KANNUR UNIVERSITY

(Abstract)

B.Sc Polymer Chemistry-Scheme & syllabus of Core Courses (I&II Semesters only) under Choice Based Credit Semester System for Under Graduate Programme-implemented with effect from 2009 admission-Orders Issued.

ACADEMIC BRANCH

No.Acad/C2/754/2007 (2) Dated, K.U.Campus. P.O,10- 07-2009.

Read: 1.Minutes of the meeting of the Board of Studies in Chemistry (UG) held on 25-05-2009.

2. Minutes of the meeting of the Faculty of Science held on 16-06-2009.

3. U.O No.Acad/C2/3838/2008 (i) dated 07-07-2009

4. Letter dated 03-07-2009 from the Chairman, BOS in Chemistry (UG).

ORDER

1.The Board of Studies in Chemistry (UG) vide paper read(1) above has prepared, finalized and recommended the Scheme and Syllabus of Core Courses for B.Sc Polymer Chemistry Programme under Choice Based Credit Semester System for implementation from 2009 admission.

2. The recommendations of the Board in restructuring the syllabus is considered by the Faculty of Science vide paper read (2) and recommended for the approval of the Academic Council.

3. The Regulations for Choice based Credit Semester System is implemented in this University vide paper read (3).

4. The Chairman, BOS in Chemistry (UG), vide paper (4) above forwarded the restructured Scheme and Syllabus of Core Courses (I &II Semesters only) for B.Sc Polymer Chemistry Programme under Choice Based Credit Semester System, prepared by the Board of Studies in Chemistry (UG) for implementation with effect from 2009 admission.

5. The Vice Chancellor, after examining the matter in detail, and in exercise of the powers of the Academic Council as per section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction ***to implement the scheme and syllabus of Core Courses (I &II Semesters only) for B.Sc Polymer Chemistry Programme restructured in line with Choice Based Credit Semester System,with effect from 2009 admission***, subject to ratification by the Academic Council.

6. The restructured scheme and syllabus of Core Courses(I &II Semesters only) for B.Sc Polymer Chemistry Programme under Choice Based Credit Semester System, implemented with effect from 2009 admission is appended.

7. The Scheme and Syllabus of Complementary Courses offered for this Programme will be available along with the syllabus of Core Courses of the Complementary subject.

8. The affiliated Colleges are not permitted to offer Complementary Courses in violation to the provisional/permanent affiliation granted by the University. Changes in Complementary Courses are permitted with prior sanction /revision in the affiliation order already issued in this regard.

9. If there is any inconsistency between the Regulations for CCSS and its application to the Scheme & Syllabus prepared, the former shall prevail.

10. Orders are issued accordingly.

Sd/-

To: REGISTRAR

1. The Principals of Colleges offering B.Sc Polymer Chemistry Programme
2. The Examination Branch (through PA to CE)

Copy To:

1. The Chairman, BOS Chemistry (UG)
2. PS to VC/PA to PVC/PA to Regr
3. DR/AR I Academic
4. Central Library 5. SF/DF/FC.

Forwarded/By Order

SECTION OFFICER

Appendix to U.O No Acad/C2/754/2007(2) dated 10-07-2009.

K A N NU R U N I V E R S I T Y

COURSE STRUCTURE

&

SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

IN

POLYMER CHEMISTRY

CORE COURSES

UNDER

CHOICE BASED CREDIT SEMESTER SYSTEM

w.e.f 2009 ADMISSION

COURSE STRUCTURE FOR UG PROGRAMME
POLYMER CHEMISTRY

SEMESTER 1

No	Title of the Course	Hours /week	Credits
1	Common Course I (English)	5	4
2	Common Course II (English)	4	3
3	Common Course I (Additional Language)	5	4
4	Core Course 1	3	3
5	Complementary 1 (Course I)	4	2
7	Complementary 2 (Course I)	4	3

SEMESTER 2

No	Title of the Course	Hours/week	Credits
1	Common Course III (English)	5	4
2	Common Course IV (English)	4	3
3	Common Course II (Additional Language)	5	4
4	Core Course 2	3	3
6	Complementary 1 (Course II)	4	2
8	Complementary 2 (Course II)	4	3

SEMESTER 3

No	Title of the Course	Hours/week	Credits
1	Common Course (General)	3	3
2	Common Course (General)	5	3
3	Core Course 4	3	3
4	Core Course 3, Practical Part I	2	-
5	Core Course 5 Practical II,Part I	2	-
6	Complementary 1 (Course III)	5	2
7	Complementary 2 (Course III)	5	3

