RANI CHANNAMMA UNIVERSITY, BELGAVI

(GOVERNMENT OF KARNATAKA)

SCHOOL OF BASIC SCIENCES
DEPARTMENT OF CHEMISTRY

REGULATIONS AND SCHEME OF EXAMINATION
FOR
DEPARTMENT OF POST-GRADUATE STUDIES IN ORGANIC CHEMISTRY
(I SEMESTER)

UNDER
CHOICE BASED CREDIT SYSTEM(CBCS)

WITH EFFECT FROM
ACADEMIC YEAR 2017-18 AND ONWARDS

Programme structure of M.Sc. in Chemistry (General) Degree shall be as follows:

Sem	No. of Compulsory and Specialization courses (Credits/Course)	Total Credits for Compulsory and Specialization courses	No. of Open Elective course (Credits/Course)	Total Credits of Open Elective course	Total Credits for the Semester
I	CT: 04(04)=16 PRA: 03(02)=06 CT: 01(02)=02	24	-	__	24
II	CT: 03(04)=12 PRA: 03(02)=06 CT:01(02)=02	20	CT: 01(04)=04	04	24
III	CT: 03(04)=12 PRA: 03(02)=06 CT: 01(02)=02	20	CT: 01(04)=04	04	24
IV	CT: 03(04)=12 PRA: 03(02)=06 CT:01(02)=02 P J: 01(04)=04	24	-	___	24
Total	CT: 14(04)= 52 PRA : 11(02)=24 CT: 03(02)=08 PJ: 01(04) = 04	88	CT: 02(04)= 08	08	96

Note : There shall be open elective course for II and III Semester and a Project for IV Semester.
Abbreviations: CT =Compulsory Theory; **PRA**=Practical**; PJ** = Project

Illustrative Model: Grade Card

Programme :
Name of the candidate : **Semester : I**
Seat No. : **Month and Year :**

Course	Course code no	Credits	Max Marks	Mark Obtained	Semester Grade Point	Credit Points
Compulsory Paper / Core Courses						
Course-I		04	100	60	6.00	24.00
Course-II		04	100	74	7.40	29.60
Course-III		04	100	43	4.30	17.20
Course-IV		04	100	52	5.20	20.80
General Theory						
Course-V		02	50	25	5.00	10.00
Practicals						
Course-VI		02	50	25	5.00	10.00
Course-VII		02	50	25	5.00	10.00
Course-VIII		02	50	25	5.00	10.00
Total		24	600	329	42.9	131.6

Illustrative Model: Grade Card

Programme :
Name of the candidate : **Semester : II**
Seat No. : **Month and Year :**

Course	**Course code no**	**Credits**	**Max Marks**	**Mark Obtained**	**Semester Grade Point**	**Credit Points**
Compulsory Paper / Core Courses						
Course-I		04	100	60	6.00	24.00
Course-II		04	100	74	7.40	29.60
Course-III		04	100	43	4.30	17.20
General Theory Course-IV		02	50	25	5.00	10.00
Open Elective Course-VI		04	100	52	5.20	20.80
Practicals						
Course-VI		02	50	25	5.00	10.00
Course-VII		02	50	25	5.00	10.00
Course-VIII		02	50	25	5.00	10.00
Total		24	600	329	42.9	131.6

Illustrative Model: Grade Card

Programme :
Name of the candidate : **Semester : III**
Seat No. : **Month and Year :**

Course	Course code no	Credits	Max Marks	Mark Obtained	Semester Grade Point	Credit Points
Compulsory Paper / Core Courses						
Course-I		04	100	60	6.00	24.00
Course-II		04	100	74	7.40	29.60
Course-III		04	100	43	4.30	17.20
General Theory Course-IV		02	50	25	5.00	10.00
Open Elective Course-VI		04	100	52	5.20	20.80
Practicals						
Course-VI		04	100	50	5.00	20.00
Course-VII		04	100	50	5.00	20.00
Course-VIII						
Total		24	600	329	32.9	131.6

Illustrative Model: Grade Card

Programme :
Name of the candidate : **Semester : IV**
Seat No. : **Month and Year :**

Course	**Course code no**	**Credits**	**Max Marks**	**Mark Obtained**	**Semester Grade Point**	**Credit Points**
Compulsory Paper / Core Courses						
Course-I		04	100	60	6.00	24.00
Course-II		04	100	74	7.40	29.60
Course-III		04	100	43	4.30	17.20
General Theory						
Course-IV		02	50	25	5.00	10.00
Project						
Course-VI		04	100	50	5.00	10.00
Practicals						
Course-VI		04	100	50	5.00	10.00
Course-VI		04	100	50	5.00	10.00
Course-VIII						
Total		24	600	327	32.7	100.80

RANI CHANNAMMA UNIVERSITY, BELGAVI
(GOVERNMENT OF KARNATAKA)

POST-GRADUATE DEPARTMENT OF STUDIES IN CHEMISTRY
SCHOOL OF BASIC SCIENCES

Post Graduate Department of Studies in Organic Chemistry
Under
School of Basic Sciences
Regulation and Scheme of Examination
for
M.Sc. Organic Chemistry Degree Course
under
Choice Based Credit System (CBCS)
(With effect from 2017-18)

1.1 Title of the Course: The course shall be called M.Sc. in Organic Chemistry or with Specialization-Organic Chemistry.

1.2 Duration of the course: The M.Sc Degree course is of two years duration, spread over four semesters each of four months duration.
1.3 Eligibility for Admission: The Bachelor's degree in Science or equivalent degree with Chemistry as one of the subject. The candidate should have obtained at least 45% of marks in optional subjects as well as in aggregate. Relaxation in respect of SC/ST/Cat -I etc. will be followed as per prevailing rules of the university.
Admission: The rules for admission are as per university notification from time to time.
Admission to other semesters: students are allowed to take admissions to successive semesters under carry over benefit (COB) facility.

