – Developing media plan – Market Analysis and Target - Interactive and Digital Media.

Unit 5

Establishing media objectives - Developing and Implementing – Evaluation and Follow up - Computers in Media Planning - Characteristics of Media.

REFERENCE BOOKS:

1. *Tom Duncan - "Principles of Advertising and IMC", Tata McGraw Hill*
2. *Kruti shah and Alan D'souza - "Advertising and Promotion" – An IMC Perspective, Tata McGraw Hill.*
3. *Mehra – "Newspaper Management"*

Evaluation Pattern – R.13 & R.16

18OEL254 Introduction to Right to Information Act 3 0 0 3

Course contents

Unit 1

Introduction to RTI Act

The evolution of the Right to Information in India - the important terms and concepts used in the Act - the salient features of the Act.

Public Authorities and their Obligations under the Act

- What is a Public Authority?
- Who are the Public Authorities covered under the Act?
- Which Public Authorities are exempted from the ambit of the Act?
- Obligations of Public Authorities.

Unit 2

Role of Public Information Officers: PIOs and APIOs - Accepting Information Request, Processing and Disposing.

The requirement for designation of Information Officers - PIOs / APIOs - in public authorities

- The specific Duties & Responsibilities of Information Officers.
- The liabilities of a PIO for non-compliance with the provisions of the Act.
- How to accept information requests and assist citizens in making information requests?
- What is the process for disposal of requests?
- The time limits for disposal of information requests.
- The fees and costs to be charged for providing information.

- The grounds on which requests can be rejected and the procedure for such rejection.

Unit 3

Exemptions from Disclosure of Information, Partial Disclosure and "Third Party" Information

- Specific provisions of the Act which exempt certain kinds of information – the classification of such exempted information.
- Application of public interest test with respect to exempted information.
- *Grounds that* allow for partial disclosure of information.

The concept of 'Third Party' and the issues and considerations revolving around its involvement.

Unit 4

The roles and responsibilities of Appellate Officers within Public Authorities.

- The process involved in making first appeals to designated Appellate Officers.
- Timelines for making a first appeal and disposal of the appeal
- First Appeals and Appellate Officers - Important Provisions

Unit 5

Information Commission: Powers and Functions

- The Role and Responsibilities of the Information Commissions.
- The relevant provisions in the RTI Act dealing with Complaints to the Information Commission and the specifications thereof.
- The "Second Appeal" process and the Commissions' mandate for the same.
- The power of Information Commissions with regard to enforcing compliance of public authorities with the provisions of the RTI Act, imposing penalty/ recommending disciplinary action against erring PIOs etc.

REFERENCES*:*

1. *S P Sathe - Right To Information, Lexisnexis India Publication*
2. *Sarbjit Sharma - Right To Information, Authors Press Publication*

Evaluation Pattern – R.13 & R.16

18OEL255 Introduction to Translation 3 0 0 3

Course contents

Unit 1

What is Translation - History of translation - The rise and development of

translation - Linguistic and Philological definition of translation.

Unit 2

Translation and Communication - Information and message; Communication channel - The sender and the receiver of the message Forms and types of translation.

Unit 3

Translating for the Media: print media – electronic media - Translating various News reports – Advertisements – editing – interviews – writing Screen Plays and Scripts for radio and T.V. – spoken media - symposia, conference, platform speech etc.

Unit 4

Translating for business: Translating Business Correspondence – Translating literature on consumer products – Technical writing.

Unit 5

Introducing various types of translation - Machine Translation - Computer aided translation etc. – Revising and rewriting – Proof reading – editing – submitting manuscript for publication – summary.

REFERENCE BOOKS AND SOURCES:

1. *Bassnett, Susan - Translation Studies, London and New York, 1980 (revised edition 1991),*
2. *Routledge Bell, Roger T. - Translation and Translating, Theory and Practice, Longman, 1991*
3. *Callow, Kathleen - Man and Message: A Guide to Meaning-Based Text Analysis, 1998,*
4. *Cumulative Index of United Nations Legal Materials Produced and Applied in Kosovo 1999-2004,*
5. *Central European and Euroasian Law Institute, USAID Duff, Alan, Translation, OUP, 1997*
6. *Gërmizaj, Shykrane - Translation Theory in the Classroom, Prishtina, 2005*

Websites: *(newspaper Selection of websites)*

1. *http://www.fortunecity.com/business/reception/19 http://accurapid.com/journal/29accom.htm http:// www.ethnologue.com/show_products http://cslu.cse.ogi.edu/HL.Tsurvey/chnode4.html http:// fiat.gslis.utexas.edu/~palmquis/courses/project98/translation/mtlinks.htm http:// www.fortunecity.com/business/reception/19 http://language.home.sprynet.com/lingdex/pwood1.ht*

Learning Outcomes: This course introduces students to translation studies as separate

discipline of knowledge, it helps in training in translation and to increases students' awareness related to social functions of translation. Furhter it helps students to develop contrastive knowledge and their critical thinking skills.

Evaluation Pattern – R.13 & R.16

18OEL256 Linguistic Abilities 3 0 0 3

Course contents

Unit 1

Listening – Importance of listening - Types of listening - Basic skills of listening - Barriers of listening – Activities - listening to radio, TV or Internet - Transcript.

Unit 2

Speaking - body language – Pronunciation - Introducing yourself – storytelling - speak on any topic - social etiquette.

Unit 3

Reading - Different types of reading – comprehensive test - Vocabulary building.

Unit 4

Writing – structure – letter – circular – memo - Note making - Paragraph Writing précis - Writing – essay.

Unit 5

Practical Module - Creative writing - Play reading - Role play - Dialogue.

REFERENCES:

1. *O' Brien Terry - Modern Writing Skills, Rupa Publciation*
2. *O' Brien Terry - Effective Speaking Skills, Rupa Publication*
3. *Olson Judith F. Writing Skills - Success in 20 Minutes a Day, Goodwill Publishing House*
4. *Meyers Judith N. - Vocabulary and Spelling, Goodwill Publishing House*

Learning Outcomes: This course helps students to develop lifelong skills, including: the ability to communicate clearly, accurately and effectively; the use of a wide range of vocabulary and correct grammar, spelling and punctuation; a personal style and an awareness of the audience being addressed.

Evaluation Pattern – R.13 & R.16

18OEL257 Literary Criticism and Theory 3 0 0 3

Course contents

Unit 1 Feminism: Indian waves - Chandra Talpade Mohanty. 'Under Western Eyes: Feminist Scholarship and Colonial Discourses'.

Unit 2 Cultural studies: Bacon's 'Of Travel' - Indian context - Travel Culture ofKerala - Introducing seminal texts - forms of travel narratives - Road movies.

Unit 3 Post colonialism: Edward Said - Introduction of 'Orientalism'.

Unit 4 Comparative Indian Literature: Methodology - Literature and other disciplines G. Arunima. 'Who is a Malayali Anyway? Language, Community and Identity in Precolonial Kerala' - A.K. Ramanujan. 'Three Hundred Ramayanas: Five Examples and Three Thoughts on Translation'.

Unit 5 Psychoanalysis: Freud - Critical tool in literary analysis - Norman N Holland. 'The Mind and the Book: A Long Look at Psychoanalytic Literary Criticism'.

REFERENCE BOOKS:

1. *Trilling, Lionel - "Freud and Literature". The Liberal Imagination: Essays on Literature and*

Society. London: Martin Secker and Warburg,

2. *Richman, Paula. Ed. - Many Ramayanas: The Diversity of a Narrative Tradition in South Asia. University of California Press*
3. *Satish Saberwal, Mushirul Hasan - Assertive Religious Identities: India and Europe.*
4. *Bassnett, Susan - Comparative Literature: A Critical Introduction. Oxford: Blackwell, 1993.*

Learning Outcomes: This course introduces basic theories of literary and cultural criticism to the students with emphasis on interdisciplinary.

Evaluation Pattern – R.13 & R.16

18OEL258 Macro Economics 3 0 0 3

Course contents

Unit 1

Introduction to Macroeconomics and National Income

Macro Economics – Goals – Government Policies – Components – Definition of National Income – Concepts – Methods of Measuring National Income – Uses – GDP and Welfare – Investment Theory.

Unit 2

Government Budget and the Economy

Government Budget – Meaning, Objectives and Components – Classification of receipts – Revenue and Capital Receipts – Classification of Expenditure - Revenue and Capital Expenditure – Measures of Government deficits – revenue, fiscal and primary deficit meaning.

Unit 3

Money and Banking

Money – Keynesian Approach – Money Market Equilibrium – Supply of Money – Money creation by the Commercial Banking system – Central Bank and its functions – Controller of Credit through CRR – SLR – Repo and Reserve Repo.

Unit 4

Macro Economic Problem

Introduction – Determinants of Consumption, Saving and Investment - Unemployment – Types - Definition and Characteristics of Trade Cycles - Different phases of trade cycles - Definition and types of Inflation and Deflation - Causes and consequences of Inflation.

Unit 5

Public Finance

Meaning - Scope of Public Finance - Role and Types of Direct and Indirect Taxes in India - Role of Monetary and Fiscal Policies in maintaining real economic growth with stability – International Trade.