SEMESTER 4

No	Title of the Course	Hours/week	Credits
1	Common Course (General)	5	7
2	Common Course (General)	3	3
3	Core Course 6	3	3
4	Core Course 5, Practical Part II	2	2
5	Core Course 3 Practical II, Part I	2	2
6	Complementary 1 (Course IV)	5	2
7	Complementary 2 (Course IV)	5	3

SEMESTER 5

No	Title of the Course	Hours / week	Credit
1	Open Course 1	2	2
2	Core Course 7	5	4
3	Core Course 8	4	4
4	Core Course 9	4	4
5	Core Course 10	5	-
6	Core Course 11	5	-

SEMESTER 6

No	Title of the Course	Hours / week	Credit
1	Open Course 2	2	2
2	Core Course 13	5	4
3	Core Course 14	4	4
4	Core Course 15(Elective)	4	4
5	Core Course 16	5	4
6	Core Course 10& 11 Practical III& IV	5	6
7.	Core Course 12 Project/Industrial Visit	*	4

The distribution of Hour/Credit for Theory/Practical shall be decided by the Board of Studies concerned.

Scheme Common Courses-General (Polymer Chemistry)

No	Semester	Course Code	Title of the Course	Hours / week	Credit
1	III	3A05PCH	Common course- Polymer Chemistry I 1	3	3
2	III	3A06PCH 3A06(A)PCH	Common course -Polymer Chemistry II Common course- Polymer Chemistry II (Practical)	3 2	3 *
3	IV	4A09PCH 4A06(A)PCH	Common course- Polymer Chemistry III Common course - Polymer Chemistry II (Practical)	3 2	3 4
4	IV	4A10PCH	Common course- Polymer Chemistry IV	3	3

Scheme Polymer Chemistry (Core)

No	Semester	Course Code	Title of the Course	Contact Hr/week	Credits
1	I	1B01PCH	Methodology of Polymer chemistry as discipline of science	3	3
2	II	2B02PCH	Theoretical and Inorganic chemistry	3	3
3	III	3B04 CHE	Inorganic chemistry-I	3	3
4	III	3B03PCH	Core course practical Volumetric analysis Part I	2	-
5	III	3B05CHE	Core course practical -I I Inorganic qualitative analysis & preparation part - I	2	-
6	IV	4B06 CHE	Inorganic chemistry-II	3	3
7	IV	4B05 CHE	Core course practical -I I Inorganic qualitative analysis & preparation part – II	2	2
8	IV	4B03PCH	Core course practical Volumetric analysis Part II	2	2
9	V	5B07 CHE	Physical chemistry –I	5	4
10	V	5B08 CHE	Physical methods in chemistry	4	4
11	V	5B09 CHE	Organic chemistry-I	4	4
12	V	5B10 CHE	Core course practical-III Gravimetric analysis	5	-
13	V	5B11 CHE	Core course practical-IV Organic chemistry	5	-
14	V&VI	5B12 CHE	Project /Industrial visit	-	4
15	VI	6B13 CHE	Physical chemistry –II	5	4
16	VI	6B14 CHE	Organic chemistry-II	4	4
17	VI	6B15 CHE	Elective	4	4
18	VI	6B10&11CHE	Core course practicals –III&IV	5	6
19	VI	6B16 CHE	Core course practical Physical chemistry	5	4

Scheme Elective

No	Semester	Course Code	Title of the Course	Contact Hr/week	Credits
1	6	6B15CHE	A. Environmental chemistry	4	4
2	6	6B15CHE	B. Food chemistry	4	4
3	6	6B15CHE	C. Industrial chemistry	4	4
4	6	6B15CHE	D. Synthetic organic chemistry	4	4
5	6	6B15CHE	E. Analytical chemistry	4	4
6	6	6B15CHE	F. Nano materials –synthesis & practice	4	4

Scheme Open Courses

No	Semester	Course Code	Title of the Course	Contact Hr/week	Credits
1	5	5D01CHE	Chemistry in service to Man	2	2
2	5	5D02CHE	Chemistry in everyday life	2	2
3	5	5D03CHE	Environmental Studies	2	2
4	6	6D04CHE	Drugs-Use & Abuse	2	2
5	6	6D05CHE	Food Science	2	2
6	6	6D06CHE	Nano Materials Synthesis & Practice	2	2

The syllabus of Common Courses (General) for III and IV Semesters shall be framed and communicated later. The rest of the Courses offered as Core Courses (Theory) will be the same as that of B.Sc Chemistry Programme.

1B01PCH – Methodology of Polymer Chemistry as a Discipline of Science

Credits-3 **(54 hrs)**

Aim: To illustrate the methodology of science in chemistry

Objectives :

- To have a broad outline of the methodology of science in general and Chemistry in particular.
- To understand the important analytical and instrumental tools used for practicing chemistry.
- To learn computer based presentation and statistical analysis of data using spreadsheet software.
- To apply these skills in the analysis of experimental data in chemistry practical.