2 Attendance:
Every student must have at least 75% attendance in each paper of the courses (Theory & Practical) in each semester. Shortage of attendance will be dealt with as per the university rules from time to time.

3 Medium of instruction: The medium of instruction shall be English.

4 Scheme of Course Structure:
There shall be three categories of courses namely, Compulsory courses, Specialization courses and Open elective courses for M.Sc. in Chemistry.
In the first semester there shall be 4 core theory papers of 4 credits in each paper and 1 core paper of 2 credits and 3 practical's each of 2 credits. In the second semester 3 core theory papers of 4 credits in each paper, 1 core paper of 2 credits, 1 open elective of 4 credits and 3 practical's of credits 4. In third semester there shall be 3 core theory papers of 4 credits, 1 core paper of 2 credits and one open elective paper of credit 4, 3 practical's with 4 credits each. In the fourth semester there shall be 3 core papers of 4 credits each, 1 core paper of 2 credits, 3 practical's with 4 credits each and 1 Project with four credits. Each Paper shall have four units of 16 hrs each.
Note: The specialization shall be in III and IV Semester.

5. Scheme of Evaluation:

5.1 There shall be an examination at the end of each semester.

5.2 Each Course shall have two evaluation components:- The semester end examination carrying 80 marks of 3 hours duration and internal assessment (IA) carrying 20 marks.

5.3 The theory and Practical Examinations of even semesters shall be evaluated through double valuation by an external examiner and an internal examiner or by two external examiners, but

not by two internal examiners. The theory and Practical Examinations of odd semesters shall be evaluated through single valuation by an internal examiner or by external examiner.

5.4 Project: The project report shall be evaluated for 80 marks by one internal and one external examiner. Internal Assessment (IA) marks for 20 marks shall be based on the presentation of the work in a seminar.

6. Pattern of question paper: 80 (Exam) + 20 (IA)

Question paper contains five questions. Question 1 is compulsory. It shall contain 10 objective type questions carrying 2 marks each, drawn from all the four units equally. Questions 2, 3, 4 and 5 should be drawn from each unit of 16 marks each.

01. Answer any EIGHT of the following questions. (08x02=16)

a.
b.
c.
d.
e.
f.
g.
h.
i.
j.

02. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**

03. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**

04. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**

05. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**

7. Maximum period for the completion of M.Sc Degree Progrmme: There shall be fully carry over system from first through fourth semesters. Maximum number of years for a student to complete the degree is as specified by the University from time to time.

8. The General Regulations Governing Post Graduate Programmes under CBCS and Regulation Governing Post Graduate Programmes in the faculty of Science and Technology under CBCS of Rani Channamma University, Belgavi are applicable to this course for all the matters not covered under this.

RANI CHANNAMMA UNIVERSITY, BELGAVI
(GOVERNMENT OF KARNATAKA)

M.Sc. Degree Programme in Chemistry (General)
(Effective from the Academic Year 2014-15)

Choice Based Credit System
Course Structure and Scheme of Examination

Sl. No.	Papers	Hours of Teaching per week	Hours of Exam	Marks			Credits
				Exam	IA	Total	
FIRST SEMESTER							
1	CHIT-1.1: Inorganic Chemistry-I	4	3	80	20	100	4
2	CHOT-1.2: Organic Chemistry-I	4	3	80	20	100	4
3	CHPT-1.3: Physical Chemistry-I	4	3	80	20	100	4
4	CHGT-1.4: Spectroscopy-I	2	2	40	10	50	2
5	CHES-1.5: Analytical Chemistry	4	3	80	20	100	4
6	CHIPr-1.6: Inorganic Chemistry Practicals-I	4	4	40	10	50	2
7	CHOPr-1.7: Organic Chemistry Practicals-I	4	4	40	10	50	2
8	CHPPr-1.8: Physical Chemistry Practicals-I	4	4	40	10	50	2
		30		480	120	600	24
SECOND SEMESTER							
1	CHIT-2.1 : Inorganic Chemistry –II	4	3	80	20	100	4
2	CHOT-2.2 : Organic Chemistry- II	4	3	80	20	100	4
3	CHPT-2.3: Physical Chemistry-II	4	3	80	20	100	4
4	CHGT-2.4: Spectroscopy-II	2	2	40	10	50	2
5	CHEG-2.5: Open elective	4	3	80	20	100	4
6	CHIPr-2.6 : Inorganic Chemistry Practicals-II	4	4	40	10	50	2
7	CHOPr-2.7 : Organic Chemistry Practicals-II	4	4	40	10	50	2
8	CHPPr-2.8 : Physical Chemistry Practicals-II	4	4	40	10	50	2
		30		480	120	600	24
THIRD SEMESTER							

1	CHORT-3.1: Organic Chemistry-IIIA	4	3	80	20	100	4
2	CHORT-3.2: Organic Chemistry-IIIB	4	3	80	20	100	4
3	CHORT-3.3: Organic Chemistry-IIIC	4	3	80	20	100	4
4	CHEG-3.4: Open elective	4	3	80	20	100	4
5	CHORPr-3.5: Organic Chemistry Practicals-IIIA	8	6	80	20	100	4
6	CHORPr-3.6 : Organic Chemistry Practicals-IIIB	8	6	80	20	100	4
		32		480	120	600	24
FOURTH SEMESTER							
1	CHORT-4.1: Organic Chemistry-IVA	4	3	80	20	100	4
2	CHORT-4.2: Organic Chemistry-IVB	4	3	80	20	100	4
3	CHORT-4.3: Organic Chemistry-IVC	4	3	80	20	100	4
4	CHORP-4.4: Project Work	4	4	80	20	100	4
	CHORPr-4.5: Organic Chemistry Practicals-IVA	8	6	80	20	100	4
	CHORPr-4.6: Organic Chemistry Practicals-IVB	8	6	80	20	100	4
		32		480	120	600	24

T : Theory, Pr : Practical, P: Project, EG : Elective General, ES : Elective Special

Total Credits : 96

Internal Assessment for the project work shall be based on the presentation of the work in a seminar. The project report shall be evaluated by one internal and one external examiner.