REFERENCE BOOKS:

1. *Principles of Economics – Deviga Vengedasalam and Karunagaran Madhavan, Third Edition – Oxford Publication Press.*
2. *Economics - Samuelson, Paul Anthony and William D. Nordhaus, 1998, Ed. 6, Tata McGraw Hill Publishing Company Ltd, New Delhi.*

Evaluation Pattern – R.13 & R.16

18OEL259 **Managing Failure** **3 0 0 3**

Course contents

Unit 1

Understanding the self - self awareness - Individual psychological processes - sculpting a unique socially desirable personality - spiritual/ ethical orientation.

Unit 2

SWOT analysis at the individual level - Developing individual competencies surviving in a

competitive environment - environment and sustainable development.

Unit 3

Emotional Intelligence - life skills - inter-personal relations - Social adjustments - Soft skills.

Unit 4

Managing at work situations - Profile of today's organization - Strategic context - environment challenges - Individual challenges and responsibilities.

Unit 5

Managing failures: Envisioning the future - managing change - unleashing creative and intuitive skills to meet failures - Remodeling individuals and organizations - Indian ethos for managing self and organizations ethically.

BOOKS FOR REFERENCE:

5. *Soft Skills and Professional Communication - Francis, Mcgraw Hill*
6. *Personality Development and Soft skills - Barun Mitra, Oxford University Press*
7. *Social and Personality development - David R. Shaffer, Cengage learning.*
8. *Ethics in Management and Indian Ethos - Ghosh BB, Vikas publishing.*

Learning Outcomes: This course helps the student to face challenges of life; to impart insights forunderstanding the self and adjusting with work scenario in organizations so as to become a responsible global citizen.

Evaluation Pattern – R.13 & R.16

18OEL260 Media Management 3 0 0 3

Course contents

Unit 1

Introduction

Introduction to principles and practice of management - Business Models and Function - Mass Media Industry Structure Media Markets - Ownership - Monopolies, Oligopolies, Conglomerates, Mergers, and Acquisitions - Media Sales Promotion and Marketing Mix.

Unit 2

Types of Media Ownership – Features Advantages & Disadvantages

Sole proprietorship – Partnership - private limited companies - public limited companies - trusts, co-operatives - religious institutions (societies) - Franchisees (Chains).

Unit 3

Ownership Patterns of Mass-Media in India

Organizational structure of newspaper and magazine - Organizational structure of Radio - Organizational structure of Television.

Unit 4

Planning & Production

Planning and execution of programme production - production terms - control practices and procedures.

Unit 5

History & Law

Historical perspective of mass media laws in India -

Basic Legal concepts Constitutional provisions for Freedom of Speech and Expressions - Article 19(1) (a) Reasonable restrictions - Article 19(2) - Freedom of the press in India Law of Defamation, Obscenity, Cinematography Act - Official Secrets Act 1923 - Copyright Act - • Contempt of Court Act - Legislative Privileges and Contempt of Legislature - Working Journalist Act.

REFERENCE BOOKS:

- *Aggarwal S.K. - Press at the crossroads in India, UDH Pub House*
- *William and Rucker - Newspaper Organization and Management, a State Pr. Publication*
- *Frank Thayer - Newspaper Management - Appleton-Century Company; 1St Edition edition (1926)*

Learning Outcomes: This course gives the students an understanding of the media industry with the waythe organization functions.

Evaluation Pattern – R.13 & R.16

18OEL261 **Micro Economics**

3 0 0 3

Course contents

Unit 1

Introduction to Microeconomics

Definition of economics – Scope – Scarce and End resource – Welfare Definition Differences between Micro and Macro economics – Basic Economic Concepts and Problems – Economic Systems.

Unit 2

Consumer's Equilibrium Demand and Supply

Consumer Equilibrium – Meaning of Utility – Law of Equi-Marginal Utility - Demand

– Law of Diminishing Marginal Utility - Law of Demand – Determinants – Types of Demands – Supply – Law of Supply – Elasticity of Demand and Supply.

Unit 3

Theory of Production

Production – Production function – Law of Production – Return to Scale – Economics and Diseconomies of Scale - Classifications – Short-run production function – Long-run production function – Isoquant Curve.

Unit 4

Cost Function

Cost and Revenue – Short run costs – Total cost – Total Fixed Cost – Variable Cost – Average Fixed – Average Variable cost and Marginal Cost – Meaning and their relationship – Average and Marginal Revenue.

Unit 5

Market Structure and Price Determination

Market – Classification of Markets – Nature – Perfect Competition - Market Structure (Monopoly, Monopolistic, Oligopoly, Duopoly) – Price Determination under Monopolistic Market – Price Discrimination.

REFERENCE BOOKS:

- *Principles of Economics – Deviga Vengedasalam and Karunagaran Madhavan, Third Edition*
  – Oxford Publication Press.
- *Economics - Samuelson, Paul Anthony and William D. Nordhaus, 1998, Ed. 6, Tata McGraw Hill Publishing Company Ltd, New Delhi.*

Evaluation Pattern – R.13 & R.16

18OEL262 Micro Finance, Small Group Management and Cooperatives 3 0 0 3

Course contents

Unit 1

Financial institutions for rural development - Basic understanding of rural and development credit. Institutional structure for rural financing in India: policy and schemes of NABARD, recent financing scheme of the Government

Unit 2

Development of cooperative banks in India with special reference to PACS, CCBs, LDBs. Rural financing through commercial banks - Policies and objectives before and after nationalization of banks, Branch expansion policy and programmes.

Unit 3

Emergence of RRBs policy, objectives, functions, progress and achievements. Micro finance at small group level: concept, emergence, objectives and thrust areas. Case studies of recent success stories.

Unit 4

Management of small groups, cluster and federation from credit and trade perspectives. Role of facilitating agencies. Linkages between small group and Banks.

Unit 5

Convergence of with development programmes and implementing departments of government. Withdrawal strategy for facilitating organizations.

SUGGESTED READINGS:

1. V S Somnath – Microfinance, Excel Books

2 Panda - Understanding Microfinance, Wiley India

1. Craig Churchill & Cheryl Frankiewicz - Making Microfinance Work, International Labour Office Publication.

Learning Outcomes: This course acquaint students with the various institutional arrangements as well as recent contribution of various innovative credit systems at the micro-level for financing rural development sector; (b) management of small groups involved in micro-finance for social and economic empowerment of their group members in particular and the society in general.

Evaluation Pattern – R.13 & R.16

18OEL263 Negotiation and Counselling 3 0 0 3

Course contents

Unit 1

Negotiation: Nature, Characteristics, Strategy and Tactics of Distributive Bargaining, Strategy and Tactics of Integrative Negotiation; Strategy and Planning for Negotiation.

Unit 2

Negotiation Sub processes: Perception, Cognition and Emotion Communication: What is communicated during negotiation and how people communicate in Negotiation.

Unit 3

Best Practices in Negotiation – Fundamental Structure of negotiation and BATNA. Case I - Role Negotiation at Bokaro Steel Plant (Understanding Organizational Behaviour. By Udai Pareek, Oxford, Second Edition Page 410-415).

Unit 4

International and Cross Cultural Negotiation: Context and Concept, Influence of Culture on Negotiation: Case II - The Dabhol Debacle (Negotiation Made Simple, SL Rao, Excel Books pp.30-35 and pp. 196-197).

Unit 5

Emergence & Growth of Counselling: Factors contributing to the emergence,
Approaches to Counselling: Behaviouristic, Humanistic Approaches and Rogers Self Theory Counselling Process: Steps in Counselling Process. Modern Trends in Counselling – Trends, Role of a Counsellor and Model of Counselling.

REFERENCE TEXTS:

1. Lewicki, Saunders & Barry – Negotiation, Tata McGraw Hill

2. B.D.Singh - Negotiation Made Simple, Excel Books, 1st Ed.

3. Rao S N - Counseling and Guidance, Tata Mc Graw Hill, 2nd Ed.

4. Singh Kavita - Counselling Skills for Manager, PHI, 1st Ed.

5. Welfel, Patternson - The Counselling Process, A Multi theoretical Integrative Approach, Thomson India, 6th Ed.

6. Pareek Udai - Understanding Organisational Behaviour, Oxford University Press

Learning Outcomess: This course provides knowledge of concepts and issues ofnegotiation and counseling such that to equip the students with valuable skills, techniques and strategies in counseling.

Evaluation Pattern – R.13 & R.16

18OEL264 **New Literatures** **3 0 0 3**

Course contents

Unit 1

Introduction to new literatures, experiments in style, narrative techniques, issues of identity, selfhood and location.

Unit 2 Fiction

Shyam Selvadurai – Cinnamon Gardens
Amitav Ghosh - The Hungry Tide

Unit 3 Poetry

Kamala Das – An Introduction
Derek Walcott – A Far Cry From Africa
Kishwar Naheed – We Sinful Women

Unit 4 Drama

Wole Soyinko – The Road

Unit 5

Assignments, Discussions, Term Test

REFERENCES:

1. *G. H. Mair - English Literature, Discovery Publishing House*
2. *Kamaladas - The Old Playhouse and other Poem, Orient Blackswan*
3. *Derek Walcott - Selected Poems, Farrar, Straus and Giroux Publication*
4. *Judith Wright - Woman to Man, Angus and Robertson Publication*

Learning Outcomes: This course introduces the emergent body of literature; to examine the approach of different writers towards the local and global social issues; to consider how literature undertakes the challenge of rethinking the world around us.

Evaluation Pattern – R.13 & R.16

18OEL265 Non-Profit Organization 3 0 0 3

Course contents

Unit 1

NGOs – An Introduction, Concepts and Functions, evolution in India, Types of non-profits, Issues in NGO Management, challenges of NGO Management.