Module - 1 **Chemistry as a discipline of Science** **(9 hrs)**

What is Science? Scientific statements, Scientific methods – observation – posing a question – formulation of hypothesis – experiment theory – law. Falsification (disproving) of hypothesis, inductive and deductive reasoning, revision of scientific theories and laws.

Methods of Science as illustrated through the following:

i) Laws of chemical combination – Faradays laws of electrolysis – Daltons atomic theory – atom models – J.J.Thomson, Rutherford, Bohr model and quantum mechanical model of atom.

ii) n-P-V-T relation of gases-gas laws – kinetic molecular theory.

Role of concepts and models in Science.

Evolution of Chemistry – ancient speculations on the nature of matter, early form of chemistry – alchemy, origin of modern chemistry. Structure of chemical science: scope of chemical science, theory and experiment, branches of chemistry. Role of Chemistry as a central science connecting Physics, Biology and other branches of science. Interdisciplinary areas involving Chemistry – Nanotechnology, Biotechnology.

Chemical science in the service of man: Drugs, food, flavouring agents, sweeteners, cosmetics, soaps and detergents, paints, varnishes, textiles, dyes, fertilizers, insecticides, fuels etc. – examples in each.

Methodology of chemistry: Symbols, formulae, Chemical equations, classification (periodic classification of elements, classification of organic compounds into homologous series), Analysis (qualitative and quantitative), preparation, synthesis, manufacture.

References

1. J.A.Lee, Scientific Endeavor, Addison Wesley Longman (chapters 1 and 2)

2. C.N.R. Rao, University Chemistry, Universities Press (India) Pvt. Ltd (Chapters 1 and 2)

Module –2. Research in Science (9 hours)

Selecting a topic – hypothesis – design of experiment: variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results, discussion of results, models. Summary of the scientific methods. Writing Science.

Reference

J.A.Lee, Scientific Endeavor, Addison Wesley Longman (chapters 3, 9 and Appendix 3)

Module-3. Analytical and synthetic methodologies in Chemistry (9 hours)

Titrimetric analysis : Fundamental concepts – mole, molarity, molality, ppm and ppb primary standard – secondary standard, quantitative dilution – problems. Acid base titrations – titration curves – pH indicators. Redox titrations – titration curve – titrations involving MnO_4^- and $Cr_2O_7^{2-}$ - redox indicators. Complexometric titrations – EDTA titrations – titration curves – indicators – **Gravimetric analysis**: Unit operations in gravimetric analysis illustrations using iron and barium estimation. **Synthetic methodologies** – condensation – addition – examples. Separation and purification techniques – Filtration, Crystallization and precipitation – concept of solubility product as applied in group separation of cations – problems. Fractional distillation, Solvent extraction.

References

1. B.R.Puri, L.R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 40).
2. D.A.Skoog, D.M.West and S.R. Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson Chapters 12-17).
3. Vogel's Text book of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd (Chapters 10, 11).
4. G.D.Christian, Analytical Chemistry, John Wiley and Sons (Chapters 5, 7, 8, 16, 17)

Module-4. Data Analysis (9 hours)

Units, significant digits, rounding, scientific and prefix notation, graphing of data – Precision and accuracy – Types of errors – Ways of expressing precision – Ways to reduce systematic errors – reporting analytical data, Statistical treatment of analytical data – population and samples – Mean and standard deviation – distribution of random errors – confidence limits – tests of significance – Correlation and regression – linear regression analysis, calculation of regression coefficients (slope, Intercept) using scientific calculator – methods of least squares.

The following section is non-evaluative for theory examination

Familiarization of software packages for analysis and graphical representation of data – MS Excel, Origin, Open office calc (Physical Chemistry experiments using software packages are included in the 5th and 6th semesters), simulations, virtual experiments, drawing molecular structures using Chemsketch, ISIS Draw.

References

1. B.R. Puri, L.R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 40)
2. J.A.Lee, Scientific Endeavor, Addison Wesley Longman (Appendices 1, 2 and 4)
3. D.A.Skoog, D.M.West and S.R.Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson (Chapters 5-8)
4. Vogel's Text book of Quantitative Chemical Analysis 6th edn, Pearsons Education Ltd (Chapters 4).
5. G.D.Christian, Analytical Chemistry, John Wiley and Sons (Chapters 2)
6. R.Crouch and F.J.Holler, Applications of Microsoft Excel in Analytical S.Chemistry, Brooks/Cole.