RANI CHANNAMMA UNIVERSITY, BELGAVI
SCHOOL OF BASIC SCIENCES : CHEMISTRY

M.Sc. CHEMISTRY
FIRST SEMESTER

CHIT-1.1 INORGANIC CHEMISTRY-I
Teaching hours per week : 04 Credits : 04
Total hours : 64

UNIT–I **16 hours**

CHEMICAL BONDING

Review of different types of chemical bonds with suitable examples.

Ionic Bonding

Formation, conditions for the formation of ionic compounds, lattice energy, Born-Lande's equation, calculation of lattice energy from Born-Lande's equation (problems should be solved), conclusions from Born-Lande equation, Born-Haber cycle and its applications (problems should be solved), Kapustinskii equation, factors affecting the lattice energy, properties of ionic substances, predictive power of thermochemical calculations on ionic compounds (Dioxygenyl tetrafluoroborate and Dioxygenyl superoxide).

Covalent character in predominantly ionic bonds, polarizing power, factors governing the degree of polarization, Fajan's rules in predicting the melting and boiling points and solubility of some compounds.

Energetics of solubility of ionic salts in polar solvents, solvation energy, relative effects of ionic radii on lattice energy and ion-solvation energy, relative solubility of ionic compounds (alkali metal halides, sulphates and hydroxides of alkaline earth metals).

Covalent bonding

Formation, conditions for the formation of ionic compounds.

Valence bond theory: hybridization of atomic orbitals, different schemes of hybridization (*sp*, sp^2, sp^3, dsp^2, sp^3d, sp^3d^2), equivalence and nonequivalence of the hybrid orbitals (sp^3d and sp^3d^3), bonding in hypervalent electron deficient molecular species (CH_5^+, CH_6^{2+}).

VSEPR theory: Predicting molecular geometries, Bent's rule of hybridization, illustration of Bent's rule with respect to CH_3F, PCl_3F_2, CH_3 radical and CF_3 radical, CH_3 carbocation, CH_3 carbanion), limitations of VSEPR theory.

Molecular orbital theory: Symmetry and overlap, molecular orbital diagrams of diatomic homo nuclear molecules/ions (up to second period elements), hetero-nuclear molecules/ions(LiH, HCl, LiF, CO, NO, NO^+, NO^-, CN^- only) and triatomic molecules – linear (CO_2, N_2O, NO_2^+ and N^{3-}) and angular (NO_2 and O_3). Magnetic properties of the molecules/ions based on the MOT, stability of molecules or ions based on bond order. Walsh diagrams for XH_2 species.

Metallic bonding: Characteristics of metallic states, electron sea model, Bloch theory, V. B. approach, band theory (MOT).

UNIT–II **16 hours**

CHEMISTRY OF NON-TRANSITION ELEMENTS

Electron deficient compounds: Classification of boranes, nomenclature of boranes. **Diborane:** Synthesis from (i) reaction of boron halides with alkali and alkali metal hydrides, (ii) reaction of sodiuum borohydride, lithium aluminium hydride with metal Boron halides, (iii) reaction of boron halide with hydrogen gas.

Reactions of diborane with water, oxygen, aqueous alkalies, alkyl lithium, alkali metal hydrides, halogens, halogen acids, alkenes, alkynes, ammonia, trimethyl ammine, dimethylether, thioether, carbon monoxide, trimethyl borane, PH_3, dimethyl phosphine and alkali metals, structure and bonding in diborane, factors supporting the bridging structure.

Higher boranes: Synthesis from (i) Stocks's method, (ii) Wurtz method, (iii) lower boranes and (iv) diborane, reactions of B_4H_{10}, B_5H_9 and $B_{10}H_{14}$.

Types of bonds found in higher boranes:, *styx* numbers, structures of boranes and anionic boranes based on styx numbers (B_2H_6, B_3H_9, B_4H_{10}, B_5H_9, B_5H_{11}, B_6H_{10}, $B_{10}H_{14}$, $B_2H_7^-$, $B_3H_8^-$), polyhedral skeletal electron pair counting using Wade's rules: classification of boron clusters using electron pair count.

Carboranes: Classification, Nomenclature, Synthesis of closo carboranes (C_2B_{10} H_{12}). Structural aspect of closo-$C_2B_{10}H_{12}$.

Metalloborane: Synthesis of $[B_{11}H_{11}AlCH_3]^{2-}$, $[Fe(CO)_3B_4H_8]$ and [2-CpCoB4H8]. Structural aspects of metalloboranes (main group and Transition)

Metallocarboranes: Syntheis of $[(C_2B_9H_{11})_2Fe]^{2-}$, $[C_2B_9H_{11}FeCp]^-$ and $[Co(C_2B_9H_{11})_2]^-$, Structure and Bonding in $[Co(C_2B_9H_{11})_2]^-$

Borazines: Synthesis, reactivity and, structure and bonding.

Silicates: Types of silicates, Clay minerals, Zeolites, isomorphous substitution.

Phosphazenes: Synthesis of Cyclophosphazenes and polyphosphaznes. Reactions of Hexachlorocyclotriphosphazene and polyphospazne. Structural aspects of Hexachlorocyclotriphosphazene.

Sulphur-Nitrogen compounds: Synthesis, structure and reactivity of S_4N_4, $S_4N_4H_4$, S_2N_2 /and $(SN)_x$

Electron Rich Compounds: Compounds of Noble gases, (clatharates, hydrates) Preparation and structure and bonding in Xenon compounds (XeF_2, XeF_4, XeF_6, $XeOF_4$, XeO_2F_2, XeO_3, XeO_4) based on VBT and VSEPR. Limitations of VBT. Structure of XeF_2 using MOT.

UNIT–III **16 hours**

COORDINATION CHEMISTRY AND METAL CLUSTERS

Coordination chemistry: Coordination numbers (1 to 7) and their geometries, higher coordination numbers, geometrical isomerism in square planar and octahedral complexes, optical isomerism in octahedral complexes.