Unit 2

Legal procedures for establishment of NGOs – Trust and Society and their differences. Formation of Trust and Society. Registration procedure for NGO.

Corporate Social Responsibility and Social Marketing.

Unit 3

Development issues, Development indicators, Poverty (Exploitation, Vulnerability and Powerlessness) and Development. HIV/AIDS, Child labor, Education and Tribal welfare. (This is to increase the level of awareness among students on issues).

Unit 4

Strategy and planning for NGOs – Elements of Strategy, SWOT analysis, Process of Management – Planning, Organization, Delegation, Co-ordination, Core-Competency and Capacity Building

Unit 5

NGOs and changing trends of development. State, market and third sector, Self-Help Group (SHG) and Empowerment of Women, Role of NGOs in Civil Society

REFERENCE BOOKS:

1. *Management of Non -Governmental Organizations towards a Developed Civil Society, JM Ovasdi, ISBN 140392868 1 Macmillan India Lid,2006*
2. *Managing the Nonprofit organizations: Principles and Practices ,Peter F Drucker , ISBN – B*
   : 9780060850049 Harper Collins publishers May 2006
3. *Nonprofit Management: Principles and Practices, Michael, J Worth, The George Washington University, Sage publications, September 2008*

Learning Outcomes: This course introduces the students to NGO Sector; provides an overview of NGOs; introduces the Basic Concepts and provides basic managerial skills for NGO personnel.

Evaluation Pattern – R.13 & R.16

18OEL266 Personal Effectiveness 3 0 0 3

Course contents

Unit 1

Personal growth - Meaning and concepts, Self-awareness and self-esteem, Life Roles, Social roles and Organizational roles. Nature and scope of personal growth. Feeling, thinking and behaviours, Personality theories, Carl Jung's theory of personality types and Myers Briggs Type Indicator test (MBTI), Trait theories - Guilford Peogut, Emotional intelligence.

Unit 2

Pedagogy and Androgogy. Adult Learning Process; learning styles and its relatedness to personality development.

Unit 3

Attitudes, beliefs, Values and their impact on behaviour. Personal change - meaning, nature and requisites. Social adjustments and habit formation. Habits of personal effectiveness. Seven habits of highly effective people.

Unit 4

Basic functions of mind - Creativity and innovation. Blocks to creativity. Creativity processes and tools - convergent and divergent thinking. Neuro Linguistic Programming - Interpersonal relations and personal growth. Interpersonal needs, motivation and behavior - FIRO-B and Johari Window. Defense Mechanism in groups.

Unit 5

Transactional Analysis - Ego states, types of transactions and time structuring. Life position, scripts and game Experience learning methodologies - T-group, sensitivity training, encounter groups and human process labs (students may go through three days personal

growth lab for experiential learning)

REFERENCE BOOKS:

7. *John. W. Newstrom and Keith Davis - Organizational Behaviour: Human Behavior at work, Tata McGraw Hill*
8. *Robert N. Lussier - Human Relations in organizations, Mc-Graw Hill Education*
9. *Whetten & Cameron - Development Management Skills, 7th Ed. Pearson, PHI.*
10. *Calvin S Hall Et Al - Theories of Personality, Wiley Publication*
11. *Stephen R Covey, Simon & Schuster - Seven Habits of Highly Effective People, Simon & Schuster*
12. *Training in Interpersonal Skills – tips for managing People at work, Stephen Robbins, Et al, Pearson, PHI.*

Evaluation Pattern – R.13 & R.16

18OEL267 Perspectives In Astrophysics and Cosmology 3 0 0 3

Course contents

Unit 1

Historical Introduction - Copernicus, Galileo - Solar system-Planets, Comets, meteorites, asteroids, satellites, Constellations and Astrology. Olvers paradox.

Unit 2

Constellations, Distance scales and measurements - Parallax methods - Moving cluster, Statistical and Spectroscopic and dynamic parallax methods.

Unit 3

Introduction to Celestial Mechanics – Kepler's laws. Black body temperature of stars Hertz-Sprung Russel diagram - Stellar evolution - white dwarfs, red giants, neutron stars, pulsars, black holes.

Unit 4

Special Relativity – Minkowski space, Introduction to General Relativity - space-time curvature.

Unit 5

Cosmology - Red shift – Galaxies - CMBR Big bang, Various cosmic models - Horizon and Flatness problem Dark matter and Energy. Anthropic Principle. Relation to Biology.

REFERENCES:

1. Arnab Rai Choudhuri, Astrophysics for Physicists, Cambridge University Press, 2010.

2. An Introduction to Astrophysics, BAIDYANATH BASU, TANUKA CHATTOPADHYAY, 2nd

Edition, PHI Learning Pvt. Ltd.

3. The New Physics and Cosmology Zanjoc, Oxford 2004.

4. An Introduction to Modern Astrophysics, 2nd Ed. by Caroll Ostie, Pearson, Addison Wesley

Evaluation Pattern – R.13 & R.16

18OEL268 Principles of Marketing 3 0 0 3

Course contents

Unit 1

Marketing, Introduction, Definition of market and marketing, Objects of marketing, features, Classification of markets, marketing and selling, Importance of marketing, modern marketing, features, marketing management, characteristics of marketing management, marketing management and sales management, Green Marketing, Market Segmentation and Target Marketing, Marketing mix, definition, elements of marketing mix, Marketing process, marketing functions, functions of exchange, functions of physical supply, facilitating functions.

Unit 2

Marketing Research, market research and marketing research, marketing research and marketing information system, procedure of marketing research.

Unit 3

Product, classification, product policies, product line, product mix, product life cycle, different stages in product life cycle, Pricing, pricing objectives, factors affecting price decisions, price determination procedure, types of pricing.

Unit 4

Promotion, objectives, forms of promotion, sales promotion, tools of sales promotion, advertising, definition, kinds of advertising media, personal selling, features, personal selling process, channels of distribution.

Unit 5

Consumer behaviour: introduction, market analysis, marketing strategy, factors influencing consumer behaviour, individual determinants, external environmental factors affecting consumer behaviour.

TEXTBOOKS:

1. R.S.N. Pillai and Bagavathi – Modern Marketing Principles and Practices, S. Chand.

2. Brahm Canzer – E-Business and Commerce: Strategic Thinking and Practice, Biztantra Publishers, New Delhi

REFERENCE BOOKS:

1. *Martin Khan – Consumer Behaviour, New Age International Publishers*
2. *Philip Kotler – Marketing Management, Prentice Hall of India*
3. *Stephen P Robbins, David A Decenzo – Fundamentals of Management of E–Business, Prentice Hall.*

Learning Outcomes: This course gives exposure to the students about principles of marketing and the knowledge of E-business.

Evaluation Pattern – R.13 & R.16

18OEL269 Principles of Public Relations 3 0 0 3

Course contents

Unit 1
Purpose & Philosophy of PR, What PR Is, Objectives of Public Relations, the Primary Purpose of PR, Hostility, Prejudice, Apathy, Ignorance, Emergence of Public Relations, Public Relations Today, Public Relations and Propaganda, Defining Objectives and Planning a Programme.

Unit 2
Four Steps Public Relations Process, Defining PR Problems, Planning and Programming, Taking action and Communicating, Evaluating the Program, Elements of Public Relations, Human Relations, Empathy, Persuasion, Dialogue, Objectives of Public Relations.

Unit 3
Public Relations as a Profession, Overview, Profession, Codes of Professional Conduct, Functions of Public Relations Department, Policy, Publicity, Product Publicity, Relations with the Government, Community Relations, Shareholders Relations, Promotion Programmes, Donations, Employee Publications, Guest Relations, Establishment of Relations with the Public, The Need for Public Relations, Scope of Public Relations, Professional Code - Public Relations.

Unit 4
Ethics and Challenges of Public Relations, International Public Relations Association (IPRA) Code of Conduct, the European Code of Professional Conduct, All about Marketing, Advertising, Functions of Advertising, PR as a Component of Communication and Strategies, Strategic Management, Theories of Communication, Mass Communication Theory and Research. Functional Approach to Mass Communication Theory, Human Action Approach.

Unit 5 Models of Communication, Communication Models, The advantages ofModels, Limitations of Models, Classical Communication Models, Transmission Model and its

Criticism, Report Writing, Copyright and Other Legal Issues.

REFERENCE BOOKS:

1. Geroge E-Belch & Michael. A. Belch - "Advertising and Promotion", Tata McGraw Hill – Sixth Edition.

2. Kruti shah and Alan D'souza - "Advertising and Promotion", Tata McGraw Hill

3. Tom Duncan - "Principles of Advertising and IMC", Tata McGraw-Hill - Second Edition

Evaluation Pattern – R.13 & R.16

18OEL270 Science, Society and Culture 3 0 0 3

Course contents

Unit 1 The nature of Sociology

The meaning of Sociology: Origin, Definition, Scope, Subject matter, Nature and relation of sociology with other social Sciences. Humanistic orientation to Sociological study.

Unit 2 Basic concepts

Society, community, Institution, Association, Group, Social structure, status and role, Human and Animal Society.

Unit 3 Institutions.

Family and kinship, religion, education, State.

Unit 4 The individual and Society.

Culture, Socialization, Relation between individual and society.

Unit 5 The use of Sociology.

Introduction to applied sociology - Sociology and social problems, Ecology and Environment: Pollution, Global warming and Greenhouse effect. Impact of Industrialization and Urbanization on Environment.

