MAHATMA GANDHI UNIVERSITY

INTEGRATED M.Sc PROGRAMME IN BASIC SCIENCES – CHEMISTRY

PROGRAMME STRUCTURE AND SYLLABUS

INTERGRATED MSc CHEMISTRY

MEST	Course Code	Theory / Practical	Title of Course	Teaching hours /Week	Credi	Total hours	al Credits for semest
I	IEN1CC01	T	English I – Communication Skills in English	5	4	90	19
	ICH1CR02	T	Elementary to Research in Chemistry - I	2	2	36	
	ICH1CR03	T	Basic level in Inorganic Chemistry	4	3	72	
	ICH1CR04	T	Basic level in Theoretical and Analytical Chemistry	4	3	72	
	ICH1CM05	T	Mathematics I – Partial Differentiation, Matrices, Trogonometry and Probability	4	3	72	
	ICH1CM06	T	Physics I – Properties of Matter and Semiconducting Materials	2	2	36	
	ICH1CP07	P	Volumetric Analysis - I	2	2	36	
	ICH1CMP08	P	Physics Practical – I	2	0	36	
II	IML2CC01/IHN2CC01	T	Malayalam – Katha,Kavitha,Athmakatha / Hindi – Katha and Kavitha	5	4	90	21
	ICH2CR02	T	Elementary to Research in Chemistry - II	2	2	36	
	ICH2CR03	T	Basic level in Organic Chemistry	4	3	72	
	ICH2CR04	T	Basic level in Physical Chemistry	4	3	72	
	ICH2CM05	T	Mathematics II – Integral Calculus and Differential Equations	4	3	72	
	ICH2CM06	T	Physics II – Mechanics and Relativity	2	2	36	
	ICH2CP07	P	Volumetric Analysis - II	2	2	36	
	ICH2CMP08	P	Physics Practical – I	2	2	36	
	ICH3CR01	T	Inorganic Chemistry - I	5	4	90	
	ICH3CR02	T	Organic Chemistry - I	4	3	72	
	ICH3CR03	T	Physical Chemistry - I	4	3	72	

III	ICH3CM04	T	Mathematics III – Partial Differential Equations, Abstract Algebra and Analytic Geometry	5	4	90	**19**
	ICH3CM05	T	Physics III – Modern Physics ,Electrodynamics and Transducers	3	3	54	
	ICH3CP06	P	Qualitative Inorganic Analysis - I	2	2	36	
	ICH3CMP07	P	Physics Practical – II	2	0	36	
IV	IEN4CC01	T	Common English - II	5	4	90	**21**
	ICH4CR02	T	Analytical Chemistry	4	3	72	
	ICH4CR03	T	Green Chemistry	4	3	72	
	ICH4CM04	T	Mathematics IV – Fourier Series,Laplace Transformations, Vector Functions and Complex Analysis	5	4	90	
	ICH4CM05	T	Physics IV – Optics,Dielectrics and Spectroscopic Instrumentation	3	3	54	
	ICH4CP06	P	Qualitative Inorganic Analysis - II	2	2	36	
	ICH4CMP07	P	Physics Practical - II	2	2	36	
V	ICH5CR01	T	Environmental Studies & Human Rights	5	4	90	**20**
	ICH5CR02	T	Inorganic Chemistry - II	4	3	72	
	ICH5CR03	T	Organic Chemistry - II	4	3	72	
	ICH5CR04	T	Physical Chemistry - II	4	3	72	
	ICH5CR05	T	Physical Chemistry - III	4	3	72	
	ICH5CP06	P	Gravimetric Analysis	2	2	36	
	ICH5CP07	P	Organic Analysis	2	2	36	
VI	ICH6CR01	T	Inorganic Chemistry - III	4	3	72	**20**
	ICH6CR02	T	Organic Chemistry - III	4	3	72	
	ICH6CR03	T	Organic Chemistry - IV	4	2	72	
	ICH6CR04	T	Physical Chemistry - IV	4	2	72	
	ICH6ELA1/2	T	Elective I	5	4	90	
	ICH6CP05	P	Physical chemistry experiments	2	2	36	
	ICH6CP06	P	Preparation and Purification Methods of Organic Compounds.	2	2	36	

	ICH6PR07		Project (Minor)		2		
VII	ICH7CR01	T	Advanced Inorganic Chemistry -I	5	5	90	**20**
	ICH7CR02	T	Advanced Theoretical Chemistry & Computational Chemistry	4	4	72	
	ICH7CR03	T	Advanced Organic Chemistry -I	4	4	72	
	ICH7CR04	T	Advanced Physical Chemistry - I	4	3	72	
	ICH7CP05	P	Inorganic Chemistry Practicals - I	4	2	72	
	ICH7CP06	P	Organic Chemistry Practicals - I	4	2	72	
VIII	ICH8CR01	T	Advanced Inorganic Chemistry - II	4	4	72	**20**
	ICH8CR02	T	Advanced Organic Chemistry -II	5	5	90	
	ICH8CR03	T	Advanced Physical Chemistry - II	4	4	72	
	ICH8ELB1/2	T	Elective 2	4	3	72	
	ICH8CP04	P	Physical chemistry Practicals	4	2	72	
	ICH8CP05	P	Instrumental methods of Analysis	4	2	72	
IX	ICH9CR01	T	Advanced Inorganic Chemistry -III	4	4	72	**20**
	ICH9CR02	T	Advanced Organic Chemistry -III	4	4	72	
	ICH9CR03	T	Advanced Physical Chemistry - III	5	5	90	
	ICH9ELC1/2	T	Elective 3	4	3	72	
	ICH9CP04	P	Inorganic Chemistry Practicals - II	4	2	72	
	ICH9CP05	P	Organic Chemistry Practicals - II	4	2	72	
X	ICHXPR01		Project (Major)	25	16	450	**20**
	ICHXVV02		Comprehensive viva		4		

Elective I - Bunch A

ICH6ELA1 - Forensic Science

ICH6ELA2 - Polymer Science

Elective I - Bunch B

ICH8ELB1 - Nanochemistry

ICH8ELB2 - Pharmaceutical Chemistry

Elective 3 - Bunch B

ICH9ELC1 - Chemical Biology

ICH9ELC2 - Food Science & Technology

Course	Details				
Code	**ICH1CR02**				
Title	**Elementary to Research in Chemistry - I**				
Degree	**Integrated M.Sc. in Basic Sciences- Chemistry**				
Branch(s)	**Basic Sciences- Chemistry**				
Year/Semester	**I/I**				
Type	**Core**				
Credits	**2**	**Hrs/Week**	**2**	**Total Hours**	**36**