Bonding theories: Review of VBT, EAN and their limitations, Crystal Field Theory, splitting of d-orbitals in trigonal planar, octahedral, tetrahedral, square planar, trigonal bipyramidal and square pyramid geometries, Jahn-Teller distortion in co-ordination compounds. Factors affecting the 10 Dq values. Limitations of CFT, evidences for metal ligand orbital overlap, Molecular Orbital Theory with σ (sigma) bonding applied to octahedral, tetrahedral and square plannar complexes. Types of π(pi)–bonding in coordination compounds, spectrochemical series, MO-Theory with π(pi)–bonding applied to octahedral complexes.

Metal Clusters

Dinuclear compounds: Delta and quadrapole bond, structural aspects of $Re_2Cl_8^{2}$, calculation of M-M bond order in $Re_2Cl_8^{2-}$, $MO_2Cl_8^{4-}$, $W_2Cl_8^{4-}$, $Tc_2Cl_8^{2-}$,$Os_2Cl_8^{2-}$ and their magnetic properties, structural aspects of dimeric chromium acetate.

Trinuclear clusters: Structural aspects of Re_3Cl_9. Bond order and magnetic property.

UNIT–IV **16 hours**

Pi (π) ACID METAL COMPLEXES AND ACID-BASE CHEMISTRY

Metal Carbonyls: Different binding modes of carbon monoxides, pi (π) acidity of CO, back bonding, synergic effect, mononuclear carbonyls, low nuclearity carbonyl clusters and high nuclearity carbonyl clusters, application of Eighteen Electron rule to metal carbonyls, prediction of nature of metal framework using Polyhedral skeletal electron pair theory (PSEPT) in high nuclear clusters. Tautometric structures of $[Co_2(CO)_8]$, $[Co_4(CO)_{12}]$ and $[Fe_3(CO)_{12}]$, preparation of $Ni(CO)_4$, $Fe(CO)_5$ and $Co_2(CO)_8$ by direct reaction of metals, $V(CO)_6$, $Cr(CO)_6$, $Ru(CO)_5$ and $Mn_2(CO)_{10}$ by reductive carbonylation, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$ and $Os_3(CO)_{12}$ by thermolysis and photolysis, structural features of simple metal carbonyls, chemical properties of $Ni(CO)_4$, $Cr(CO)_6$, $Mo(CO)_6$, $Fe(CO)_5$, $Mn_2(CO)_{10}$, $Co_2(CO)_8$.

Metal Nitrosyls: Coordinating behavior of NO, NO as abridging ligand, factors favoring linear and bent M-N-O linkage, synthesis of nirosyl complexes by direct replacement of carbonyl using NO, using nitrous acid, nitrosonium salt and hydroxylamine, importance of some nitrosyl complexes(Roussin's salt, nitroprusside ion, brown ring complex).

Dinitrogen Complexes: Reason for poor coordinating behavior of N_2 compared to it's isoelectronic species, binding modes of N_2, preparation of Ruthenium and Molybdenum dinitrogen complexes.

Acid-Base Chemistry: Bronsted-Lowry concept, Lux-Flood theory, solvent-system definition, Lewis theory, Usanovich concept, Hammett acidity function (superacids), different types of Lewis acids(the proton, metal ions, molecules with the central atom having an incomplete octet, molecules with central atom having vacant d orbitals, molecules having multiple bond between the atoms of different electronegativity such as CO_2, SO_3, acceptor-donor interaction between the electron deficient and electron rich molecules such as TCNE, picric acid), important factors governing the acid-base strength in terms of both Bronsted and Lewis theory (inductive effect, Entropic effect, d-orbital participation, a generalized concept of acid and bases, basicity of metal oxides, acidity of oxy acids, factors governing the strength of oxy acids, steric factors involved in the formation of adduct from Lewis and Lewis Base (F-Strain, B-Strain, proton sponge, hydride sponge), HSAB theory.

REFERENCE BOOKS:

01. Inorganic Chemistry: Principles, structure and reactivity, 1997, J. E. Huheey, Keiter and Keiter.

02. Inorganic Chemistry, 3rd edition, C. E. Housecroft and A. G. Sharpe.

03. Inorganic Chemistry by Purcel and Kotz.

04. Inorganic Chemistry by J. D. Lee.

05. Inorganic Chemistry by W. W. Porterfield.

06. Concepts and Models of Inorganic chemistry by Douglass, Alexander and Mcdaniel.

07. Advanced Inorganic Chemistry by Cotton and Wilkinson.

08. Inorganic Chemistry by Miessler and Tarr.

09. Fundamental concepts of Inorganic Chemistry by A. K. Das, volume 1 to 7.

10. Chemistry of Elements by N N Greenwood and A. Earnshaw (2nd Ed) 1997

RANI CHANNAMMA UNIVERSITY, BELGAVI
SCHOOL OF BASIC SCIENCES : CHEMISTRY

M.Sc. CHEMISTRY
FIRST SEMESTER

CHIPr -1.6 **INORGANIC CHEMISTRY PRACTICAL-I**
Laboratory hours per week : 04 Credits : 02
Total hours : 64

Ore Analysis:
Haematite: Iron by volumetric (potassium dichromate and Ceric ammonium sulphate) method and *by colorimetric method*
Pyrolusite: Determination of manganese dioxide in pyrolusite using permanganate titration
Estimation of calcium and magnesium carbonates in dolomite using EDTA titration, and gravimetric analysis of insoluble residue.

Alloy Analysis :
01. Quantitative analysis of Copper-Nickel in alloy /mixture:
i. Copper volumetrically using KIO_3.
ii. Nickel gravimetrically using DMG
02. Quantitative analysis of Copper-Zinc in alloy/mixture:
i. Copper gravimetrically as Cu(I) thiocyanate.
ii. Zinc by volumetrically by EDTA method

Determination of COD and BOD of polluted water.