REFERENCE TEXTS:

- *Harlambos, M - Sociology: Themes and perspectives, Oxford University Press.*
- *Inkeles, Alex - What is Sociology, Prentice-Hall of India.*
- *Jaiaram - What is Sociology, Macmillan*
- *Johnson, Harry M, Sociology: A Systematic Introduction, Allied Publishers.*

Learning Outcomes: This course acquaint the students with sociology as asocial science and the distinctiveness of its approach among the social science. It is organized in such a

way that even students without any previous exposure to sociology could acquire an interest in the subject and follow it.

Evaluation Pattern – R.13 & R.16

18OEL271 Statistical Analysis 3 0 0 3

Course contents

Unit 1

Correlation Analysis: meaning and definition - positive correlation - negative correlation - no correlation - scatter diagram - Karl Pearson's correlation co-efficient - interpretation.

Unit 2

Regression Analysis: introduction – uses of regression analysis – regression lines - the two regression equations.

Unit 3

Time series Analysis: meaning – components of time series - methods of estimating trend – graphic method – semi-average method – moving-average method.

Unit 4

Probability: introduction - classical definition- relative frequency theory-subjective approach - Axiomatic approach to probability - Addition theorem - Multiplication theorem - - conditional probability.

Unit 5

Theoretical distributions: discrete and continuous distributions - Binomial distribution – Normal distribution.

REFERENCE BOOKS:

1. *S P Gupta – Statistical Methods, Sultan Chand & Sons, New Delhi.*
2. *Dr.P.R.Vittal &, V.Malini -Statistical and Numerical Methods, Margham Publications; 1 edition (2012)*

Learning Outcomes: This course help the students to understand the concepts of statistical analysis and to apply the results in real life business problems.

Evaluation Pattern – R.13 & R.16

18OEL272 Teamwork and Collaboration 2 0 1 3

Course contents

Unit 1

Leadership – Meaning, Concepts and Myths about Leadership, Components of Leadership - Leader, Followers and situation. Assessing Leadership & Measuring Its effects.

Unit 2

Focus on the Leader – Power and Influence; Leadership and Values. Leadership Traits; Leadership Behaviour; Contingency Theories of Leadership; Leadership and Change.

Unit 3

Groups, Teams and Their Leadership. Groups – Nature, Group Size, Stages of Group Development, Group Roles, Group Norms, Group Cohesion.

Unit 4

Teams – Effective Team Characteristics and Team Building, Ginnetts Team Effectiveness Leadership Model.

Unit 5

Leadership Skills – Basic Leadership Skills, Building Technical Competency, Advanced Leadership Skills, Team Building for Work Teams, Building High Performance Teams.

REFERENCE TEXTS:

1. *Hughes, Ginnett, Curphy - Leadership, Enhancing The Lessons of Experience, Tata McGraw Hill, 5th Ed.*
2. *Yukl G - Leadership in Organisations, Pearson, 6th Ed.*
3. *West Michael - Effective Team Work, Excel Books, 1st Ed.*
4. *Sadler Philip – Leadership, Crest Publishing House*

Evaluation Pattern – R.13 & R.16

18OEL273 The Message of Bhagavad Gita 3 0 0 3

Course contents

Unit 1

Introduction: Background of the Bhagavad Gita – The Epic of Mahabharatha.

Arjuna Vishada Yoga: Scene at Kurukshetra – Arjuna's anguish and confusion.

Symbolism of the war within – Psychological analysis of the human condition.

Unit 2

Sankhya Yoga: Importance of Self-knowledge. Body–Mind-Intellect Chart, Concept of Pancha Kosas, Concept of Vasanas. Nature of the Self–Indestructibility of Consciousness.

Unit 3

Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Concept of Swadharma

Unit 4

Sthitaprajna: Qualities of a person established in wisdom. Dynamics of the Three Gunas: Tamas, Rajas, Sattva – Going Beyond the Three Gunas – Description of a Gunatheetha.

Unit 5

Other topics: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence. Yoga of Devotion – Form and Formless Aspects of the Divine – Inner Qualities of a True Devotee.

TEXTBOOKS/ REFERENCES:

1. Swami Chinmayananda, "The Holy Geeta", Central Chinmaya Mission Trust, 2002.

2. Eknath Easwaran, "The Bhagavad Gita", Nilgiri Press, 2007.

Evaluation Pattern – R.13 & R.16

18OEL274 Understanding Travel and Tourism 3 0 0 3

Course contents

Unit 1 Growth and Development of Tourism

Tourism as an ancient phenomenon - pleasure travel - religion as a motivator Industrial revolution and development of tourism. Effects of Great World Wars on transport system - advent of jet and high speed trains. Causes of rapid growth - meaning, nature and components of tourism-basic travel motivations.

Unit 2 Need for Organization - factors influencing types of organization - theNational tourist organization - tourist organization in India - International organization of Tourism International Union on Official Travel Organization (IUOTO) - World tourism Organization (WTO) – Pacific Area Travel Association (PATA) – International Air Transport Association(IATA) – American Society of Travel Agents (ASTA).

Unit 3 Measurement of Tourism

Need for measuring tourism phenomenon - methods of measurement - importance of tourist statistics - types of tourist statistics. Definition of the terms tourist, domestic tourism and international tourism - tourism planning and development - planning for tourism. Assessment of tourist demand and supply - basic infrastructure - financial planning - human resources planning - tourism marketing - environmental and regional planning.

Unit 4 Tourism and Economic Development

Economic and social significance of tourism - economic benefits - multiplier effect - infrastructure development - regional development – employment opportunities - cultural tourism - international understanding.

Unit 5 Role of travel agencies in tourism

Thomas Cook and organization of travel - introduction of railway and air travel - travel

agency - tour operator, Need for legislation - travel agencies in India – TAA.

TEXTBOOKS:

1. Vara V V Prasad - Travel and Tourism Management, Excel books

2. Ghosh, Biswanath – Tourism and Travel Management, Vikas Publishing House

REFERENCES:

- *Douglas Foster – Travel and Tourism Management, Palgrave MacMillan*
- *B S Badan, Harish Bhatt – Travel Agencies and Tourism Management, Common Wealth Publishers*

Learning Outcomes: This course helps to create a basic knowledge on the growth and development of tourism and to have understanding of various national and international tourism organizations.

Evaluation Pattern – R.13 & R.16

18OEL275 Videography 1 0 2 3

Course contents

Unit 1

Fundamentals of TV production techniques; Principle of video; TV camera, components of camera lens, basic shots and its composition, sound and lighting and its types, special effects,

Unit 2

Lighting for television - types of lights, Three point and Multi-point lighting; Sound - Types of microphones and characteristics of sound; Sound recording - tape and tapeless;

Unit 3

Stages of TV programmes - pre-production, rehearsal and set-up, actual production and post-production, graphics-CG and VG, animation, ENG-DSNG and OB broadcasting.

Unit 4

Type of editing - Assemble and Insert; Modes of editing - Online, Offline, Linea and Non – linear type software's and graphics early.

Unit 5

W riting for television - script writing - genres of TV programmes - news, documentary, talk shows, panel discussion, quiz, current affairs and special audience programmes - women, children, youth - post production, reviews, sports, musical and dance programmes, phone-in programmes.

BOOKSRECOMMENDED:

1. *Allan Wurtzel: Television Production*
2. *Zettl Herbert: Television Production*
3. *Gerald Millerson: The Technique of Television Production*
4. *Hartwig, Robert: Basic TV Technology, digital and Analog*
5. *Chattedji P.C: Broadcast News*
6. *John Watkinson: An Introduction to Digital Video*

Evaluation Pattern – R.13 & R.16

18OEL276 Vistas of English Literature 3 0 0 3

Course contents

Unit 1

1 Introduction – What literature is – enjoyment of literature – Holding a mirror to life – Ages of literature – Different literatures

2 WH Auden – The Unknown Citizen

Unit 2

3 Rabindranath Tagore – The Child

4 RK Narayan – Sweets for Angels

5 Toru Dutt – Lakshman

Unit 3

6 Jane Austen – Pride and Prejudice (Chapter 1)

7 Sarojini Naidu – The Queen

8 AG Gardiner – A Fellow Traveller

Unit 4

9 Shakespeare – Macbeth: The Murder Scene

10 Oliver Goldsmith – The Man in Black

Unit 5

11 Robert Browning – My Last Duchess

Evaluation Pattern – R.13 & R.16

18OEL277 Web-Designing Techniques 1 0 2 3

Course contents

Unit 1

Introduction to web technologies, How the website works?, Client and Server scripting languages, Difference between a web designer and web developer, Types of websites (Static and Dynamic), Web standards and W3C recommendations.

Unit 2

HTML: Introduction to Internet, Understanding Browsers, Starting with HTML, HTML Page Structure. Defining Web Layout(Head & Body), Head Tags, BODY tag with Background color, Background with image and text color. Text formatting, Text attributes. Importance of heading tags (H1–H6). Marquee text with or without background, Blink the text attributes. Divide section using <HR> line with width, align, size.
Knowing Images format for web: Working with images, Images attributes. Working with Tables: Table attributes, Colspan, Rowspan, Table Border, Align, Valign, Table background image, color to cell, Nesting tables.

Unit 3

Using list: Ordered list, Unordered list. Working with Links: Internal Links, External Links, Anchor Link, Email Link, Linking with text, Links with images. Working with controls. Working with forms: knowing get and post action.