Specific Objectives	To introduce the importance of Chemistry as a Central Science, its scope in research & everyday life
Course Outcomes	Ensures the students • to understand the importance of Chemistry as central Science • to identify and analyse the applications of chemistry in different fields of life. • to understand, to apply and to evaluate the different aspects that comes with doing research. • to understand and to apply the lab safety methodology of research in chemistry

Module	Course Description	Hrs
1.0	**Evolution of Chemistry as Central Science**	**6**
1.1	Evolution of Chemistry - ancient speculations on the nature of matter, early form of chemistry-alchemy, Robert Boyle and the origins of modern chemistry in the latter 1600s - Antoine Lavoisier and the revolution in chemistry -Chemical atomism—background and thought of John Dalton.	6

	Atom models- Daltons, J. J. Thomson, Rutherford, Bohr model – Major contributions of Friedrich Wöhler, Mendeleev, Michael Faraday and Marie Skłodowska-Curie. Structure of chemical science: scope of chemical science, branches of chemistry. Chemistry – the central science, Basic ideas of interdisciplinary areas involving Chemistry	
2.0	**Chemistry in Everyday Life**	14
2.1	Relevance of chemistry in everyday life, Applications in different fields: - industry, agriculture, food, medicine and health care, textile, building materials (paint, cement etc), plastics, paper, cosmetics, ceramics.	14
3.0	**Research in Chemistry**	**10**
3.1	Research: Definition, meaning, importance of research. The research process and types of research. Scientific methods, empiricism, Serendipity (any four examples), Observation, Selecting a topic, hypothesis, experiment – data collection, theory, law. Falsification of hypothesis – inductive and deductive reasoning. Revision of scientific theories and laws. Illustration of methods of science – law of chemical combination, faraday's law of electrolysis, Bohr model, quantum mechanical model (identifying the scientific process in each method).	10
4.0	**Awareness on Lab Safety Measures**	**6**
4.1	Introduction to lab safety - regulatory requirements-labels, material safety. Knowledge of hazard warning information and symbols. Explosive compounds (elementary idea), potentially dangerous mixtures - Fire hazards (basic ideas about flammable solvents, ignition sources used in laboratories, metal hydrides), Emergency procedures in chemical splashes to skin and eyes, burns and electric shock. Reactive inorganic reactants and their toxicity (strong acids, bases, halogens, chromates). Hazards due to chemicals, toxic-solids, liquids, gases, and other harmful substances - carcinogenic substances.	6

References

1. C.N.R. Rao - Understanding Chemistry, University Press (India) Pvt.Ltd.
2. J.A. Lee, Scientific Endeavour, Addison Wesley Longman.
3. T.F. Gieryn, Cultural boundaries of science Univ. Chicago Press 1999.
4. B. Sreelakshmi, Food Science, New Age International, New Delhi, 2015.

5. J.W. Hill, T.W. McCreary and D.K. Kolb, Chemistry for Changing Times, Prentice Hall, 12th edn., 2010.
6. V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Polymer Science, 2nd edn., New Age, New Delhi, 2015.
7. D. Sriram and P. Yogeeswari, Medicinal Chemistry, 2nd edn. Pearson, 2011.
8. S.L. Tisdale, W.L. Nelson and J.D. Beaton, Soil Fertility and Fertilizers, Macmillan Publishing Company, New York, 1990.
9. K.H. Buchel, Chemistry of Pesticides, John Wiley & Sons, New York, 1983
10. K. Singh, Chemistry in Daily Life; Prentice Hall of India, New Delhi, 2008.
11. R.L. Dominoswki, Research Methods, Prentice Hall, 1981.
12. J.W. Best, J.V. Kahn, Research in Education, 10th Edn., Pearson/Allyn & Bacon, 2006.
13. Hazards in chemical laboratories and guide to safe practices in chemical laboratories published by Royal Society of Chemistry.

Course	Details				
Code	ICH1CR03				
Title	Basic Level in Inorganic Chemistry				
Degree	Integrated M.Sc. in Basic Sciences-Chemistry				
Branch(s)	Pure Chemistry				
Year/Semester	1/I				
Type	Core				
Credits	3	Hrs/Week	4	Total Hours	72

Specific objectives	To introduce the principles & fundamental aspects of Inorganic Chemistry
Course outcomes	Ensures the students • to understand and acquire knowledge on generalized concepts of Acid -base reactions • to apply oxidation - reduction concepts in calculating the equivalent weight of oxidizing and reducing agents • to understand and analyse the periodic properties of s, p, d & f block elements. • to understand and acquire knowledge on nuclear chemistry and chemistry of alkali and alkaline earth metals.

Module	Course Description	
1.0	**Periodic Table and Periodic Properties**	17
1.1	Modern periodic law - long form periodic table - Periodicity in properties along periods & groups- Atomic, ionic, covalent radii - ionisation potential, electron affinity, - Electronegativity - Paulings, Mulliken, Allred Rochow's Scale of electronegativity. Radius ratio - Effective nuclear change - Screening effect - Slater rules- factors affecting the periodic properties	4
1.2	**Chemistry of s and p Block Elements:** Periodicity in s-and p- block elements with respect to electronic configuration, atomic and ionic size, ionization energy and electro negativity. Inert pair effect	3

1.3	**Chemistry of d and f Block Elements:** *Transition Metals:* General characteristics: Metallic character, oxidation states, size, density, melting points, boiling points, ionization energy, colour, magnetic properties, reducing properties, catalytic properties, non-stoichiometric compounds, complex formation and alloy formation. Difference between first row and other two rows. Preparation, properties, structure and uses of $KMnO_4$ and $K_2Cr_2O_7$. *Lanthanides:* Electronic configurationand general characteristics-Occurrence of lanthanides Isolation of lanthanides from monazite sand - Separation by ion exchange method. Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides. Actinides - Oxidation states, ionic radii, colour, complex formation, actinide contraction, comparison with lanthanides.	**10**
2.0	**Hydrogen, Hydrides and Alkali and Alkaline Earth Metals**	**6**
2.1	**Hydrogen, Hydrides and Alkali and Alkaline Earth Metals**: Hydrogen: Electronic structure, abundance, preparation and properties, isotopes, ortho- and para hydrogen. Hydrides: ionic, covalent, metallic and intermediate hydrides; Hydrogen bonding.	3
2.2	Alkali metals: Introduction, halides, oxides and hydroxides, salts of oxoacids and aqueous solution chemistry. Alkalineearth metals: Introduction, halides, oxides and hydroxides, salts of oxoacids, and aqueous solution chemistry	3
3.0	**Group Study-Boron to Noble Gases**	**27**
3.1	**Boron Group**: Introduction; oxidation states, hydrides, halides, oxides, oxo acids, hydroxides, oxoanions, nitrogen and phosphorous derivatives. Al, Ga, In and Tl salts of oxoacids and aqueous solution chemistry, organometallic compounds.-18 electron rule-Metal Carbonyl Complexes **Carbon Group**: Introduction; allotropes of carbon, Intercalation compounds of graphite; hydrides, carbides, silicides, halides, oxides, oxo acids, hydroxides; silicates; silicones, cyanogen, its derivatives and silicon nitride; aqueous solution chemistry and oxoacid salts of Sn and Pb. **Nitrogen Group**: Introduction; oxidation states, hydrides; halides; oxides; oxo acids; salts of oxo acids; oxo anions; hydroxides; nitrides, phosphides and arsenides; Phosphazenes; aqueous solution chemistry; organic derivatives. **Oxygen Group and Halogen Family**: Oxygen group: Introduction - Hydrides; Halides, Oxohalides and complex halides - Oxides, Oxoacids	27