RANI CHANNAMMA UNIVERSITY, BELGAVI
SCHOOL OF BASIC SCIENCES : CHEMISTRY

M.Sc. CHEMISTRY
I SEMESTER

CHOT-1.2 : ORGANIC CHEMISTRY-I
Teaching hours per week : 04 Credits : 04
Total hours : 64

UNIT-I **16 hours**

BASIC CONCEPTS AND REACTION MECHANISM

Concept of hybridization : sp^3, sp^2, sp – with examples.
Electronic effects : Inductive, electronic, resonance and hyperconjugation.
Classification of organic reagents and reactions.
Reactive Intermediates : carbocations, carbanions, free radicals, carbenes, nitrenes, and arynes-their formation, stability, structure and reactions.
Organic acid and bases : Effect of substituents with examples
Reaction Mechanism I: Classification, Determination of reaction mechanism by kinetic and non-kinetic-methods.
Kinetic Method: Mechanistic implications from rate laws, the transition state theory, ambiguities in interpreting kinetic data, solvent effect, ionic effect, isotopic effect, solvent isotopic effect, substituent effect, steric effect, linear free energy relationships – Hammett equation and Taft treatment.
Non-kinetic methods: Energy profile diagram, identification of products, testing possible in termediates, trapping of intermediates, cross over experiments, isotopic labeling, sterochemical studies, limitations.

UNIT-II **16 hours**

ADDITION AND ELIMINATION REACTIONS

Addition reactions: Addition to Carbon-Carbon double bond-addition of hydrogen halide(Markonikov's rule), bromine. Addition to Carbon-Hetero multiple bonds-addition of HCN, bisulphate, Grignard reagent, hydride, amino compounds alcohols and thiols to C=O.
Elimination reactions: E_1, E_2, E_{1CB} mechanisms, orientation during elimination reactions-Saytzeff and Hoffmann rules, pyrolytic eliminations, Chugave, Cope eliminations, Hoffmann degradation and dehalogenation of vicinal di halides.
Competition between substitution and elimination taking suitable example.

UNIT-III **16 hours**

SUBSTITUTION REACTIONS

Aromatic electrophilic substitution reactions: General mechanism of electrophilic substitution in aromatic systems using examples of nitration, halogenations, sulphonation and Friedal Craft alkylation and acylation.
Orientation effect of disubstitution in aromatic systems with suitable examples.
Nucleophilic substitution at saturated carbon: Mechanism of S_N1, S_N2 , S_Ni reactions – effect of solvent, substrate and leaving group, neighboring group participation, substitution at vinylic and allylic carbon.
Aromatic nucleophilic substitution reactions: Substitution of hydrogen, substitution other than hydrogen, S_NAR reactions, S_N1, S_N2 and benzyne mechanism, Bucherer reaction.

UNIT-IV **16 hours**

STEREOCHEMISTRY

Optical isomerism: Concepts of chirality-symmetry elements and cause for optical activity, chiral structures, relative configuration- Fischer's DL notation, threo and erythro nomenclature , absolute configurations- R, S nomenclature.

Molecular presentation : Sawhorse, Newman, Fischer and fly wedge formulae, enantiomers, epimers, anomers, recemic mixtures, resolution of racemic mixtures-Mechanical, biochemical and chemical method.

New methods of asymmetric synthesis: using optically active reagents, optically active substrates and optically active catalysts with suitable examples.

Enantio selective synthesis and diastereo selective synthesis.

Conformational analysis: Simple acyclic systems (butane, 1,2-dichloroethane) and cyclic systems(chair and boat forms of cyclohexane), effect of conformation on reactivity in acyclic and cyclic systems with suitable examples, stereoisomerism in biphenyls, allenes, and spirans.

Geometrical isomerism: Cis-trans, E, Z and syn-anti notations for geometrical isomers.

Geometrical isomerism in substituted alkenes, oximes, monocyclic and fused and bridge ring system.

Determination of configuration of geometrical isomers-Physical and chemical methods.

REFERENCE BOOKS:

01. Understanding organic reaction mechanisms, A. Jacob, Cambridge Univ. Press, 1997.
02. Introduction to organic chemistry A. Streitweiser, Jr and C. H. Heathcock, Macmillan, 1985.
03. Physical and mechanistic organic chemistry, R.A.Y. Jones, 1st Edn. Cambridge Univ. Press, 1979.
04. Mechanisms of molecular migrations, Vols I and II, B. S. Thiagarajan, 1st Edn. Pergamon Press, Oxford, 1979.
05. P. J. Garratt in Comprehensive organic chemistry, D. Barton and W. D. Ollis, 1st Edn. Pergamon Press, Oxford, 1979.
06. Radicals in organic synthesis, B. Giese, Pergamon Press, 1986.
07. Stereoelectronic effects in organic chemistry, P. Deslongchamps, 1st Edn. Pergamon Press, 1983.
08. Organic photochemistry, J. M. Coxon and B. Halton, 1st Edn, Cambridge Univ. Press, London, 1974.
09. Molecular reactions and photochemistry, C. H. Deputy and D. S. Chapman, 1st Edn. Prentice-hall India, New Delhi, 1972.
10. Stereochemistry of carbon compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley & Sons, 1994.
11. Stereochemistry, Potapov, MIR, Moscow, 1984.
12. Stereochemistry, Nasipuri, D, New Age, 1999.
13. Advanced organic chemistry, J. March, 4th Edn. John Wiley, 2008.
14. Organic Chemistry, R. E. Ireland Prentice-Hall India, New Delhi, 1975.
15. Some modern methods of Organic Synthesis, W. Caruthers, Cambridge Uni. Press London, 2nd Edn. 1998.
16. Stereochemistry of organic compounds- Principle and applications, D. Nasipuri, 2nd Edn., New Age International Publishers, 2001.