Further Reading

1. J.Mills and P.Evans, Core Chemistry, Foundation books Pvt. Ltd, New Delhi (2004)
2. T.F.Gieryn,Cultural boundaries of science, University Chicago Press, 1999.
3. H.Collins and T.Pinch, The Golem, What everyone should know about science, Cambridge University Press, 1993.
4. Hewitt, Paul G, S.Lyons, J.A.Suchocki and J.Yeh, Conceptual Integrated Science, Addison Wesley, 2007.
5. Methods for Teaching Science as Inquiry, Allyn and Bacon, 2009.
6. K.V.S. Sarma, Statistics made simple, Prentice – Hall of India, New Delhi.
7. R.Crouch and F.J.Holler, Applications of Microsoft Excel in Analytical S.Chemistry, Brooks/Cole.
8. R.D.Jarrard, Scientific Methods, jarrad@mines.utah.edu,2001.
9. R.Sangenburg D.K.Moser, History of Science (5 Volumes), Universities Press (India) Ltd.

Module – 5 : Redox Reactions (18 Hours)

Classical concept of Oxidation and Reduction. Electronic concept of oxidation number. Rules for assigning oxidation number. Calculation of oxidation number. Balancing redox reaction – oxidation number method and iron electron method.

References

1. Inorganic chemistry by Puri & Sharma
2. Advanced inorganic chemistry by F.A. Cotton & Wilkinson.

2B02PCH : Theoretical and Inorganic Chemistry

Credits-3 **(54 Hrs)**

Aim

To impart essential theoretical knowledge on atomic structure, periodic properties, chemical bonding, and nuclear chemistry.

Objectives:

- To study the various atom models.
- To understand the important features of the quantum mechanical model of the atom.
- To study the periodic properties of elements.
- To explain the formation of different types of bonds.
- To predict the geometry of simple molecules.
- To explain the different types of hybridisation and draw shapes of simple covalent molecules.
- To understand the molecular orbital theory of diatomic molecules.
- To develop interest in various branches of inorganic chemistry.
- To study nuclear models and nuclear reactions.

Module – 1. **Atomic Structure** **(10 Hrs)**

Bohr model of hydrogen atom, Bohr's equation for the energy of electron in hydrogen atom, the hydrogen spectrum, limitations of Bohr theory, photoelectric effect, idea of de Broglie matter waves, Heisenberg's uncertainty principle and its significance, Schrodinger wave equation (derivation not expected), wave functions, significance of Ψ (psi) and Ψ^2, atomic orbitals, Nodal planes in atomic orbitals, quantum numbers (n, l, m), Zeeman effect, Stern-Gerlac experiment, spin quantum number(s), shapes of s, p and d orbitals. Aufbau and Pauli's exclusion principles, Hund's rule, energy level diagram of a multielectron atom, concept of effective nuclear charge, Slater's rules and applications, Electronic configuration of atoms.

References

1. J.D.Lee, Concise Inorganic Chemistry, 5th edn, Blackwell Science, London (Chapter 1)
2. B.R.Puri, L.R.Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 1).
3. C.N.R.Rao, University General Chemistry, Macmillan, 3rd edn., John Wiley 2001 (Chapter 1).
4. F.A.Cotton, G.Wilkinson and P.L.Gans, Basic Inorganic Chemistry, 3rd edn., John Wiley (Chapter 2).
5. D.F.Shriver and P.W.Atkins, Inorganic Chemistry, 3rd edn., Oxford University Press (Chapter 1).

6. B.Douglas, D.Me Daniel, John Alexander, Concepts and models in Inorganic Chemistry (Chapter 1).

Module – 2. Chemical Bonding (16 hrs)

Ionic bond – nature of ionic bond, properties of ionic compounds, radius ratio and coordination number, factors favouring the formation of ionic compounds. Lattice energy, Born-Lande equation with derivation, factors affecting lattice enthalpy, Born-Haber cycle and its applications, solvation enthalpy and solubility of ionic compounds.

Covalent bond – valence bond theory and its limitations, concept of resonance, resonance energy, hybridisation and shapes of simple molecules (BeF_2, PCI_3, SF_6, CH_4, Ethane, ethene and ethyne) VSEPR theory, shapes of molecules and ions (NH_3, XeF_6, CIF_3, NH_4^+, H_3O^+). Molecular orbital theory – LCAO method, molecular orbital energy diagram and properties of homo and hetero diatomic molecules (N_2, O_2, CO and NO), bond strength and bond energy. Polarisation of covalent bond, polarising power and polarisability of ions, Fajan's rule.

Dipole moment and molecular structure – percentage ionic character from dipole moment.

Metallic bonding – free electron theory, valence bond theory and band theory, explanation of metallic properties based on these theories.

Weak chemical forces – hydrogen bond, inter and intra molecular hydrogen bonds, effects of hydrogen bonding, van der Waals forces.