	and their salts - Sulphur-nitrogen compounds - Aqueous solution chemistry of S, Se and Te - Organic derivatives. Halogen family: comparative study of halogens and their compounds - Oxides and oxoacids of halogens (structure only) - Basic properties of halogens - Inter-halogen compounds - preparation, properties and uses - Pseudohalogens - Preparation, properties and uses of cyanogens and thiocyanogen comparison with halogens - Anomalous properties of fluorine. **Noble gases**: Introduction - compounds of Xe, Kr and Rn - Preparation, structure and bonding - Reactivity	
4.0	**Compounds of non-transition Elements**	**6**
4.1	Manufacture and uses of the following: Glass - different types of glasses. Borax - boron hydrides, boron nitrides, borazole and carboranes. Oxides and oxyacids of phosphorus. Refractory carbides, nitrides, salt-like carbides, borides, and silicides.	6
5.0	**Acids, Bases and Non Aqueous Solvents**	**4**
5.1	Generalized acid -Base Concepts. Gas phase acid-base chemistry -Proton Sponges- Solvent levelling effects. Chemistry in aqueous and Non-aqueous Solvents- liquid NH_3, liq.SO_2 and HF.- super acids - molten salts, Unreactivity of Molten Salts	4
6.0	**Nuclear Chemistry**	**12**
6.1	Nuclear Chemistry: Introduction - composition of nucleus and nuclear forces. Nuclear stability - n/p ratio, mass defect, binding energy, packing fraction and magic numbers, shell and drop models. Isotopes - detection and separation. Isotopic constitution of elements and whole number rule. Deviation of atomic weights from whole numbers. Isobars, isotones and isomers.	**5**
6.2	Radioactivity and Nuclear Transformations: Radioactivity - discovery, detection and measurements (Wilson cloud chamber). Radioactive emanations. Disintegration theory - modes of decay - Group displacement law - Rate of disintegration - Half life and average life - Radioactive series. Nuclear transformations - use of projectiles - nuclear reactions - fission and fusion. Nuclear reactors.	7

References

1. Lee J. D., Concise Inorganic Chemistry, 5th Edition, Blackwell Science, 1996.
2. Puri, Sharma & Kalia ., Principles of Inorganic Chemistry, 33rd edition.

3. Sharpe G., Inorganic Chemistry, 3rd Edition, Pearson, 2010
4. Atkins P., Overton T., Rourke J., Weller M., and Armstrong F., Inorganic Chemistry, 5th Edition, Oxford University Press, 2010.
5. Arnikar, H. J., Essentials of Nuclear Chemistry, 4th edition, New Age International Publishers Ltd., New Delhi, 1995.
6. Loveland, W. D., Morrissey, D. J., Seaborg, G. T., Modern Nuclear Chemistry, Wiley-VCH Verlag GmbH Co. KGaA, 2006.
7. Huheey, J. E., Keiter, E. A., Keiter, R. L., and Medhi, O. K.; Inorganic Chemistry - Principles of Structure and Reactivity, 4th edition, Pearson Education, 2006.
8. Glasstone, Source Book on Atomic Energy, 3rd edition, Affiliated East West Press, 1979.
9. R. Gopalan, *Inorganic Chemistry for Undergraduates,* Universities Press, Hyderabad, 2009.
10. Greenwood N. N. and Earnshaw A., Chemistry of the Elements, 2nd edition, Elsevier, 2005.
11. Housecraft C. E. and Sharpe A. G., Inorganic Chemistry, 4th edition, Pearson, 2012.
12. Chang R., Chemistry, 1st Indian edition, Tata-McGraw Hill, 2007.
13. Douglas B., McDaniel D. and Alexander J., Concepts and Models of Inorganic Chemistry, 3rd edition, John Wiley & Sons, 2010.
14. Cotton F. A., Wilkinson G., Murillo C. A. and Bochmann M., Advanced Inorganic Chemistry, 6^{th} edition, John Wiley & Sons, 2008
15. A.I. Vogel, A Textbook of Practical Organic Chemistry, 5/e Pearson, 1989.

Course	Details				
Code	**ICH1CR04**				
Title	**Basic Level in Theoretical and Analytical chemistry**				
Degree	**Integrated M.Sc.in Basic Sciences-Chemistry**				
Branch(s)	**Chemistry**				
Year/Semester	**1/I**				
Type	**Core**				
Credits	**3**	**Hrs /Week**	**4**	**Total Hours**	**72**

Specific objectives	To introduce fundamental aspects of Theoretical and Analytical Chemistry
Course outcomes	1. To understand the fundamentals of atomic structure. 2. To understand and apply simple quantum mechanical treatments of atoms and molecules. 3. To understand chemical bonding and different types of hybridization 4. To apply the concept of hybridisation on different molecules to find out their geometries. 5. To understand & apply different analytical methods and techniques

Module	Course Description	Hrs
1.0	**Atomic Structure**	**21**
1.1	**Dawn of quantum theory** - Introduction based on historical development – Atomic models – Dalton, Thomson and Rutherford models. Bohr theory of atom - quantization of angular momentum, discrete energy level structure, concept of quantum numbers, and Franck-Hertz experiment. Photo-electric effect, dual nature of light and matter, de-Broglie's relation, blackbody radiation, electron diffraction by crystals, double slit experiments with light and matter, Stern-Gerlach experiment, and concepts of spin and orbital angular momenta. Heisenberg's uncertainty principle.	6