Unit 4

CSS: Introduction to Cascading Style Sheets, Types of Style Sheets , Class Selector, ID Selector, Absolute Relative Positioning, Inline menu, DIV + CSS Layout Design, PSD to CSS Conversion.

Unit 5

JavaScript: Introduction to JavaScript, Understanding variables & functions, Working with alert, confirm and prompt, Understanding loop, arrays, Creating rollover image, Working with operators.

TEXTBOOK/ REFERENCES:

1. *Ivan Bayross - Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP, BPB Publicationa*
2. *Dionysios Synodinos, Michael Bowers, Victor Sumner - Pro HTML 5 and CSS 3 Design Patterns, Springer India Publication*
3. *Jennifer Niederst Robbins - Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, Shroff Publishers*
4. *David Pitt - Modern Web Essentials Using JavaScript and HTML5, InfoQ Publications*

Evaluation Pattern – R.13 & R.16

18OEL278 Organic Farming 1 0 2 3

Course contents

Unit I

Introduction to Organic farming: Definition, Basic principles of Organic farming, Chemical intensive farming versus Organic farming, Advantages and disadvantages.

Organic inputs: Advantages of using organic inputs, Organic manures, Biofertilizers, Biopesticides, Organic growth promoters, Biocontrol agents.

Unit II

Basics of Organic Vegetable cultivation: Selection of varieties, seeds or seedlings, Liming of soil, Potting mixture preparation and filling of grow-bags/pots, Precautions during planting and transplanting, Details of Organic inputs required for cultivation and its application methods, 100 day schedule for organic vegetable farmers, Nutrient management and Plant protection measures.

Unit III

Land reclamation using green manuring crops: Soil degradation due to chemical fertilizers, Crops used for green manuring, Benefits, ITK used by farmers in plant growth and protection.

Assessing the quality of organic inputs: Quality of organic manures, Analysis-agencies involved

Quality standards, Governance and Legal Institutions Involved in Organic certification.

Unit IV

Introduction to organic livestock production: Conventional farming versus Organic livestock production, Principles of Organic livestock production.

Safe egg and meat production in homesteads: Selection of suitable poultry breeds, Housing requirements, Feeding management, Care and management, Vaccination and other routine medicines, Safe withholding periods, Common diseases and their management.

Unit V

Safe fish production in Homesteads: Homestead fish farming methods, Location specific models, Stepwise Installation procedure, Species selection, Feeding and management, Culture-Package of Practice, Harvesting, storage and marketing.

Storage and Value addition of excess produce: Refrigerated storage, Drying and dehydration, Pickles, Jam, Squash preparation, Home recipes.

Reference Books:

1. Palaniappan, Annadurai - Organic Farming: Theory and Practice, Scientific Publishers Journals Dept
2. Amitava Rakshit, HB Singh – ABC of Organaic Farming, Jain Brothers Publication
3. B. Subrahmanyeswari Mahesh Chander – Organic Livestock Farming, ICAR Publication
4. Handbook of Fishers and Aquaculture – ICAR Publication

Evaluation Pattern – R.13 & R.16

18OEL279 Basic Legal Awareness on Protection of Women and Rights 3 0 0 3

Course contents

Unit 1

Introduction/Overview: The meaning of law, social security legislations, free legal aid to the poor, Indian Evidence Act, various modes of dispute settlement mechanisms- Lok Adalats, Family Courts, Mahila Courts, Crime Against Women Cells, NCW, NHRC, State Commissions.

Women and the Constitution: Fundamental Rights, Constitutional Remedies (Writs), Electoral Law, Voting Rights for Women, participation in Panchayats and governance.

Unit 2

Women & Family Laws: Marriage Law, Separation, Divorce, Maintenance, Adoption, Right to Property and Succession, Guardianship, unmarried mother and the legitimacy of her children.

Unit 3

Criminal Law and Women: Major offences against women, Women in Custody- Arrest, grounds of arrest, kinds of offences (bailable and non-bailable), arrest warrant, powers of police, rights of arrested persons including the right to bail, the immediate procedure to be adopted in case of violation of rights.

Unit 4

Procedure in Action: Procedure for seeking redressal, Complaints to Police Station, Courts, Lok Adalat.

Unit 5

Rights under different laws: Rights at work place Equal Remuneration / Minimum Wages Act / Rights under Factories Act, Maternity Benefit Act, Mines and Plantation Act, Rules of work - in such specific areas, Sexual harassment at work place, Reproductive Health Rights - Foeticide, Infanticide, Preconception and Prenatal Diagnostic Techniques (Prohibition of Sex Selection) Act 1994, The Medical Termination of Pregnancy Act 1971.

Learning Outcomes: This course gives the students a basic awareness on Women's rights and the legal frame work for the protection of their rights.

Evaluation Pattern – R.13 & R.16

18OEL280 Ritual Performances of Kerala 3 0 0 3

Course contents

Unit 1

Introduction: Kerala – Land and People – social structure – Agrarian society – Kerala society today.

Meta Physical World: mythology and religion and its relation to the festivals and rituals of

Kerala – special reference to Kali.

Padayani: Legend behind the dance ritual – description of performances – musical instruments and music of Padayani – rhythm of Padayani songs. Main Kolams in Padayani: – its artistic features of making marks – drawing on arecanut sheaths. Dance in Padayani: different Kolams and its dance features. Padayani as a Performance, Devotional Aspects, Eminent artists of this dance form.

Unit 2

Mudiyettu: Geographical area of Mudiyettu – land and people – main centers of performances – a complete folk drama – myth behind Mudiyettu – Kali – Darika fight – scenes in Mudiyettu and its contents. Characters in Mudiyettu**:** Naradan, Darikan, Danavendran, Kali, Kooli, Koimbadaran. Abhinaya in Mudiyettu**:** Aangikam, Vachikam, Aaharyam. Rituals in Mudiyettu: Mudiyettu itself is a ritual – ritual inside Mudiyettu – drawing of Kolam, Kolam Pooja, uzhiyal, etc. Devotional aspects of Mudiyettu.

Unit 3

Teyyam: Kolathunad – land and people – folk religion of Kolathunad and its features. Deities in Teyyam: Hindu Gods and Goddesses – heroine cult – deities defied after death – family deity – caste deity – local deity. Teyyam as a Ritual Performance – principles of bringing down deities – appease – bringing down – sending back. Ritual Acts: kodiyila vangal, kodiyila tottam, tottam/ vellattam, teyyam, mudiyazhikkal. Features of Tottam Songs – varavili, tottam songs – mumbsthanam. Ornaments and Decorations of Teyyam – thalachamayam kaikkaru, arachamayam kaikkaru. Mukhattezhuttu and Mekkezhuttu. Devotional Aspects of Teyyam.

Comparative aspects of Padayani, Mudiyettu and Teyyam – theme, decorative elements and form, dance, enactment, faith and other aspects.

REFERENCE BOOKS:

1. *Kadammanitta Vasudevan Pillai, 'Palayile Kolangal', Kerala Bhasha Institute.*
2. *Kadammanitta Vasudevan Pillai, 'Padayani'.*
3. *Chummar Chhondal, 'Mudiyettu'.*
4. *M V Vishnu Namboodiri, 'Teyyam', D C Books, Kottayam.*
5. *Raghavan Payyanad, 'Methodology for Folkloristics', English Dept., Farook College, Farook, 2013.*
6. *C Achutha Menon, 'Keralathile Kali Seva', Madras University, 1943.*
7. *M D Raghavan, 'Folk plays and Dances of Kerala'.*
8. *Sreedhara Menon, 'Cultural History of Kerala'.*

Learning Outcomes: This course provides an overall view of Ritual Performances of Kerala in general and 'Padayani', 'Mudiyettu' and 'Theyyam' performances in particular. Land, people, social and political system and worldview are the deciding factors of ritual performances. The course gives a clear understanding of these performances and their unique features.

Evaluation Pattern – R.13 & R.16

18OEL281 Documenting Social Issues 3 0 0 3

Course contents

Unit 1

Screening documentary films on various social issues – gender discrimination, women empowerment, dowry, female infanticide and skewed sex ratios, maternal and child care, role of technology in transforming societies, changing caste and class barriers etc. etc.,

Unit 2

Selecting the topic: Migration of labour from other regions to the southern states due to labour shortage and their integration in the society as local youth turn away from traditional occupations of their families and go in search of white-collar jobs, alcohol consumption and rising crime, drug addiction among students etc. etc..

Unit 3

Data collection on the ground, interviews and shooting schedule.

Unit 4

Pre-production, production and post-production processes with approval from the guide.

Unit 5

Preview of the film & analysis.

REFERENCES:

1. *Aufderheide, Patricia (1997) Public Intimacy: The Development of First-Person Documentary, New York: Afterimage-Rochester. 25, 16-18.*
2. *Nichols, B. (2010). Introduction to documentary. Indiana University Press.*
3. *Rosenthal, Alan (1990) Writing, Directing, and Producing Documentary Films and Videos. Carbondale: Southern Illinois University Press.*
4. *Walker, J., & Waldman, D. (1999). Feminism and Documentary. University of Minnesota Press*

FILMS:

5. *Flaherty, Robert J (1922) Nanook of the North*
6. *Kauffman, R., and Briski, Z. (2005). Born into brothels. ThinkFilm.*
7. *Srinivasan, R R (2009) En Peyar Palaru*
8. *Srinivasan; R R (2000) Nadhiyin Maranam*

Learning Outcomes: Upon completion of this course, the student will be able to write the script and shoot a documentary film of 5-10 minutes, highlighting a key issue.