References

1. J.D.Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London (Chapter 2-5).
2. B.R.Puri, L.R.Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 4, 5).
3. C.N.R.Rao, University General Chemistry, Macmillan 3rd edn., John Wiley, 2001 (Chapter 3)
4. F.A.Cotton, G.Wilkinson and P.L.Gans, Basic Inorganic Chemistry, 3rd edn., John Wiley (Chapter 3, 4).
5. D.F.Shriver and P.W.Atkins, Inorganic Chemistry, 3rd edn., Oxford University Press (Chapter 2, 3).

Module 3 :Nuclear Chemistry (10 Hrs)

Nuclear particles, nuclear forces, nuclear size, nuclear density, stability of nucleus, binding energy, magic numbers, packing fraction, n/p ratio. Nuclear models – liquid drop model and shell model.

Natural radioactivity, modes of decay, decay constant, half life period, average life, radioactive equilibrium, Geiger-Nuttal rule, units of radioactivity, radiation dosage.

Induced radioactivity, nuclear reactions induced by charged projectiles, neutrons and γ rays fission reactions, fusion reactions, spallation reactions, preparation of transuranic elements, Q values of nuclear reactions. Fertile and fissile isotopes, chain reaction, stellar energy.

References

1. B.R.Puri, L.R.Sharma, Kalia Principles of Inorganic Chemsitry, Milestone Publishers, New Delhi (Chapter 38).
2. H.J.Arnikar, Essentials of Nuclear Chemistry, New Age International (Chapter 3 –5).
3. R.Gopalan, Elements of Nuclear Chemistry, Vikas, Publ. House.

Further Reading

1. J.E.Huheey, E.A.Keiter, R.L.Keiter, Inorganic Chemistry, 4th edn., Harper Collins, 1993.
2. G.Wulfsberg, Inorganic Chemistry, Viva Books.
3. W.L.Jolly, Inorganic Chemistry, Ttata Mc Graw Hill.
4. J.D.Lee, New Concise Inorganic Chemistry.
5. M.N.Greenwood and A.Earnshaw, Chemistry of the elements 2nd edn., Butterworth.
6. Manas Chanda, Atomic structure and chemical bonding.
7. H.J.Emeleus, A.G.Sharpe, Modern Aspects of Inorganic Chemistry, Universal Book Stall.
8. J.David Brown, the Chemical Bond in Inorganic Chemistry, Oxford Science Publication.

Module 4: Non aqueous solvents (18 Hours)

Classification of solvents- solubility of various substances. Liquid ammonia-solubility of ironic compounds-solubility of organic compounds-solubility of alkali and alkaline earth metals and its characteristics-solvolysis-reactions in liquid ammonia, liquid sulphurdiaoxide-solubility of substances in liquid sulphurdiaxide. Acid-base and solvolytic reaction-liquid hydrogen fluoride. Behaviour of different substances in liquid hydrogen fluoride. Chemical reactions in liquid hydrogen fluoride.

References

3. Inorganic chemistry by Puri & Sharma
4. Advanced inorganic chemistry by F.A. Cotton & Wilkinson.

Sd/-
Dr.K.Pradeep Kumar,
Chairman, BOS Chemistry (UG).

K A N N U R U N I V E R S I T Y

(Abstract)

B.Sc Polymer Chemistry Programme-Revised scheme & syllabus of General Courses (III & IV Semesters) effective from 2009 admission under Choice based Credit Semester System-Implemented-Orders Issued.

ACADEMIC BRANCH

No.Acad/C2/754/2007 (1) Dated, K.U.Campus. P.O, 08-06-2010.

Read: 1.U.O.No Acad/C2/754/2007(2) dated 10-07-2009.

2. Minutes of the meeting of the Board of Studies in Chemistry(UG) held on 30-10-2009.

3. Letter dated 21-05-2010 from the Chairman, BOS in Chemistry (UG).

O R D E R

1.The Scheme(full) and Syllabus (I and II Semesters only) of B.Sc Polymer Chemistry Programme under Choice based Credit Semester System were implemented in this University with effect from 2009 admission, as per paper read(1) above.

2.The Board of Studies in Chemistry (UG) vide paper read(2) above has recommended to revise the scheme and finalise the syllabus of the General Courses of B.Sc Polymer Chemistry Programme for implementation with effect from 2009 admission.

3. The Chairman, BOS in Chemistry (UG), vide paper read (3) above has forwarded the revised scheme and finalised Syllabus of General Courses (III &IV Semesters) for B.Sc Polymer Chemistry Programme under Choice based Credit Semester System, for implementation with effect from 2009 admission.