1.2	**The atom and its structure** - Limitations of Bohr theory. Sommerfeld modification. Classical wave equation. Postulates of quantum mechanics – Born interpretation of wave function, well behaved wave functions, orthonormality of wave functions, Operator postulate – linear and non linear operators, Laplacian operator, commuting and non commuting operators, Hermitian operators, eigen functions and eigen values of an operator, Time-dependent Schrödinger equation, conservative systems, – time-independent Schrödinger equation.	9
1.3	**Applications of Schrödinger equation to systems** – Free particle in one dimension, particle in a one dimensional box (infinite potential barriers), particle in one dimensional box with finite potential barriers, tunneling, particle in a three dimensional box, separation of variables, degeneracy.	6
2.0	**Symmetry**	**6**
2.1	Molecular symmetry, symmetry elements, symmetry operations, point groups. Determination of point groups of molecules and ions belonging to C_n, C_s, C_i, C_{nv}, C_{nh}, $C_{\infty v}$, D_{nh}, $D_{\infty h}$, T_d and O_h.	
3.0	**Chemical Bonding**	**18**
3.1	Introduction – Octet rule and its limitations. Types of bonds: Ionic bond, Covalent bond and metallic bond Ionic Bond - properties of ionic compounds - polarisation of ions – Fajan's rule and its applications. Covalent Bond – Properties of covalent compounds - polarity of bonds – percentage of ionic character – dipole moment and molecular structure. Valence Bond Theory and its limitations. Concept of resonance - Hybridization: Definition and characteristics – shape of molecules ($BeCl_2$, C_2H_2, BF_3, C_2H_4, CH_4, NH_3, H_2O, NH_4^+, H_3O^+, PCl_5, SF_6 and IF_7). VSEPR theory: Postulates - applications - shapes of molecules CCl_4, NH_3, H_2O, ClF_3, XeF_2, SF_6, IF_5, XeF_4, IF_7 and XeF_6. Molecular Orbital Theory – LCAO - bonding and anti-bonding molecular orbitals – bond order and its significance. MO diagrams of homonuclear and heteronuclear diatomic molecules: H_2, He_2, Li_2, Be_2, B_2, C_2, N_2, O_2, F_2, CO and NO – comparison of bond length, magnetic behavior and bond energy of O_2 and its ions. Metallic Bond: free electron theory, valence bond theory and band theory (qualitative treatment only) - explanation of metallic properties based on these theories.	

	Intermolecular forces: Hydrogen bond - intra and inter molecular hydrogen bonds – effect on physical properties. Van der Waals forces, ion-dipole, dipole-dipole, ion-induced dipole, dipole-induced dipole and induced dipole-induced dipole interactions.	
4.0	**Analytical methods in chemistry**	**15**
4.1	**Oxidation & Reduction Reactions**: Molecular mass & Mole Concept. Oxidation and reduction reactions – oxidation number concept, and variable valency, balancing redox equations by oxidation number method and ion-electron method – equivalent weight of oxidizing and reducing agents.	3
4.2	**Qualitative analysis**: Applications of solubility product and common ion effect in the precipitation of cations. Principle of intergroup separation of cations. Interfering acid radicals and their elimination (oxalate, fluoride, borate and phosphate).	3
4.3	**Titrimetric analysis** - fundamental concepts. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm. and ppb. Primary and secondary standards, 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 – metal ion indicators. Double burette method of titration: Principle and advantages. Microanalysis and its advantages.	6
4.4	**Gravimetric analysis**: Unit operations in gravimetric analysis illustrations using iron and barium estimation.	3
	Separation and purification techniques – filtration, crystallization and precipitation – fractional distillation, solvent extraction.	
5.0	**Chromatographic techniques**	**12**

4.1	Column Chromatography: Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications. Thin Layer Chromatography: Principle, choice of adsorbent and solvent, preparation of Chromato plates, Rf-values, significance of Rf values. Ion exchange chromatography: Principle and experimental techniques. Gas Chromatography: Principle and experimental techniques. High Performance Liquid Chromatography (HPLC): Principle and experimental techniques. Applications of Chromatographic techniques	12

References:

1. J.A.Lee, Scientific Endeavour, Addison Wesley Longman
2. C.N.R.Rao, University General Chemistry, MacMillan India (Ltd.)
3. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, *Fundamentals of Analytical Chemistry*, 8th Edition, Brooks/Cole, Thomson Learning, Inc., USA, 2004.
4. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London, 2010.
5. .R. Puri, L.R. Sharma and K.C. Kalia, *Principles of Inorganic Chemistry*, 31st Edition, Milestone Publishers and Distributors, New Delhi, 2013.
6. Satya Prakash, *Advanced Inorganic Chemistry, Volume 1,* 5th Edition, S. Chand and Sons, New Delhi, 2012.
7. J. Mendham, R.C. Denney, J. D. Barnes and M. Thomas, *Vogel's Text Book of Quantitative Chemical Analysis*, 6th Edition, Pearson Education, Noida, 2013.
8. R. Gopalan, *Inorganic Chemistry for Undergraduates*, Universities Press, Hyderabad, 2009.
9. Vogels Textbook of Quantitative Chemical Analysis, 6thEdn., Pearson Education Ltd.
10. R.K. Prasad, *Quantum Chemistry*, New Age International, 2001
11. McQuarrie, J. D. Simon, *Physical Chemistry – A molecular Approach*, Viva Books.
12. I. N. Levine, *Physical Chemistry*, Tata McGraw Hill,

13. ManasChanda, *Atomic structure and Chemical bonding in Molecular Spectroscopy"* Tata McGraw Hill.
14. F. A. Cotton, G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd edn., John Wiley.
15. B. Douglas, D. Mc Daniel, J. Alexander, Concepts and models in Inorganic Chemistry.

SEMESTER I - CORE CHEMISTRY PRACTICALS

ICH1CP07 - VOLUMETRIC ANALYSIS-I

Credits:2 (36 hrs)

A. Acidimetry and Alkalimetry

1. Strong acid-Strong base
2. Strong acid – Weak base
3. Strong base – Weak acid
4. Estimation of Na_2CO_3 and $NaHCO_3$ in a mixture
5. Estimation of NaOH and Na_2CO_3 in a mixture
6. Estimation of ammonia in ammonium salts by direct and indirect methods

B. Complexometric Titrations Using EDTA

1. Estimation of Zn
2. Estimation of Mg
3. Estimation of Mg and Ca in a mixture
4. Estimation of Ni
5. Determination of hardness of water

C. Double Burette Titration method

1. HCl and NaOH titration
2. HCl and Na2CO3 titration
3. CH3COOH and NaOH titration

References:

1. A. I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': (Third Ed.) (ELBS)
2. D.A.Skoog, D.M.West and S.R.crouch, Fundamentals of Analytical Chemistry, 8thEdn., Brooks/Cole Nelson.
3. Vogels Textbook of Quantitative Chemical Analysis, 6thEdn., Pearson Education Ltd.

Course	Details				
Code	**ICH2CR02**				
Title	**Elementary to Research in Chemistry - II**				
Degree	**Integrated M.Sc. in Basic Sciences- Chemistry**				
Branch(s)	**Basic Sciences- Chemistry**				
Year/Semester	**I/II**				
Type	**Core**				
Credits	**2**	**Hrs/Week**	**2**	**Total Hours**	**36**

Specific Objectives	To introduce the importance of Chemistry as a Central Science, its scope in research & everyday life
Course Outcomes	Ensures the students ● to identify and analyse the applications of chemistry in different fields of life. ● in understanding for how using valid scientific methods of measurement and scaling can improve and create knowledge. ● Analyse and interpret methods of quantitative and qualitative data. ● in developing, completing, writing, and presenting a valid and ethical research report.