RANI CHANNAMMA UNIVERSITY, BELGAVI
SCHOOL OF BASIC SCIENCES : CHEMISTRY

M.Sc. CHEMISTRY
FIRST SEMESTER

CHOPr-1.7: ORGANIC CHEMISTRY PRACTICAL-I

Laboratory hours per week : 04 Credits : 02
Total hours : 64

TWO STEP PREPARATIONS

01. Preparation of acetanilide from aniline
02. Preparation of p-bromoacetanilide from acetanilide
03. Preparation of hydrolysis of p-bromoacetanilide to p-bromoaniline
04. Preparation of p-nitroacetanilide from acetanilide
05. Preparation of hydrolysis of p-nitroacetanilide to p-nitroaniline
06. Preparation of bezoic acid from benzaldehyde
07. Preparation of 2-hydroxynaphthaldehye from 2-naphthol
08. Preparation of 2,4,6 tribromo benzene from aniline
09. Preparation of phenylazo-β-naphthol
10. Preparation of 1-phenyl-3-methyl-pyrazolone

NOTE : Two preparations are to be given for Practical Examinations.

REFERENCE BOOKS:

01. Vogel's Text Book of Practical Organic Chemistry ELBS Longmann	Furniss, Hannaford, Smith and Tatchell,
02. Advanced Practical Organic Chemistry	N.K. Vishnoi, Vikas, Publishing House
03. Handbook of Practical Organic Chemistry	Clark
04. Practical Organic Chemistry	O.P. Agrawal

RANI CHANNAMMA UNIVERSITY, BELGAVI
SCHOOL OF BASIC SCIENCES: CHEMISTRY

M.Sc. CHEMISTRY
I SEMESTER

CHPT-1.3 : PHYSICAL CHEMISTRY-I
Teaching hours per week: 04 Credits: 04
Total hours: 64

UNIT–I **16 hours**

QUANTUM CHEMISTRY-I

A brief resume of black body radiation, comparative studies between classical and quantum theory (classical and Plank quantum theory, term symbols). Photoelectric and Compton effects. Derivation of Bohr's principle of quantization of angular momentum of electron from de-Broglie's relationship, consequences of de-Broglie equation, de-Broglie concept (To be derived). Uncertainty principle, mathematical expression for uncertainty principle. Postulates of quantum mechanics, operators, algebra of operators, ψ properties. Hamiltonian properties of operators, Hamiltonian operators form of Schrödinger's equation (with respect to space and time time). Physical significance of ψ and Characteristics of wave function, eigen function and eigen values, probability distribution function, normalization of ψ, orthogonality of ψ boundary valued condition. Application of equation to one dimension box.

UNIT-II **16 hours**

THERMODYNAMICS-I

Review of basic principles of thermodynamics (I and II laws of thermodynamics, concept of free energy and entropy, combined form of first and second laws of thermodynamics. Criteria for equilibrium and spontaneity, derivation of the variation of free energy with temperature and pressure). Maxwell's relation (to be derived). Thermodynamic equations of equipartition of energy, Classius-Clapeyron equation (to be derived) and its application. Entropy of vaporization. Vant-Hoff's equation, integrated form of vant-Hoff's equation. Nernst's equation and comparison with third law. Third law of thermodynamics, consequences of third law, determination of absolute entropies, concept of residual entropy of CO, NO_2, H_2, conclusion. Experimental verification of the third law. Entropies of real gases, entropy changes in chemical reactions. The Boltzmann entropy equation, thermodynamics of systems of variable compositions (problems to be solved).

UNIT–III **16 hours**

ELECTROCHEMISTRY-I

Electrolytic solutions, strong electrolytes, ionic atmosphere, relaxation and electrophoretic effects, quantitative treatment of Debey-Huckel theory and its extension by Onsogar activity co-efficient, mean ionic strength (Debey-Huckel limiting law). Qualitative treatment of Helmoltz-Perrin, Guoy-chapman and stern models, over potentials, exchange current density. Liquid junction potential and its determination. Equivalent conductance, specific conductance, electrochemical cell reactions. Derivation of Buttler-Volmer equation polarization and over voltage. Decomposition potential, electro chemical energy systems- introduction, fundamentals of batteries, classification of batteries, size of batteries, battery characteristics, primary batteries, dry cell, alkaline MnO_2 batteries and other batteries, secondary batteries-lead acid, alkaline storage batteries and fuel cells types-applications.

UNIT–IV **16 hours**

POLYMER AND NANOSCIENCE

Basic concepts: Monomers, polymers and degree of polymerization, general classification of polymers, homopolymers, copolymers, terpolymers. Linear, branched and graft network polymers. Polymer molecular weight: Number average and weight average molecular weights, polydispersity and molecular weight distribution in polymers. Characterization of polymers by IR and NMR. Addition polymers and condensation polymers, comparison between thermoplastics and thermosetting polymers. Techniques of free radical polymerization: Bulk, solution, emulsion and precification polymersization.

NANOSCIENCE: Nano particles. One dimention, two dymention, three dymention and quantum dots. Characterization of materials, splitting of bands, properties and applications. Synthesis: Chemical vapour transportor (CVT) and sol-gel methods. Metal oxides nanoparticles with supercritical water and precursor method. Synthesis of metal oxides and its composite nanoparticles by solvothermal and hydrothermal methods. Carbon nanotube, carbon nanowires and its composites. Applications of nanomaterials in renewable energy. Inorganic and organic nanoporous aerogels.

REFERENCE BOOKS:

01. Physical chemistry –Moore,Orient Longman,1972.
02. Principle of polymer science, by Bhahadur and N.V Shastry, 2nd addition Nonasa, 2011
03. An introduction to Chemical Thermodynamics –R. P.Rastogi and S.S.Misra, Vikash, Delhi, 1978.
04. Thermodynamics –Rajaram and Kunakose,East West, Nagin Cx,Dehli,1986.
05. An introduction to Electrochemistry –Glastone,East west Ltd.
06. Electrochemistry principles and applications –Porter
07. Introduction to electrochemistry by S. Glasstone.
08. Modern electrochemistry Vol. I and II, by J.O.M. Bockris and A.K.N. Reddy, Pentium Press, New York (1970).
09. Electrochemistry –Principles and applications by E.G. Potter.
10. Electrochemistry by Reiger, Prentice Hall (1987).
11. Industrial Electrochemistry – D. Pletcher and F. C. Walsh, Chapman ,II Edition,1984
12. Introductory Quantum Mechanics – Atkins ,Claredon,Oxford
13. Quantum chemistry-Kauzman,Academic Press,1957.
14. Quantum chemistry-R.K.Prasad ,II.Ed,New Age Int-2000
15. Textbook of polymer science –Billmeyer, Willey Intersection.
16. Polymer Science- V. R. Gowariker, 2010.