4. The Vice Chancellor, after examining the matter in detail, and in exercise of the powers of the Academic Council as per section 11(1) of Kannur University Act 1996 and all other enabling provisions read together with, has accorded sanction ***to implement the revised scheme and syllabus of General Courses (III &IV Semesters) for B.Sc Polymer Chemistry Programme in line with Choice based Credit Semester System, with effect from 2009 admission,*** subject to report to the Academic Council.

5. The syllabus of General Courses (III &IV Semesters) for B.Sc Polymer Chemistry Programme under Choice based Credit Semester System, implemented with effect from 2009 admission are appended.

6.***The rest of the Courses for Polymer Chemistry Programme will be the same as that of B.Sc Chemistry Programme, effective from 2009 admission.***

7.Orders are issued accordingly.

8.The U.O read above stands modified to this extent.

Sd/-

To: REGISTRAR

The Principals of Colleges offering B.Sc Polymer Chemistry Programme

Copy To:

1.The Examination Branch (through PA to CE) Forwarded/By Order

2.The Chairman, BOS Chemistry (UG)

3. PS to VC/PA to PVC/PA to Regr

4.The Computer Programmer(to publish in the website) SECTION OFFICER

5. DR/AR I Academic 6. SF/DF/FC.

Appendix to U.O No Acad/C2/754/2007(1) dated 08-06-2010.

K A N N U R U N I V E R S I T Y

SCHEME
&
SYLLABUS (III to VI Semesters)

FOR

UNDERGRADUATE PROGRAMME

IN

POLYMER CHEMISTRY

CORE/GENERAL COURSES

UNDER

CHOICE BASED CREDIT SEMESTER SYSTEM

w.e.f 2009 ADMISSION

Scheme-Core Course Chemistry (applicable for Polymer Chemistry also)

No	Semester	Course Code	Title of the Course	Contact Hours/week	Credits
1	III	3B04 CHE	Inorganic Chemistry-I	3	3
2	III	3B03CHE	Core Course Practical Volumetric Analysis Part I	2	-
3	III	3B05CHE	Core Course Practical -I I Inorganic Qualitative Analysis & Preparation Part -I	2	-
4	IV	4B06 CHE	Inorganic Chemistry-II	3	3
5	IV	4B05 CHE	Core Course Practical -I I Inorganic Qualitative Analysis & Preparation Part -II	2	2
6	IV	4B03CHE	Core Course Practical Volumetric Analysis Part I	2	2
7	V	5B07 CHE	Physical Chemistry –I	5	4
8	V	5B08 CHE	Physical Methods in Chemistry	4	4
9	V	5B09 CHE	Organic Chemistry-I	4	4
10	V	5B10 CHE	Core Course Practical-III Gravimetric Analysis	5	-
11	V	5B11 CHE	Core Course Practical-IV Organic Chemistry	5	-
12	V	5B12 CHE	Project /Industrial Visit	-	4
13	VI	6B13 CHE	Physical Chemistry –II	5	4
14	VI	6B14 CHE	Organic Chemistry-II	4	4
15	VI	6B15 CHE	Elective	4	4
16	VI	6B10&11CHE	Core Course Practicals –III&IV	5	6
17	VI	6B16 CHE	Core Course Practical- Physical Chemistry	5	4

Scheme Common (General) Courses

No	Semester	Course Code	Title of the Course	Hours / week	Credit
1	III	3A05PCH	Polymer Chemistry I	3	3
2	III	3A06PCH	Polymer Chemistry II	3	3
3	III	3A06(A)PCH	Polymer Chemistry II (Practical)	2	*
4	IV	4A09PCH	Polymer Chemistry III	3	3
5	IV	4A06(A)PCH	Polymer Chemistry II (Practical)	2	4
6	IV	4A10PCH	Polymer Chemistry IV	3	3

3A05PCH POLYMER CHEMISTRY I

Credits:3 **Total Hours :54**

Module-1 Introduction to Polymers (10 hrs)

Basic concepts- historical development- Present status-Classification of polymers-Nomenclature- Natural and synthetic polymers- Organic and inorganic polymers-Thermoplastics and thermo sets- Plastics,elastomers, fibers and liquid resins-Addition polymers and condensation polymers-Homopolymers and copolymers- linear, branched and cross linked polymers-graft and block co-polymers-characteristic features of each.
Basic concept of monomers-Functionality.

Module-2 Molecular weight of Polymers(12 hrs)

Importance of molecular weight control-arithmetic mean – Number average, weight average, Viscosity average- Polydispersity and PDI-Molecular weight distribution in polymers and its importance from the point of application – Degree of polymerization-Molecular weight and mechanical properties.