Module	Course Description	Hrs
1.0	**Chemistry in Everyday Life - applications**	**9**
1.1	Applications in different fields: - Solar cells, biofuel feedstocks- sugar/starch/plant and animal fats, biodiesel. Bioreactors and its applications. Nanochemistry – applications, impact and future outlook.	9
2.0	**Process of Research in Chemistry**	**18**
2.1	**Measurement, Sampling and data analysis** - Necessity of units and dimensions, significant digits, scientific and prefix notation, Accuracy and precision, types of errors and ways to reduce errors, variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results,	9

	discussion of results, models., statistical analysis of experimental data using computers, mean, mode, deviation, standard deviation, Plotting graphs.	
2.2	**Writing a research article** – how to prepare a paper to publish in peer reviewed journals - Indian Journal of Chemistry- Section A and Journal of American Chemical Society. Comparing the differences in publishing papers in different journals. **Database** - Internet as a knowledge repository – INFLIBNET, NICNET, BRNET, NPTEL, Shodganga (elementary level only). Citation database – Scopus. **Research Metrics** - Impact Factor of Journal and its relevance, Citation Report, SNIP, Cite Score. Metrics: h-index	9
3.0	**Research Ethics**	**9**
3.1	Ethics with respect to science and research, Intellectual honesty and research integrity. Basic concepts of IPR, copyright and patents. Scientific misconducts: Falsification, Fabrication, and Plagiarism. Plagiarism check – software used (Turnitin). Cybercrime	9

References

1. Dipak Kumar Bhattacharyya (2006) Research Methodology Excel Books
2. Kothari, C.R. (2005) Research Methodology New Age Publishers
3. Michael P Marder (2004) Research Methods for Science. Oxford Press
4. The Ethics of Teaching and Scientific Research; Miro Todorovich; Paul Kurtz; Sidney Hook.
5. Research Ethics: A Psychological Approach; Barbara H. Stanley; Joan E. Sieber; Gary B., Melton

Course	Details				
Code	ICH2CR03				
Title	Basic Level in Organic Chemistry				
Degree	Integrated M.Sc.				
Branch(s)	Integrated M.Sc. in Basic Sciences-Chemistry				
Year/Semester	1/II				
Type	Core				
Credits	3	Hrs/Week	4	Total Hours	72

Specific objectives	To introduce fundamental concepts of Organic Chemistry and different functional groups
Course outcomes	• To apply the IUPAC rules in naming organic molecules. • To apply the concepts of electronic displacements and types of reactions inorganic reaction mechanisms. • To understand the preparation & properties of Aliphatic Hydrocarbons • To understand the preparation & properties of Aromatic Hydrocarbons • To understand the preparation & properties of Alcohols and Phenols • To understand the preparation & properties of Aldehydes and ketones

Module	Course Description	Hrs
1.0	**Fundamentals of Organic Chemistry**	21
1.1	Classification and IUPAC system of nomenclature of common organic compounds (both aliphatic and aromatic). Structure and bonding of alkanes. Hybridization and shapes of simple molecules– methane, ethane, ethylene, acetylene. Polarity of bonds. Electronic displacements: Inductive effect, electromeric effect, mesomeric effect, resonance and hyperconjugation, steric effects. Cleavage of bonds: Homolysis and heterolysis with suitable examples. Curved arrow formalism.	9
1.2	Types of reagents: Nucleophiles and electrophiles. Reactive intermediates: carbocations, carbanions, free radicals and carbenes – types,shape and relative stability. Structure and preparation of nitrene	3

	and benzyne intermediate	
1.3	Types of organic reactions: addition, elimination, substitution, rearrangement and redox reactions (definition and one example each). Substitution reactions: nucleophilic substitution of alkyl halides- S_N1 and S_N2 mechanisms with stereochemical aspects and effects of substrate structure, solvent, nucleophile and leaving group. Electrophilic substitutions in benzene – reaction mechanism. Addition reactions: electrophilic addition to alkene and alkynes regioselectivity: Markovnikov's addition-carbocation mechanism, anti-Markovnikov's addition-radical mechanism. Elimination reactions: E1 and E2mechanisms. Saytzeff and Hoffman rule. Rearrangement reaction-Wagner–Meerwein rearrangement. Redox reactions- Cannizaro reaction.	9
2	**Aliphatic Hydrocarbons and Alkyl Halides**	**9**
2.1	*Alkanes:* Preparation - catalytic hydrogenation, Wurtz reaction, Wurtz-Fittig reaction, fromGrignard reagent. Reactions- free radical substitution– halogenation.	2
2.2	*Alkenes:* Preparation - Dehydration of alkenes and dehydrohalogenation of alkyl halides with mechanism. Reactions - *cis*-addition (alkaline $KMnO_4$) and *trans*-addition (bromine). Addition of HX with mechanisms, Hydration, Ozonolysis. Addition of carbenes, 1,3dipolar addition, free radical allylic substitution.	4
2.3	*Alkynes:* Preparation - Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetrahalides and dehydrohalogenation of vicinal dihalides. Reactions - Acidity of alkynes, formation of metal acetylides, alkylation of terminal alkynes and conversion into higher alkynes,addition of bromine and alkaline $KMnO_4$.	3
3	**Aromatic Hydrocarbons and Aryl Halides**	**12**
3.1	Aromaticity : Definition, Hückel's rule - application to benzenoid (benzene, naphthalene and anthracene) and non-benzenoid (cyclopropenyl cation, cyclopentadienyl anion, tropylium cation and annulene) compounds. Anti-and homo-aromatic systems - Fullerenes, Carbon nanotubes and Graphene.	3
3.2	Benzene: Molecular orbital picture and resonance energy. Preparation	6