Evaluation Pattern – R.13 & R.16

18OEL282 Fabrication of Advanced Solar Cell 3 0 0 3

Course contents

Unit 1

The Solar Resource and types of solar energy converters, Requirements of an ideal photoconverter, Principles of a solar cell design, material and design issues; Revisions of

Semiconductor Physics, Physics of semiconductor Junctions; p-n junction under dark and under illumination, effect on junction characteristics, Other device structures. Photovoltaic cell and power generation, Characteristic of the Photovoltaic Cell.

Unit 2

Silicon Solar cell, Mono -crystalline and poly–crystalline cells, Metallurgical Grade Si, Electronic Grade Si, wafer production, Mono–crystalline Si Ingots, Poly–crystalline Si Ingots, Si–wafers, Si–sheets, Solar grade Silicon, Si usage in solar PV, Commercial Si solar cells, process flow of commercial Si cell technology, Process in solar cell technologies, Sawing and surface texturing, diffusion process, thin film layers, Metal contact.

Unit 3

2nd generation solar cell, Thin film solar cell,Advantage of thin film, Thin film deposition techniques, Evaporation, Sputtering, LPCVD and APCVD, Plasma Enhanced, Hot Wire CVD, closed space sublimation, Ion Assisted Deposition, Substrate and Super-state configuration, Thin film module manufacturing, Thin film and Amorphous Si Solar cell, Cadmium Telluride Solar Cell, CIGS solar Cell, CZTS solar cell, New materials for thin film solar cell.

Optics in solar energy conversion: antireflection coatings, concentration of light: Light confinement, photon recycling, multiple exciton generation.

Unit 4

3rd generation Solar cell; **Advances in Photovoltaics**, Photochemical and photosynthetic energy conversion; DSSC,, Solution processed thin film, Organic Solar Cell, Hydride Perovskite solar cell and multi junction tandem solar cells;

Solar PV modules: Series and Parallel connections, Mismatch between cell and module, Design and structure, PV module power output, PV system configuration, standalone system with DC / AC load with and without battery, Hybrid system, Grid connected systems.

Unit 5

Hand on experience on solar cell fabrication, DSSC fabrication, Perovskite solar cell fabrication, Thin-film solar cell fabrication.

TEXTBOOKS/ REFERENCES:

1. Physics of Solar cells-Jenny Nelson, Imperial College Press (2006)

2. Crystalline Silicon Solar Cells, by A. Goetzberger, J. Knobloc h, and B. Voss (Wiley, 1998)

3. Third Generation Photovoltaics: Advanced Solar Energy Conversion, by M. A. Green (Springer, 2006)

4. Semiconductor Materials for Solar Photovoltaic Cells; Paranthaman, M.P. (et al.) (Eds.) (2016)

Evaluation Pattern – R.13 & R.16

18OEL283 Basic Concepts of X-Ray Diffraction 3 0 0 3

Course contents

Unit 1
The geometry of the crystalline structure
Unit 2
X-RAY BASICS
The scattering of X-rays, Diffraction from a crystal
X-ray interaction with matter, X-ray sources, X-ray optics, X-ray detectors

Unit 3
X-RAYDIFFRACTOMETERS
High-ResolutionDiffractometers
Powder Diffractometers
Unit 4
Experimental Collection of Diffraction Data
The factors affecting the X-ray intensities
Unit 5
Determination of Space group and crystal structures
Accuracy and refinement process
REFERENCES:
1. Emil Zolotoyabko; Basic Concepts of X-Ray Diffraction; John Wiley & Sons, 21-Apr-2014 - Science
2. M. M. Woolfson; An Introduction to X-ray Crystallography; Cambridge University Press
3. Werner Massa; Crystal Structure Determination; (March 31, 2004) ISBN-10: 3540206442

Evaluation Pattern – R.13 & R.16

18OEL284 Introduction to Fortran and Gnuplot 3 0 0 3

Course contents

Unit 1 Introduction
Introduction to Computing, Basic Fortran, Data Types, Constants and Variables, Naming Convention. Operation and Intrinsic Functions, Expressions and Assignment Statements, Logical Operators and Logical Expression.

Unit 2 Control Statements and I/O
IF statement and construct, nested if statement, GOTO, Case Construct, Do Loop, nested do

loop, do while loop. Fortran I/O and External Files, Formatted Output, Formatted Input, File Processing.

Unit 3 Subroutines and Functions

Defining and referring subroutine and function, arguments, conditions on arguments, Dummy arguments or parameters and actual arguments, Scope of variables.

Unit 4 Arrays

Arrays and elements, Array properties, Array storage, Whole array assignment, Array section assignment, Array Operations, Array Processing, Mask Array, Allocatable Arrays, Functions Return Arrays.

Unit 5 Gnuplot

Introduction to gnuplot,function plot, data plot, analyse a function, various options in gnuplot, Scientific Graphic Library, Linking Fortran Programs to gnuplot Graphic Library.

TEXTBOOK:

Stephen J. Chapman, "Fortran 95/2003 for Scientists and Engineers", McGraw-Hill (3rd edition).

REFERENCES:

1. Michael Metcalf and John Reid, "Fortran 90/95 Explained", Oxford University Press (2007).

2. Jeanne C. Adams, Walter S. Brainerd, Richard A. Hendrickson, Richard E. Maine, Jeanne T. Martin and Brian T. Smith, "The Fortran 2003 Handbook", Springer (2009).

3. Michael Metcalf, John Reid and Malcolm Cohen, "Modern Fortran Explained", Oxford University Press (2011).

4. William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery, "Numerical Recipes in Fortran Vol. 1 & 2", Cambridge University Press (1996).

5. Documentation given with gnuplot software (2015).

6. Lee Phillips, "gnuplot Cookbook", Packt Publishing (2012).

Evaluation Pattern – R.13 & R.16

18OEL285 Introduction to Porous Materials 3 0 0 3

Course contents

Unit 1 General introduction to porous materials

Introduction to porous materials, Classification based on the pore size: microporous materials, mesoporous materials and nanoporous materials; Classification based on materials: Zeolites, Transition metal oxides, Metal organic frame works and types-new era of porous materials.

Unit 2 Metal organic frameworks, Mesoporous materials and Zeolites

Introduction, significance of metal organic frameworks, covalent organic frame works and

their evolving applications at lab scale and industrial scale. Zeolites: Definitions, Structure, Chemical composition and Types, Mesoporous Materials: SBA-15, MCM-41

Unit 3 Characterization of porous materials

Introduction to adsorption, classification-physical and chemical adsorption, surface area, factors affecting the surface area, gas adsorption for surface area analysis, adsorption isotherms and their classification, Langmuir and BET adsorption isotherms, pore analysis: calculation of pore size and pore volume, mercury porosimetry.

Unit 4 Synthesis of porous materials

Sol-Gel Processing for synthesis of porous materials**:** factors affecting the sol gel process, xerogels and aerogels, Template based methods for the synthesis of porous materials: Brief introduction to the synthesis of porous materials like MCM 41 and SBA 15 and hydrothermal methods for the synthesis of MOFs and zeolites

Unit 5 Applications

Applications of mesoporous materials in catalysis, gas adsorption and drug delivery; importance of zeolites in petroleum industry, application of MOFs

REFERENCE BOOKS:

1. *Lowel, S., Shields, J. E., Thomas, M. A., Thommes, M., Characterization of Porous Solids and Powders: Surface area, Pore size and Density; SpringerPublications, 2004.*
2. *Liu, P.S., Chen, G.F., Porous Materials: Processing and Applications, First Edition, Elsevier Publications, 2014.*
3. *Ishizaki, K., Komarneni, S., Nanko, M., Porous Materials Processing Technology and Applications, First Edition, Springer Publications, 1998.*
4. *Kickelbick, G., (editor) Hybrid Materials: Synthesis, Characterization and Applications; First Edition, Wiley-VCH, 2007*
5. *Bruce, D.W., O'Hare, D., Walton, R.I.,(editors) Porous Materials (Inorganic materials series) First Edition, John Wiley and Sons, 2011*

Evaluation Pattern – R.13 & R.16

18OEL286 Forensic Science 3 0 0 3

Course contents

Unit 1 Introduction

Origin of forensic science, need for forensic science, trace and contact evidence, marks and impression, examination of documents, blood stain analysis, microscope in analysis, explosives, chemical analysis of explosives, forensic laboratories and courses in India.

Unit 2 Narcotics

Narcotics, classification of drugs, specific drugs- Psychotropic drugs, chemical screening of drugs, chemical extraction and sample preparation, chemical identification of drugs using analytical methods.

Unit 3 Fingerprinting and Firearm Analysis

History of fingerprinting, principles of fingerprinting, constituents of latent finger marks, fingerprint detection, chemical methods of detection, firearm examination, chemical analysis of firearm, analysis of gunshot residue.

Unit 4 Toxicology

Introduction to Toxicology, alcohol and human body, testing of blood alcohol concentration, Toxins & Biological Poisons, Measuring Toxicity as LD50, sample and analysis, inorganic poisons, nerve agents, radioactive toxins, Pharmacokinetics and Toxicokinetics, tests for toxins, reported case studies.

Unit 5 Postmortem Toxicology

Introduction, tissue and fluid specimens, specimen collection and storage, extraction procedure, analytical techniques, interpretation, case studies.