Module-3 Molecular forces and chemical bonding in Polymers(10 hrs)

Crystallinity and amorphous behavior of polymers- Tacticity in polymers-Isotactic, syndiotactic and atactic polymers- Thermal transition in polymers- T_g and T_m – Thermal transitions and associated properties-Determination of Tg-Dilatometric method, Calorimetric method – Glass transition temperature and molecular weight – Importance of T_g – Plasticizers and their action. Secondary bonding forces that exist in polymers.

Module-4 Polymer Solutions (08 hrs)

Criteria of solubility of polymers-Thermodynamics of polymer dissolution- effect of molecular weight on solubility – polymer fractionation – Fractional precipitation technique – Partial dissolution technique – Gel permeation chromatography-Gradient elution technique.

Module-5 Techniques of Polymerization (14 hrs)

Bulk polymerization – Solution polymerization – Suspension polymerization – Emulsion polymerization – Advantages and disadvantages of these techniques – comparison of the above. Batch and continuous process.

3A06PCH POLYMER CHEMISTRY II

Credits:3 **Total Hours :54**

Module-1 Characterization of Polymers (10 hrs)

Molecular weight determination – Method based on colligative property measurements – cryoscopy –ebullioscopy –osmometry –membrane osmometry –vapour-pressure osmometry –Methods based on viscosity. Measurements –viscometry –Light scattering method –ultracentrifuge technique –End group analysis –GPC method.

Thermal methods of analysis in polymers – TGA, DTA, DSC.

Module-2 Chemistry of Polymerization (10 hrs)

Addition polymerization –Free radical polymerization –Initiation, Propagation and termination –inhibitors and retarders.

Ionic polymerization –cationic and anionic –Living polymers. Co-ordination polymerization –Zeigler –Natta catalysts.

Condensation polymerization –Extend of reaction and DP –Carother's equation and its significance. Three dimensional polymerization –cross linking –gel point –Ring scission polymerization.

Module-3 Kinetics of Polymerization (10 hrs)

Kinetics of free-radical polymerization –Kinetic chain length and DP. Derivation for rate expression and expression for kinetic chain length and hence degree of polymerization. Kinetics of polycondensation with polyester as example. Simple kinetic expression – catalised and uncatalised polycodensation.

Module-4 Natural Polymers (10 hrs)

Natural rubber –Structure and properties of NR –trans-poly –isoprene –Cellulose – Cellulose based polymers –Cotton, Rayon –Nitrocellulose –cellulose acetate. Shellac, Casein.

Module-5 Inorganic Polymers (14 hrs)

General properties –classification –Boron based polymers – Borazine, Polymeric boron nitride –Phosphorous based polymers –Polyphophonitrilic chloride –polyphosphoric acids –phosphorous based net work polymers –Silicon based polymers – Organotinpolymers .

Reference Books:

1. A text Book of Polymer Science –F.W.Billmeyer.
2. Polymer Science –V.R. Gowariker, N.V.Viswanathan, J.Sreedhar
3. Principles of Polymer Chemistry –P.J.Flory
4. Rubber Technology –Maurice Morton
5. Plastic materials-J.A.Brydson
6. Macromolecules-H.G.Elias
7. Principles of Polymerization –G.Odian
8. Polymer Science and Technology –Joel R. Fried
9. Polymer Chemistry –Raymon B Sepmour
10. Principles of polymerization-F.Rooriquez

4A09PCH POLYMER CHEMISTRY III

Credits:3 **Total Hours :54**

Module-1 Commercial Polymers (10 hrs)

Plastics –Thermoplastics and themosets: Manufacture, properties and applications of the following plastics - LDPE, HDPE, Polypropylene, Polystyrene PVC, PMMA, PAN, Polyacrylic acid, Polymethacrylic acid. Polyamides –Nylon 6.6 and Nylon 6. Aromatic polyamides –Nomex, Kevlar. Polyesters –PET. Unsaturated polyesters. Polycarbonates –Acetal resins –Polysulphones –PPO –Phenolic resins –Novalac formation –Resole formation. Urea – formaldehyde, Melamine – formaldehyde resins.

Module-2 Synthetic Rubbers (10 hrs)

Manufacture, general properties and applications of SBR, Polyisoprene, Polybutadiene, Butyl rubber, Ethylene –propylene rubber, Neoprene rubber, Speciality rubbers: Silicon rubbers, Nitrile rubbers, Polyacrylic rubbers –Polyurethane rubbers –Hypalon –Fluorocarbon elastomers –Thermoplastic elastomer,reclaimed rubber,foam rubber.

Module-3 Polymer Degradation (15 hrs)

Type of degradation – Thermal degradation –factors effecting thermal stability –Polymer degradation involving substituent groups – mechanical degradation –Photodegradation –Photostabilizers –Degradation by high energy radiation Oxidative degradation –antioxidants.