	– from phenol,by decarboxylation, from acetylene, from aromatic acids. Reactions – electrophilic aromatic substitution: nitration, halogenation, sulphonation and Friedel-Craft's reaction (alkylation and acylation) with their mechanism. Orientation of aromatic substitution.ortho, para and meta directing effects of groups. Ring activating and deactivating groups with examples.	
3.3	Naphthalene and anthracene: Molecular orbital picture and resonance energy. Preparation of naphthalene: Haworth synthesis. Reactions – Electrophilic substitutions (halogenation, nitration and sulphonation) of naphthalene.	3
4	**Alcohols and Phenols**	**9**
4.1	*Alcohols*: Preparation - 1^{o}, 2^{o} and 3^{o} alcohols using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acids and esters(Bouveault-Blanc reduction). Reactions – with sodium, HX (Lucas test), esterification, oxidation (with PCC, alkaline $KMnO_4$, OsO_4, acidic dichromate, conc. HNO_3). Oppenauer oxidation. Ascent and descent of alcohol series. Diols: Preparation – hydroxylation of alkenes, hydrolysis of epoxides. Reactions – oxidative cleavage of diols using lead tetraacetate and periodic acid. Pinacol – Pinacolone rearrangement.	6
4.2	Phenols: Preparation – cumene hydroperoxide method, from diazonium salts. Reactions – Electrophilic substitution - nitration, halogenation and sulphonation. Reimer – Tiemann reaction and Fries rearrangement. Preparation and uses of nitrophenols, picric acid, resorcinol and quinol.	3
5	**Aldehydes and Ketones**	**21**
5.1	Preparation – from alcohols, acid chlorides, esters ans nitriles. Reactions- Structure of the carbonyl group and acidity of α-hydrogen.	3
5.2	(i) Addition reactions – with HCN, ROH, $NaHSO_3$, Grignard reagent and ammonia derivatives. Aldol, Claisen, Claisen-Schmidt, Knoevenagel and Benzoin condensations (with mechanisms). Cannizzaro reaction, Wittig reaction. Structure and reactions of α, β – unsaturated carbonyl compounds involving electrophilic and nucleophilic addition – Michael addition, Mannich reaction, Robinson annulation (with mechanisms).	7
5.3	(ii) Oxidation reactions - Tollen's and Fehling's tests, Iodoform test, Baeyer-Villiger oxidation (with mechanism).	3
5.4	(iii) Reduction reactions – Clemmensen, Wolff-Kishner, Meerwein-	3

	Pondorff-Verley, $LiAlH_4$, and $NaBH_4$ reductions (with mechanisms)	
5.5	(iv) Rearrangement reactions - Beckmann, and benzil-benzilic acid rearrangements (with mechanisms).	3
5.6	Preparation, properties and reactions of formaldehyde, acetaldehyde, acetone, benzaldehyde and benzophenone.	2

References:

1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. Organic Chemistry,7thed.,DorlingKindersley(India) Pvt. Ltd(PearsonEducation), 2011.
2. Graham Solomon,T.W.,Fryhle, C.B. & Snyder, S.A. Organic Chemistry,John Wiley&Sons, 2014.
3. McMurry, J. Organic Chemistry,7th Edn. Cengage Learning, 2013.
4. Sykes, P. A. GuidebooktoMechanism inOrganic Chemistry,Orient Longman, 1988.
5. Finar,I.L.Organic Chemistry (Vol. 1 & 2),Dorling Kindersley (India) Pvt. Ltd (PearsonEducation), 2009.
6. Jain, M.K. & Sharma, S.C. Modern Organic Chemistry,Vishal Publishing Co. 2010.
7. Bahl, A. & Bahl, B.S. AdvancedOrganic Chemistry, S. Chand, 2010.
8. Pillai, C.N. Organic Chemistry,Universities Press, 2008.
9. Gupta, S.S. Organic Chemistry, Oxford University Press, 2014.
10. March, J. & Smith, M. B. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 6thEdn.,Wiley, 2007.

Course	Details				
Code	ICH2CR04				
Title	Basic level in Physical Chemistry				
Degree	Integrated M.Sc.				
Branch(s)	Integrated M.Sc. in Basic Sciences - Chemistry				
Year/Semester	1/II				
Type	Core				
Credits	3	Hrs/Week	4	Total Hours	72

Specific objectives	To introduce fundamental aspects of different states of matter
Course outcomes	1. To understand different states of matter and its properties. 2. To understand and apply the physical principles that govern chemical systems. 3. To make the students aware of the kinetic theory of gases and application of kinetic gas equation. 4. To acquire basic knowledge in solid state and crystallography.

Module	Course Description	Hrs	
1.0	Gaseous state	36	
1.1	Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Derivation of Maxwell Boltzmann distribution laws of molecular velocities and molecular energies, graphical representation, experimental verification of the law. Temperature dependence of these distributions. Derivation of average, root mean square velocities and most probable velocities	9	
1.2	Collision properties: Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Relation between mean free path and coefficient of viscosity. Degree of freedom of a gaseous molecule, frequency of collision, Principle of equipartition of energy, Barometric formula. Effusion, the rate of effusion, time dependence of pressure of an effusing gas, transport properties of gases.	9	
	Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases.		

1.3	Boyle temperature (derivation not required). Critical phenomena and Andrews isotherms of CO_2, critical constants and their calculation from van der Waals equation. Virial equation of state, van der Waals equation expressed in virial form.	9	
1.4	Other Equations of State: Dieterici equation, Berthelot equation, Clausius equation, Redlich Kwong equation. (Elementary ideas only) Intermolecular Interactions: Hard sphere potential, Lennard-Jones potential, ion-ion, ion-dipole, ion-induced dipole, dipole-dipole, dipole-induced dipole and induced dipole-induced dipole interactions, Keesom interactions, Debye interactions, London interactions.	9	
2.0	**Liquid State**	**12**	
2.1	Liquids: Nature of the liquid state, Intermolecular forces in liquids (qualitative idea only), vapor pressure, surface tension, capillary rise and measurement of surface tension, spreading of liquid, temperature dependence of surface tension.General features of fluid flow (streamline and turbulent), Reynold number, Newton'equation, viscosity coefficient. Poiseuille's equation (with derivation), temperature dependence of viscosity, falling sphere method. Viscosity of gases vs. liquids.	12	
3.0	**Solid State**	**15**	
3.1	The nature of the solid state – anisotropy – Forms of solids. Unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography–Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Bragg's X-ray diffractometer method and powder pattern method. Analysis of powder diffraction patterns of NaCl and KCl, density of cubic crystals.	9	
3.2	Structure of ionic compounds of the type AX (NaCl, CsCl, ZnS) andAX_2 (CaF_2, Na_2O) Defects in crystals – stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects. Electrical conductivity, semiconductors, n-type, p-type, Superconductivity – An introduction	6	

4	**Liquid Crystals**	**9**	
4.1	Liquid crystals and its thermographic behaviour. Types – smectic, nematic and cholesteric liquid crystals, Characterization of liquid crystals, Swarm theory of liquid crystals, uses of liquid crystals, characterization of LC materials by DSC, PLM and x-ray	9	

References:

1. R P W Atkins, “Physical Chemistry”, Oxford University Press
2. R J Silby and R A Alberty, “Physical Chemistry”, John Wiley & Sons
3. F Daniels and A Alberty, “Physical Chemistry”, Wiley Eastern
4. Puri, Sharma and Pathania, “Principles of Physical Chemistry”, Millennium Edition, Vishal Publishing Co
5. Barrow, G.M. “Physical Chemistry”,Tata McGraw-Hill (2007).
6. Castellan, G.W. “Physical Chemistry”,4th Ed. Narosa (2004).
7. K. L. Kapoor, “A Textbook of Physical chemistry”, Volume 1, Macmillan India Ltd.,
8. L V Azaroff, “Introduction to Solids”, McGraw Hill.
9. N B Hannay, “Solid State Chemistry”, Prentice Hall.
10. McQuarrie, J. D. Simon, “Physical Chemistry – A molecular Approach”, Viva Books Pvt. Ltd.