RANI CHANNAMMA UNIVERSITY, BELGAVI
SCHOOL OF BASIC SCIENCES : CHEMISTRY

M.Sc. CHEMISTRY
FIRST SEMESTER

CHPPr-1.8 PHYSICAL CHEMISTRY PRACTICAL-I

Laboratory hours per week : 04 Credits : 02
Total hours : 64

01. Analysis of binary mixture of two miscible liquids by viscometry and the relation between viscosity of solution and electrical conductivity
02. To determine the percentage composition of unknown mixture of A and B liquids by Abbe's refractometer by graphical method
03. To determine the percentage composition of unknown mixture of A and B liquids by Abbe's refractometer by formula method
04. Potentiometric titration of halides in a mixture of Cl^-, Br^- and I^- with $AgNO_3$
05. Titration of phosphoric acid solution with NaOH using quinhydrone electrode by potentiometrically
06. To determine the redox potential of Fe(II)/Fe(III) system by potentioametric method and estimate the amount of Fe(II)/$FeSO_4$ present in a given solution
07. Precipitation titration of $BaCl_2$ vs Na_2SO_4 by conductometrically
08. Precipitation titration of KCl vs $AgNO_3$ by conductometrically
09. Determination of parachor value for CH_2 groups by surface tension between two liquids 1) ethanol+propanol 2) ethanol+surfactant 3) propanol+surfactant
10. Conductometric acid base titration of polybasic acid (H_3PO_4) vs NaOH
11. Verification of Beers lamberts law by colarimetric method and calculation of molar extinction co-efficient (molar absorption co-efficient)
12. Determination of P^H of buffer solution by P^H meter and calculate pK_a of acetic acid

REFERENCE BOOKS:

01. Advanced Physico-Chemical Experiments –J. Rose.
02. Practical Physical Chemistry –S.R. Palit.
03. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
04. Experiments in Physical Chemistry – Palmer.
05. Experiments in Chemistry –D.V. Jahagirdar, Himalaya Publishing House, Bombay, (1994).
06. Experimental Physical Chemistry –Das. R.C. and Behera B, Tata Mc Graw Hill

RANI CHANNAMMA UNIVERSITY, BELGAVI
SCHOOL OF BASIC SCIENCES : CHEMISTRY

M.Sc. CHEMISTRY
I SEMESTER

CHGT-1.4 SPECTROSCOPY-I
Teaching hours per week : 02 Credits : 02
Total hours : 32

UNIT–I **16 hours**

MICROWAVE and UV-VISIBLE SPECTROSCOPY

electromagnetic radiation: Interaction of radiation with matter-absorption, emission, reflection, refraction, transmission, dispersion, polarization, interference and scattering, natural line width and broadening (Doppler effect), Heisenberg uncertainity and intensity of spectral lines, regions of electromagnetic spectrum and their corresponding energies: rotational, vibrational and electronic transitions and their energy levels, selection rules.

Microwave spectroscopy: Diatomic molecules**-r**igid and non rigid rotator model(No derivation), rotational quantum number and the selection rule, effect of isotopic substitution on rotation spectra, relative intensities of the spectral lines, classification of polyatomic molecules based on moment of inertia-linear, symmetric top, asymmetric top and spherical molecules, rotation spectra of polyatomic molecules(CO_2, CH_3F and BCl_3), moment of inertia expression for linear tri-atomic molecules, experimental techniques-microwave spectrometer, applications-principles of determination of bond length and moment of inertia from rotational spectra, Stark effect in rotation spectra and determination of dipole moments.

UV-visible spectroscopy: Types of transitions and their theoretical interpretation, Beer's law, Lambert's law, Beer's-Lambert's law, limitations, chromophores, auxochromes, effect of substituents on the position of λmax, prediction of λmax for polyenes, α,β-unsaturated aldehydes and ketones (Woodward- Fisher rules), aromatic systems and their derivatives. basic components of instrumentation-single and double beam designs, applications-analysis of binary mixtures, measurement of dissociation constants of acids and bases, photometric titrations and kinetic studies.

UNIT–II **16 hours**

IR and RAMAN SPECTROSCOPY

IR spectroscopy: Vibration of diatomic molecules, vibrational energy curves for simple harmonic oscillator, effects of anharmonic oscillation, vibration-rotation spectra of carbon monoxide(No derivation), expressions for fundamental and overtone frequencies, vibrations of polyatomic molecules– The number of degrees of freedom of vibration, , modes of vibration(CO_2 and H_2O), fundamental, overtone, combination, hot bands, Fermi resonance, force constant and its significance, theoretical group frequency, intensity of absorption band and types of absorptions, identification of functional groups-alkanes, alkenes, aromatics, carboxylic acids, carbonyl compounds(aldehydes and ketones, esters), amides and amines, fingerprint region, vibrational coupling, hydrogen bonding, steric effect and ring strain.

Raman spectroscopy: Introduction, Raman and Rayleigh scattering, Stokes and anti-Stokes lines, polarization of Raman lines, depolarization factor, polarizability ellipsoid, theories of Raman spectra - classical and quantum theory, rotational-Raman and vibrational- Raman spectra, comparison of Raman and IR spectra, rule of mutual exclusion principle, advantages of Raman spectra.

REFERENCE BOOKS:

01. Fundamentals of Molecular Spectroscopy, C. N. Banwell and E. M. McCash. 4th edition, Tata McGraw-Hill, New Delhi.

02. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw-Hill, New York.