Module-4 Plastic Processing (19 hrs)

Basic principles of processing –shape and size –processing parameters –their effects and behavior –Rheology of ideal fluids and polymers. Polymer compounding –additives –filers, Plasticizers, antioxidants, Flame retardants, stabilizers, colourants etc.

Process techniques: Injection moulding, Compression moulding, Transfer moulding, Blow moulding, Extrusion moulding Rotational moulding, Calendering, Foaming, Laminating.Coating, Casting, Spinning and Thermoforming.

4A10PCH POLYMER CHEMISTRY IV

Credits:3 **Total Hours :5**

Module-1 Latex Technology (15 hrs)

Rubber latex –Latex processing – Preserved field latex-Latex concentration by processes like centrifuging and creaming –Preparation of Ribbed Smoked Sheets – Technically specified forms of rubber –Superior processing rubbers –Latex compounding –additives used – manufacture techniques of rubber goods from latex –dipping –casting and moulding –Latex form rubber.

Rubber processing –Mastication –Additives used in rubber compounding Rubber fabrication –Mixing –two roll mill –Internal mixers –calendaring moulding – extrusion.

Vulcanization –Sulphur vulcanization and non –sulphur vulcanization. Unique properties of Rubber.

Module-2 Testing of Polymers and Polymer products. (15 hrs)

Need for testing, Need for Standards and specification –National and International standards –Organizations like ASTM, BIS, BS, DIN, ISO etc.

Mechanical properties: Short term strengths – Tensile properties, compression properties, flexural properties, shear properties, Impact resistance, toughness, tear resistance, abrasion resistance and hardness.,scorch and cure rate.

Long term strength –m dynamic stress and strain properties and their measurements –creep, stress relaxation fatigue properties, flexing and resilience.

Module-3 Special Topics in Polymer Science (24 hrs)

Blends/Alloys –Composites –Examples and application in engineering, biochemical, agriculture, defense and aerospace.

Specialty polymers –Biopolymers, Conducting polymers, engineering polymers–applications. Pollution ,hazards in rubber industry and their control.

Plastic Waste management –Chemical recycling –incineration –Pyrolysis –mixed waste recycling –value addition and application development for recycled materials.

Reference Books:

1. A text Book of Polymer Science –F.W.Billmeyer.
2. Polymer Science –V.R. Gowariker, N.V.Viswanathan, J.Sreedhar
3. Principles of Polymer Chemistry –P.J.Flory
4. Rubber Technology –Maurice Morton
5. Rubber Technology and manufacuture. –C.M.Blow
6. Synthetic rubbers. –D.C. Blackley
7. Plastic materials –J.A.Brydson
8. Hand book of rubber Test method –R.P.Brown
9. Hand book of plastic Test method - R.P.Brown
10. High performance Polymers, their origin and development –Seymour R.B.Klrschenbaun, G.S.Elsevier.
11. Principles of polymerization-F.Rooriquez.

3A06(A)PCH POLYMER CHEMISTRY – PRACTICAL

Credits:0 **Total Hours :36**

1.Identification of Plastic and Rubbers (10 samples)

2.Preparation of Polymer – PMMA, Nylon6, 6., Polystyrene by mass polymerization, Polystyrene by Pearl polymerization, Polyacrylamide by Free radical polymerization, Polyacrylamide by Redox polymerization, Polyaniline, Phenol – formaldehyde resin, Urea-formaldehyde resin, Aniline – formaldehyde resin.

4A06(A)PCH POLYMER CHEMISTRY – PRACTICAL

Credits:4 **Total Hours :36**

1. Latex Analysis –Determination of Dry Rubber Content, Total solid content, Ammonia Content, pH of latex.

2. Relative Viscosity measurement of Polymer solutions

3. Analysis and estimation of phenolic group by bromination method.

MODEL QUESTION PAPER

3A06(A)PCH& 4A06(A)PCH Polymer Chemistry Practical

Time : 4 Hrs

Credit :4

Instruction: Candidate should submit bonafide record at the time of examination

1. Write in the first 5 minutes, in the separate sheet of paper provided a brief outline of the procedure you would adopt for the ……..

2. Analyse systematically and qualitatively the given uncompounded polymer sample and identify it. Submit a report of the procedure and tests adopted for identification.

3. Convert the given …….monomer to …….....

(Styrene to poly styrene / Methyl methacrylate to PMMA)

Submit the whole of the product for inspection.

4. Estimate the percentage(W/W)of ammonia in the given sample of Rubber Latex. You are supplied with analar Sodium carbonate and an approximately 0.1N Solution of Hydrochloric Acid.

Sd/-
Dr.K.Pradeep Kumar,
Chairman, BOS Chemistry (UG).