2. Anthony R. West, “Solid State Chemistry and its Applications”, Wiley Eastern

SEMESTER II - CORE CHEMISTRY PRACTICALS

ICH2CP07 - VOLUMETRIC ANALYSIS-II

Total Credits: 2 (36 Hrs)

A.Oxidation – Reduction

Titrations I. Permanganometry

1. Estimation of ferrous iron
2. Estimation of oxalic acid
3. Estimation of sodium oxalate
4. Estimation of calcium

II. Dichrometry

1. Estimation of ferrous iron using internal indicator
2. Estimation of ferrous iron using external indicator
3. Estimation of ferric iron using internal indicator
4. Estimation of ferric iron using external indicator

III. Iodimetry and Iodometry

1. Estimation of copper
2. Estimation of arsenious oxide

B. Precipitation titration

1.Mohr's method of estimation of chloride ions using silver ions.

C. Application - Volumetric Analysis (any one)

1. Estimation of acetic acid in vinegar sample.
2. Estimation of citric acid in fruit juices.

References:

4. A. I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': (Third Ed.) (ELBS)
5. D.A.Skoog, D.M.West and S.R.crouch, Fundamentals of Analytical Chemistry, 8thEdn., Brooks/Cole Nelson.
6. Vogels Textbook of Quantitative Chemical Analysis, 6thEdn., Pearson Education Ltd.

SYLLABUS OF COMPLEMENTARY PHYSICS FOR

INTEGRATED POST GRADUATE CHEMISTRY PROGRAMME

STRUCTURE

Semester	Course Code	Course Title	Credits	Teaching hours
I	ICH1CM06	Properties of Matter and Semiconducting Materials	2	36
	ICH1CMP08	Complementary Physics Practical – I	Nil	36
II	ICH2CM06	Mechanics and Relativity	2	36
	ICH2CMP08	Complementary Physics Practical – I	2	36
III	ICH3CM05	Modern Physics, Electrodynamicsand Transducers	3	54
	ICH3CMP07	Complementary Physics Practical – II	Nil	36
IV	ICH4CM05	Optics, Dielectrics and Spectroscopic Instrumentation	3	54
	ICH4CMP07	Complementary Physics Practical – II	2	36
		Total	**14**	

SYLLABUS

SEMESTER I

ICH1CM06 - PHYSICS – I
PROPERTIES OF MATTER AND SEMICONDUCTING MATERIALS

Credits: 2 (36 hours)

Module I

Elasticity (11 hrs) Stress - Strain - Hooke's law - Elastic moduli - Poisson's ratio - bending of beams - cantilever, uniform and non-uniform bending, I-section girder-twisting couple - determination of rigidity modulus - static torsion - torsion pendulum, Bulk Modulus – Isothermal and Adiabatic.

Module II

Surface Tension (3 hrs) Molecular theory of surface tension - surface energy - excess pressure in a liquid drop, factors affecting surface tension – applications.

Hydrodynamics (4 hrs) Streamline and turbulent flow - critical velocity - Coefficient of viscosity - Derivation of Poiseuille's equation, Stokes equation - Determination of viscosity by Poiseuille's method.

Text Books

1. Elements of properties of matter, D S Mathur
2. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co.)
3. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5thEdn.) 4. Modern Physics- G. Aruldas and P. Rajagopal (PHIPub)
5. Physics- Resnick and Halliday

Module II

Semiconducting Materials (18 hrs) Conductivity of semiconductors, intrinsic and extrinsic semiconductors, n-type and p-type semiconductors, - PN Junction diode – V-I characteristics – Diode parameters, Diode current equation- Rectification - Half wave, Full wave, Centre tapped and Bridge rectifier circuits - Nature of rectified output, efficiency, ripple factor - Filter circuits – inductor Filter, capacitor Filter-Zener diode voltage regulator-LED-photodiode-phototransistor-Bipolar junction transistors- Transistor biasing, CB, CC, CE configurations and current gain α, β, γ and their relationships-Characteristics of CE configuration-Feedback amplifiers – Gain and characteristics

Text Books

1. Principles of electronics, V K Mehta, S Chand
2. A Textbook of Applied Electronics - R. S. Sedha
3. Basic Electronics - B. L. Theraja
4. Electronic Principles-Sahdev (Dhanpat Rai Co.)
5. Electronic Devices and Circuit Theory-Robert L Boylestad & Louis Nashelsky, PHI 6. Foundations of Electronics-D Chattopadhyay, P.C.Rakshit, B Saha, N.N.Purkait(New Age International Publishers)
7. Electronic Devices and Circuits-Sanjeev Gupta,Santosh Gupta(Dhanpat Rai Publications)
8. Basic Electronics and Linear Circuits-N.N.Bhargava,D.C.Kulshreshtha&S.C.Gupta (Tata McGrawHill)
9. Introduction to Semiconductor Devices, Kevin Brennan ,Cambridge Univ. Press

SEMESTER II

ICH2CM06 – PHYSICS – II

MECHANICS AND RELATIVITY

Credits: 2 (36 hours)

Module I

Motion under gravity (3hours) Velocity- acceleration- force – acceleration due to gravity - compound pendulum (symmetric and asymmetric) radius of gyration –centripetal acceleration and force - centrifugal force

Rotational dynamics (10 hours) Angular velocity- angular momentum- torque- conservation of angular momentum- angular acceleration- moment of inertia- parallel and perpendicular axes theorems- moment of inertia of rod, ring, disc, cylinder and sphere- flywheel

Module II

Oscillations (9 hours) Periodic and oscillatory motion- simple harmonic motion- differential equation, expression for displacement, velocity and acceleration- graphical representation- energy of a particle executing simple harmonic motion damped oscillation- forced oscillation and resonance.

Waves (4 hours) Waves-classifications- progressive wave- energy of progressive wave- superposition of waves-theory of beats- Doppler effect.

Module III

Relativity (10 hours) Special theory of relativity: Postulates, Geometry of relativity - time dilation - length contraction - relativity of simultaneity, Lorentz transformation - Galilean transformation, Structure of spacetime – 4 vector – invariant - spacetime diagrams; Relativistic mechanics: Proper time and proper velocity, Relativistic energy and momentum, Relativistic kinematics.