REFERENCE BOOKS:

5. *Lawrence Kobilinsky, Forensic Chemistry Handbook, John Wiley & Sons, New Jersey, 2012*
6. *David E. Newton, Forensic Chemistry, Facts On File, Inc, New York, 2007*
7. *Jay A. Siegel, Forensic Chemistry fundamentals and applications, Wiley Blackwell.*
8. *Suzanne Bell, Drugs, Poisons, and Chemistry, Facts On File, Inc. New York, 2009.*

Evaluation Pattern – R.13 & R.16

18OEL287 Introduction to Solar Physics 3 0 0 3

Course contents

Unit 1 Sun

Solar parameters: Mass, Radius, Distance and Luminosity, Spectral energy distribution, Construction of a Model, Conservation law, Equation of State, Nuclear Energy Source and Energy transport, Chemical composition of the Sun.

Unit 2 Tools for Solar Observation

High-Resolution Telescope, Spectrographs and Spectrometers, Filters and Monochromators, Polarimetry, Special purpose Instruments.

Unit 3 Sun's Oscillations and Rotations:

Linear Adiabatic Oscillations of Non-Rotating Sun, Helioseismology, Excitation and Damping, The Angular Velocity of Sun, Models of Rotating Convection Zone.

Unit 4 Magnetic properties of Sun:

Fields and Conducting Matter, Flux tubes, Sunspots and Solar Cycle.

Unit 5 Chromosphere, Corona and Solar Wind
Empirical Facts, Consequence of High Temperature, Outer Atmosphere, Energy Balance, Explosive Events.
TEXTBOOK:
The Sun: An Introduction second edition by Michael Stix

18OEL288 Recycling, Recovery and Treatment Methods For Wastes 3 0 0 3

Course contents

Unit 1 Biowaste
Agrowaste - Biopesticide from solid waste, biomass to bioethanol, biowaste as carbon source, other applications of agrowaste.

Animal waste – bio-digestor - generation of renewable energy, biogas from animal waste-daily consumption, Equipment sizing and design.

Food waste-management, anaerobic digestion of food waste – kitchen waste composting.

Unit 2 Plastic & Rubber
Recycling plastic fibre and packaging waste – methods of recycling – Erema Process, Erema vented process for recycling plastics.

Recycling of rubber – Devulcanisation - thermal, mechanical and microbial process - characterization of devulcanized rubber - products from rubber waste.

Pyrolysis of plastics and rubber - Catalytic process of treatment- plastic waste to fuel, oil and wax.

Unit 3 Utilized Products recycling
Paper recycling - types of paper, Mechanical and chemical re-pulping,

Glass waste - bottle recycling, cullet recycling, process in glass recycling

Metals - Iron & steel, iron & steel remanufacturing, Aluminium remanufacturing

Unit 4 Electronic waste
Electronic wastes – printed circuit board, monitors and batteries, Processing - hydrometallurgical and pyrometallurgical route. Recovery of heavy metals from electronic waste.

Unit 5 Biomedical & Hazardous Waste
Biomedical waste and its category, Treatment - autoclaving, shredding, deep burial & chemical treatment of biomedical waste

Radioactive waste – Nuclear waste type and source, long lived and short lived radionuclide,

treatment of radioactive waste - immobilization-cement based material for disposal of waste.

REFERENCES:

1. Thomas H. Christensen, Solid Waste Technology & Management, Vol.1, Blackwell Publishing Ltd, 2011.

2. Elena Cristina Rada, Biological Treatment Of Solid Waste, CRC press, 2016.

3. Martin Forrest, Recycling and Re-use of Waste Rubber, Smithers Rapra Technology Ltd, 2014.

4. Jonathan W.-C. Wong, Rajeshwar D. Tyagi, Ashok Pandey, Current Developments in Biotechnology and Bioengineering, Elsevier, 2017.

5. John scheirs and Walter kaminsky, Feedstock Recycling and Pyrolysis of Waste Plastics, John Wiley & Sons Ltd, 2006.

6. Ramesha Chandrappa, Diganta Bhusan Das, Solid Waste Management: Principles and Practice, Springer, 2012.

7. Shinya Nagasaki, Shinichi Nakayama, Radioactive Waste Engineering and Management, springer, 2011.

8. Ronald E. Hester, Roy M. Harrison, Electronic Waste Management, RSC publishing, 2009.

9. Hugo Marcelo Veit, Andréa Moura, Electronic Waste: Recycling Techniques, springer, 2015.

10. Lifeng Zhang, Gregory K. Krumdick, Recycling of Electronic Waste II: Proceedings of the Second Symposium, John Wiley & Sons, Inc, 2011.

Evaluation Pattern – R.13 & R.16

18OEL289 Acting and Dramatic Presentation 2 0 2 3

Course contents

Unit 1

Rasa theory in Bharata's Natyasastra. Classical theatre in India.

Practical: Warming-up exercises - Relaxation Exercises.

Unit 2

Greek drama and dramatic theories. Use of masks.

Practical: Voice modulation - Breath control.

Unit 3

Shakespearean theatre.

Practical: Practice in Monologues - Training in articulation of emotions through dramatic speech.

Unit 4

20th century theatre. Stanislavskian method, and Brechtian epic theatre.

Practical: Developing body and facial expressions in drama - Articulating narratives through body movements - Building up a repertoire of gestures.

Unit 5

Theatre semiotics and dramaturgy.

Practical: Building up units of action to create a Theatrical Ensemble - Plotting movements

of different characters within a scene.

TEXTBOOK:

The Semiotics of Theatre and Drama by Keir Elam

REFERENCES:

1. *Theatre as Sign System: A Semiotics of Text and Performance By Elaine Aston, George Savona*
2. *Theatre Semiotics: Text and Staging in Modern Theatre By Fernando de Toro*
3. *Acting For Real: Drama Therapy Process, Technique, And Performance By Renee Emunah*
4. *Natyasastra by sage Bharata.*

Learning Outcomes: This course will help the students to cultivate communication skills through teaching of theory and skills of theatre and Dramatics.

Evaluation Pattern – R.13 & R.16

18OEL290 Computerised Accounting 2 0 2 3

Course contents

Unit 1

Business, meaning, Book Keeping, Accounting – meaning, functions and importance and objectives – users of accounting – branches of accounting – accounting terminologies – Accounting Concepts and Conventions – Accounting Standards in India, Accounting Systems – Double Entry System and Single Entry System – Account – types of accounts – Rules for Debit and Credit – Accounting Equation – Journal – Journal entries – journalizing – compound entries – Banking transactions.

Unit 2

Sub Divisions of Journal or Subsidiary Books: Advantages of Subsidiary Books and limitations of journal – Purchase Day Book – Purchase Returns Book – Sales Book – Sales Returns Book – Cash Book – Petty Cash Book – Imprest System.

Ledger: Meaning and importance – preparation of ledger accounts or posting – balancing an account – account balance – Trial Balance – objectives and functions of trial balance.

Unit 3

Final Accounts: Trading and Profit and Loss Accounts, Balance Sheet – simple adjustments like outstanding expenses, prepaid expenses, bad debts, accrued income, unearned income.

Depreciation: Meaning and definition – causes of depreciation – need for depreciation – Fixed Installment Method and Diminishing Balance Method.

Unit 4

Getting started with Tally – Company information - Tally accounting - Chart of accounts – Ledgers and Groups - financial and trading vouchers – Voucher creation and entry.

Unit 5

Tally Inventory – inventory vouchers - Display and reporting – reporting and printing

Reference Books:

1. *Goyal and Ruchi Goyal – Financial Accounting, Prentice Hall India*

2. *Jain and Narang – Advanced Accounts Volume 1, Kalyani Publishers*
3. *Tally for everyone – Roopa, Add to Cart Publishing*
4. *Nadhani – Tally ERP 9 Training Guide – BPB Publication*

Learning Outcomes: The course will provide an understanding of the Accounting practices including the final accounts, inventory keeping practices, financial reporting and printing. Tally is proposed to be used as the mail tool.

Evaluation Pattern – R.13 & R.16

18OEL291 **Kerala Mural Art and Painting** **2 0 2 3**

Course contents

Unit 1 Introduction, history and evaluation, preparation method of pigments.

Unit 2 Technical details, methods and techniques of wall preparation, preparation of the colors and brushes.

Unit 3 Basics of mural drawing and traditional style, drawing anatomy and study of mural style.

Unit 4 Basics of mural painting.

Unit 5 Mural painting in acrylic colours, drawing and painting.

ReferenceBooks:
1. *Chithrasoothram - Translated by K.K. Warrier.*
2. *Chithralakshanam - K.K Warrier.*

Learning Outcomes: This course provides knowledge and traning of Mural painting through the theory and practical workshop.

Evaluation Pattern – R.13 & R.16

18OEL292 **Painting** **2 0 2 3**

Course contents

Unit 1
Introduction to Materials and Medium: Water colours, Oil colours, Acrylic colours, Gouache, Oil Pastels and Dry Pastels, Additives and Solvents, Brushes, Paper-types and texture, Canvas types.
Basic sketching with charcoal, pencil and pen.

Unit 2

Watercolour and Gouache Painting - Styles and techniques - wet on wet, wet on dry, ink and pen techniques, painting with water colour pencils, Wash techniques, Layer on Layer technique.

Unit 3

Oil Painting - stretching canvas, surface preparation with gesso; Styles and technique - Wet on wet, wet on dry, impasto, finishing touches.

Unit 4

Acrylic Painting - Acrylic on Paper; Acrylic on canvas, using acrylic retarders and medium, Wet on wet, wet on dry, impasto, finishing touches.