Text Books:

1. Elements of properties of matter, D S Mathur- S Chand.
2. Mechanics- D S Mathur- S Chand.
3. Solid State Physics- P K Palanisamy- Scitech.
4. An Introduction to Electrodynamics, D J Griffth, 3rd Edn., PHI.

References

1. Properties of Matter- Brijlal and N. Subrahmanyam (S. Chand and Co. 2. A

text book on oscillations waves and acoustics, M.Ghosh, D Bhattacharya.

3. Solid State Physics- R. K. Puri and V.K. Babbar (S. Chand and Co.
4. Elementary Solid State Physics,Ali Omar 5. Modern Physics- Murugeshan- S Chand.
5. Modern Physics Authors: R. Murugeshan, Krithiga Sivaprasath; Publisher: S Chand.
6. Concepts of Modern Physics- A. Beiser (Tata McGraw-Hill, 5thEdn.

COMPLEMENTARY PHYSICS PRACTICALS

SEMESTER I & II

ICH1CMP08,ICH2CMP08 - COMPLEMENTARY PHYSICS PRACTICAL - I

(A minimum of 12 experiments has to be done)

Credits: 2 (72 hours)

1. Measurement of density of a solid – Sensibility method to find mass using beam balance and screw gauge / vernier calipers for dimension measurements
2. Spectrometer - Refractive Index of material of prism.
3. Spectrometer – Hollow Prism – Determination of refractive index of liquid
4. Liquid Lens - Refractive Index of a liquid
5. Diode characteristics- ac and dc resistance
6. Surface Tension – Capillary rise method
7. Determination of Young's Modulus- Cantilever (Scale and Telescope)
8. Determination ofYoung's Modulus - Uniform bending (Optic lever method)
9. Determination of Young's Modulus - Non-uniform bending (Pin and Microscope method)
10. Acceleration due to gravity (g)- Symmetric Compound Pendulum

    OR Kater's pendulum
11. Symmetric Compound Pendulum - Determination of Radius of gyration and moment of inertia
12. Fly wheel – Moment of Inertia
13. Torsion pendulum -Rigidity modulus
14. Spring Constant – Hooke's Law - oscillation
15. Resistivity of the material of the wire- Ohm's law and verification by multimeter
16. Construction of half wave rectifier with and without filter – Ripple factor
17. Laser- Transmission **OR** Reflection Grating-Determination of wavelength
18. Poisson's ratio of rubber
19. Temperature dependence of capacitance- polymer and ceramiccapacitors
20. Resistance of a galvanometer and its figure of merit.
21. Potentiometer – Measurement of resistance of wire

FIRSTSEMESTER
ICH1CM05
PARTIAL DIFFERENTIATION, MATRICES, TRIGONOMETRY AND PROBABILITY

4hours/week (Total Hrs:72) 3 credits

Syllabus

(Use of Non-Programmable Scientific Calculator is permitted)

Text Books:-

1. George B. Thomas, Jr: Thomas' Calculus, 12th Edition,Pearson.

2. Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand. 3. S. L. Loney – Plane Trigonometry Part–II, AITBS Publishers India, 2009. 4. S. P. Gupta, V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

Module I: Partial Differentiation (14hrs)

Functions of several variables (Definitions and simple graphs only), Partial derivatives, The Chain Rule. Text 1 Chapter14 (Sections 14.1 (Definitions and simple graphs only), 14.3 and 14.4)

Module II: Matrices (21hrs)

Rank of a Matrix, Elementary transformations of a matrix, Reduction to Normal form, Employment of only row (column) transformations, System of Linear Homogeneous Equations, Systems of linear non homogenous equations, Characteristic roots and characteristic vectors of a square matrix, Characteristic matrix and Characteristic equation of a matrix, Cayley-Hamilton theorem, Expression of the inverse of a nonsingular matrix A as apolynomial in A with scalar coefficients

Text 2 Chapter4 (Sections4.1 to 4.8 and 4.11), Chapter6 (Sections 6.1, 6.2 and 6.6), Chapter11 (Sections 11.1 and 11.11) (Proofs of all Theorems in Module II are excluded.)

Module III: Trigonometry (23hrs)

Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$, $\sin^n\theta$, $\cos^n\theta$, $\sin^n\theta\cos^m\theta$, circular and hyperbolic functions, inverse circular and hyperbolic function, Separation into real and imaginary parts, Summation of infinite series based on C+iS method.

Text 3 (Relevant Sections of Chapters 3 to 5and 8)

Module IV: Permutation, Combination and Probability (14Hrs)

Introduction, Short History, Basic Terminology, Mathematical Probability, Statistical Probability Text 4 (Sections 3.1 to 3.5)

ReferenceBooks:

1. Shanti Narayan: Differential Calculus (S. Chand)

2. George B. Thomas Jr .and Ross L. Finney: Calculus, LPE, 9th edition, Pearson Education. 3. S. S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.
4. John E. Freund: Mathematical Statistics, Prentice Hall of India.

SECOND SEMESTER

ICH2CM05

INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

4 hours/week (Total Hrs : 72) **3 Credits**

Syllabus

Text Books:-

1. George B. Thomas, Jr.: Thomas' Calculus 12th Edition,(Pearson).

2. A. H. Siddiqi, P. Manchanada: A first Course in Differential Equations with Applications (Macmillan India Ltd 2006)

3. John Clark Derek and Allen Holton - A first look at graph theory, Allied

Publishers Module I: Integral Calculus (15 hrs)

Volumes using Cross-Sections, Volumes using Cylindrical shells, Arc lengths, Areas of surfaces of Revolution.
Text 1: Chapter 6 (Sections 6.1 to 6.4)

Module II: Multiple Integrals (17 hrs)

Double and iterated integrals over rectangles, Double integrals over general regions, Area by double integration, Triple integrals in rectangular co-ordinates.
Text 1: Chapter 15 (Sections 15.1, 15.2, 15.3, 15.5)

Module III: Ordinary Differential Equations (20 Hrs)

Separable Variables, Exact Differential Equation, Equations reducible to exact form, Linear Equations, Solutions by Substitutions, Homogeneous equations and Bernoulli's Equations. Text 2 : Chapter 2

Module IV: Graph Theory (20 Hrs)

An introduction to graph, Graphs as Models, Definition of a Graph, More definitions, Vertex Degrees, Sub graphs, Matrix representation of graphs
Text 1: Chapter 1 (Sections 1.1 to 1.5 and 1.7 (Proof of Theorem 1.5 and 1.6

excluded) **Reference Books:**

1. Shanti Narayan, P. K. Mittal : Integral Calculus (S. Chand & Company)
2. Differential Equations, E. Rukmangadachari, Pearson.

3. R. K. Ghosh, K. C. Maity – An introduction to Differential Equations, New Central Books.