Unit 5

Oil and Dry Pastels, Pastels on Coloured Paper, Pre colouring, hatching and cross hatching, Blending techniques, Fixing techniques.

BOOKS RECOMMENDED:

Reader's Digest - Complete Guide to Drawing and Painting ISBN-10: 0895779560 ISBN-13: 978-0895779564

Learning Outcomes: This course helps in cultivating the artistic skills of students through teaching of theory and skills of painting using different media, techniques and tools.

Evaluation Pattern – R.13 & R.16

18OEL293 Reporting Rural Issues 3 0 0 3

Course contents

Unit 1

Reporting rural India - problems and prospects: Poor connectivity and infrastructure, electrification and drinking water supply, state of primary healthcare centres, growing literacy and education breaking down caste and class barriers

Unit 2

Role of women in rural areas, gender discrimination, female infanticide and patriarchy, women role models who have asserted themselves in social, political and economic life of the society overcoming all odds and helped breakdown social barriers.

Unit 3

Government development programmes for rural areas. Are they reaching the intended beneficiaries? Success and failure stories, women empowerment and youth upliftment programs.

Unit 4

Agriculture – shrinking areas under cultivation, drying irrigation sources, high cost of inputs, labour shortage and rising wages. Need to ensure fair prices for the farmers' produce by setting up agro-industries and cold storage chains in rural areas and introducing appropriate

technology.

Unit 5

Role of media in highlighting rural issues so that authorities in the cities take note and take remedial measures.

REFERENCES:

1. *Bang, R., Khorgade, S., and Chinai, R (2010) Putting Women First: Women and Health in a Rural Community. New Delhi: Stree and Samya.*
2. *Fukuoka, M. (2009). The One-Straw Revolution: An Introduction to Natural Farming. New York: Review of Books.*
3. *Patra, S.C., and Vachhani, A. (2012). Socio Economic Profile of Rural India: Series II, Volume II: North East India (Assam, Manipur, Tripura and Nagaland). New Delhi: Concept Publishing.*
4. *Patil, D.A. (2010). Communication for Rural Development in India: From Green Revolution to 'E' Revolution. New Delhi: Serials Publications*
5. *Pokharapurkar, R. (1993). Rural Development Through Community Television (CISCED). New Delhi: Concept Publishing*
6. *Islam, N. (2006). Reducing Rural Poverty in Asia: Challenges and Opportunities for Microenterprises and Public Employment Schemes. New York, London, Oxford: Food Products Press*

VIDEOS:

The Noer

Faces of Prestea

Hotville Alabama

WEB REFERENCES:

http://www.un.org/en/ecosoc/docs/pdfs/an_integrated_approach_to_rural_development.pdf

http://www.epw.in/frontpage?0=ip_login_no_cache%3D4806b5974dc3439b9a9343b7b5674286

http://www.worldbank.org/en/news/feature/2012/05/17/india-agriculture-issues-priorities

https://www.youtube.com/watch?v=eCBIcWAwOds

Learning Outcomes: This course gives information about the news coverage of rural areas, issues ranging from health, education and civic amenities to government welfare schemes and the state of agriculture with farming losing its sheen among rural youth and resultant urban migration. New trends like mechanization of farming due to shortage of labour, the growth of self-help groups and mushrooming cottage industries, changes in the social and political life of the rural communities, inter-caste and class dynamics and how technological penetration is changing rural life and aspirations, success stories, best practices in farming, growing consumerism and its impact on environment, rural businesses and innovations.

Evaluation Pattern – R.13 & R.16

18OEL294 **A Study of Traditional Indian Paintings** **1 0 2 3**

Course contents

Unit 1

Introduction to Indian Arts: Architecture, Painting, Sculpture, Dance, Music and theatre

Theoretical introduction to Traditional Indian miniature, mural, scroll paintings and decorative.
Theoretical introduction to Ritualistic paintings

Unit 2
Introduction to Traditional Kerala Mural paintings: Theoretical, conceptual and contextual framework of Kerala Mural paintings. Colours, Forms and historic and mythological contexts. Surface preparation. Painting in Kerala Mural- from the textual narrative to execution

Unit 3
Introduction to Cheriyal Scroll paintings: Theoretical, conceptual and contextual framework of Cheriyal paintings. Colours, Forms and historic and mythological contexts. Surface preparation. Painting in Cheriyal style- from the textual narrative to execution.

Unit 4
Introduction to Pahari paintings: Theoretical, conceptual and contextual framework of Cheriyal paintings. Colours, Forms and historic and mythological contexts. Surface preparation. Painting in Cheriyal style- from the textual narrative to execution.

Unit 5
Introduction to traditional Madubani paintings: Theoretical, conceptual and contextual framework of Madhubani paintings. Colours, Forms and historic and mythological contexts. Surface preparation. Painting in Madhubani style- from the textual narrative to execution.

Text book
a) BN Goswamy - The Spirit of Indian Painting

Reference books
a) Bernard S. Myers - Encyclopaedia of Painting: Painters and Painting of the World from Prehistoric Times to the Present Day
b) Partha Mitter - Indian Art (Oxford History of Art)
c) Sherman E. Lee, George Montgomery - Rajput Painting

Evaluation Pattern – R.13 & R.16

18OEL297 HISTORY AND PHILOSOPHY OF SCIENCE 3 0 0 3

Course contents

Unit 1
Why History of Science? Astronomy in the ancient world - people, theory and instruments (4 hours) - Astronomy across civilizations of the old world, main discoveries, their contribution and instruments during those times.

Unit 2
The Dark ages in Europe - the Arabian influence - The Islamic science, translations and original contributions of Arabians, dark ages Europe, logic, literature and scientific method, early universities of Europe.

Unit 3

Indian tradition in Science and Technology - an overview - Indian contributions in science and technology - mathematics, astronomy and other sciences.

Unit 4

Texts that changed the course of history science - Elements of Euclid, Aryabhatiya of Aryabhata, BrahmasputaSidhanta of Brahmagupta, Yuktibhasa of Jyestadeva, PhilosophiaeNatturalis Principia Mathematica.

Unit 5

The Copernican revolution and the rise of modern science - The background of Copernican revolution, interaction between civilizations, the rise of modern sciences - when and why?

Text and Background Literature:

History and philosophy of science is yet to be established as full-fledged discipline. A suggested anthology of reading materials:

1. Essential reading on history of sciences (in-house publication)
2. http://www.Open2.net/whattheancients/ (Documentaries)

Evaluation Pattern – R.13 & R.16

18OEL298 EU HISTORY OF SCIENCE AND TECHNOLOGY 4 0 0 3

Course contents

From Galileo to Einstein, from the split of science and religion to the discovery of machines and computers, science have played a major role in the history of European Union and largely contributed to the place of European Union in the world nowadays.

In this course we will review some major contributions in science and technology made in EU, in particular in Physics, which allowed cultural, philosophical and technical revolutions. We will try to put as best as we can the discovery in their historical context and present elements of biography of the some of the most prominent scientists involved in these discoveries. We will also look at past and present influence, in particular Indian influence on EU science and technology advances. These courses will outreach scientific concept of each discovery for bachelor students in science. The course will follow thematic line, which will be as much as possible historically ordered.

1. The Greek legacy: Eratosthenes, Ptolemy (2h):
    a. Pre-Socratic period: the Pythagoreans school.
    b. Classic period: Plato and Aristotle
    c. Astronomy and Mathematics in the Hellenistic period: Ptolemy, Eratosthenes, Hipparchus, Euclid, Archimedes.
2. Elements of Indian Astronomy and Mathematics and their influence on Europe (6h):
    a. Prehistory: the Vedic period, discoveries in mathematics, astronomy and medicine.
    b. Middle age

    c. Late middle age: science technology transfer with Europe.
3. The scientific revolution at renaissance. (6h)
    a. Copernicus, Galileo, Kepler, Newton: motion in the solar system.
    b. Separation between science and religion.
    c. Technology major inventions: printing technics, navigation instrument: astrolabe, sextant.
4. Thermodynamics and thermal machine and the industrial revolution (6h).
    a. Invention of thermal machine and industrial revolution in Europe.
    b. XVIIe to XVIIIe: the birth of thermodynamic with chemistry and thermal machine
    c. XIXe: Formalization of thermodynamic laws and principles (Carnot, Joule, Clapeyron, Kelvin)
    d. Development of statistical mechanics (Boltzmann, Gibbs)
5. Light, Electricity and electromagnetism:
    a. Coulomb, Maxwell, Ampere (4h)
6. Einstein contribution (Photo electric effect, Relativity, etc.) (2h)
7. Radioactivity: Pierre et Marie Curie (2h).
    a. Introduction on Mendeley and periodic table.
    b. Discovery of Radioactivity
    c. Elements of biography of Marie Curie
8. Discovery of quantum mechanics:
    a. Introduction on black body radiation (Planck), photo electric effect (Einstein) and wave-particle duality.
    b. The Copenhagen interpretation: Bohr, Heisenberg, Pauli, Planck
9. Technology discovery in the context of the 2nd world war (4h)
    a. Nuclear energy
    b. Turing machine
    c. Jet engine
10. A few remarkable recent advances in quantum mechanics (4h):
    a. Violation of Bell's inequalities (A. Aspect)
    b. Mesoscopic physics and quantum Circuits
    c. Cold atoms (C. Cohen Tannoudji)
    d. Quantum material: Graphene, topological insulators.

Evaluation Pattern – R.13 & R.16