03. Introduction to Spectroscopy. Pavia, Lampman and Kriz, 3rd edition, Thomson.

04. Spectroscopy, B. P. Straughan and S. Walker, John Wiley & Sons Inc., New York, Vol. 1 & 2, 1976.

05. Vibration Spectroscopy Theory and Applications, D. N. Satyanarayana, New age International, New Delhi.

06. Organic Spectroscopy, William Kemp, 3rd edition, Palgrava, 1991.

07. Optical Method of Analysis, E. D. Olsen, McGraw Hill Inc, 1975.

08. Spectroscopy of organic compounds – P. S. Kalasi, Wiley Eastern Ltd, India 1993.

09. Introduction to instrumental analysis – R. D. Braun, McGraw Hill Book company 1982.

10. Physical methods in inorganic chemistry – R. Drago, East West Pvt. Ltd, 1968.

11. Instrumental methods of chemical analysis – Gurdeep Chatwal and Anand.

12. Organic Spectroscopy, 2nd edition– Jag Mohan, Narosa Publishing House New Delhi.

13. Applications of IR and Raman spectroscopy to coordination and organometallic compounds, K. Nakamoto.

RANI CHANNAMMA UNIVERSITY, BELGAVI
SCHOOL OF BASIC SCIENCES : CHEMISTRY

M.Sc. CHEMISTRY
FIRST SEMESTER

CHES-1.5: ANALYTICAL CHEMISTRY
Teaching hours per week : 04 Credits : 04
Total hours : 64

UNIT-I **16 hours**

DATA ANALYSIS

Classification of analytical methods: Types of instrumental analysis, analytical methods on the basis of simple size. Errors, types of errors, determinate and indeterminate errors, accuracy and precision. Distribution of random errors, frequency distributions normal error curves. Statistical treatment of finet samples, measure central tendency -mean, medium, range, average deviation, relative average deviation, standard deviation and variance. Students' confidence interval of the mean. Testing for significance, comparison of two means and two standard deviations. Criteria for rejection of an observation-Q test, control chart, propagation of errors, significant figures. Least square methods of deriving calibration of plots. Principles of sampling the sampling step. Methods for sampling solid, liquid and gaseous samples. Need for quality assurance: ISO 9000 series of quality of system.

THERMAL METHODS OF ANALYSIS

Introduction, thermogravimetric analysis (TGA), types of thermogravimetric analysis, principle and method, automatic thermogravimetric analysis, instrumentation, types of recording thermobalances, sample holders, factors influencing thermograms and applications, isothermal analysis, Differential Thermal Analysis(DTA), principle of working, theory and instrumentation, simultaneous DTA-TGA curves, factors affecting results and applications. Differential Scanning Colorimetry(DSC), principle of working, theory, instrumentation and applications, thermometric titrations.

UNIT–II **16 hours**

CHROMATOGRAPHY

General description of chromatography, classification, chromatograms, migration rates of solute, retention time and column efficiency, plate theory and rate theory, Van-Deemeters equation, column resolution, factors influencing resolution.

PLANAR CHROMATOGRAPHY

Thin layer chromatography, stationary and mobile phase, various techniques of developments, visualization and evaluation of chromatograms, applications.

ION EXCHANGE CHROMATOGRAPHY

Introduction, principle, ion exchangers, classification of ion exchangers, regeneration, ion exchange techniques, applications of ion exchangers.

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

Introduction, classes of liquid chromatography, HPLC-instrumentation, column, pumping systems, detector and applications.

GAS CHROMATOGRAPHY

Introduction, instrumentation, sample introduction systems, columns, detector (FID and ECD), substrates, temperature control, evaluation, resolution, and applications (qualitative and quantitative).

UNIT–III **16 hours**

SEPERATION TECHNIQUES

SOLVENT EXTRACTION

Definition, types, principle and efficiency of extraction, sequence of extraction process, factors affecting extraction-pH, oxidation state, modifiers, synergistic, masking and salting out agents, techniques-batch and continuous extraction, applications.

ELECTROPHORESIS

Introduction, types and techniques of electrophoresis, factor affecting migration of ions, continuous electrophoresis, thin layer electrophoresis, moving boundary electrophoresis, zone electrophoresis, and Curtain electrophoresis, reverse osmosis electro dialysis, capillary electrophoresis and applications.

ULTRACENTRIFUGATION

Centrifugation, centrifugal force, sedimentation, centrifugal decantation, centrifuges, selection of centrifuge tubes, preparative, density gradient and isopycinic centrifugation, analytical sedimentation, sedimentation coefficient, sedimentation velocity-Application of the technique in biological separation; membrane separation - principle and applications.

UNIT–IV **16 hours**

ELECTROANALYTICAL TECHNIQUES

Introduction, electrochemical cells, faradic and non-faradic current, mass transfer in cells, galvanic and electrolytic cells, anodes and cathodes, liquid junction potential, schematic representation of cells.

Polarography: Theory, principle and applications classical polarography, dropping mercury electrode, polarogram, polarographic measurements, polarographic current, Ilkovic equation, current and concentration relationship, half wave potential, oxygen interference- advantages and limitations. Qualitative and quantitative analysis. Derivative polarography.

Amperometry and Coulometry at controlled potential and at constant current.

Cyclic voltametry - basic principles, instrumentation and applications.

Electrogravimetry - theory, electrode reactions, over-voltage, characteristics of a good deposit, completeness of deposition, separation of metals at controlled cathode potential. Determination of copper and nickel in Cu-Ni alloy.

REFERENCE BOOKS:

01. Principle of Quantitative Chemical Analysis – Robert de levie, International edition (1997) McGraw Hill Co.

02. Quantitative Analysis- Day and Underwood, Prinitce Hall Indian, Pvt Ltd 6thedition (1993).

03. Vogel's Textbook of quantitative chemical analysis- Revised by G.H.jaffery, J. Bassett, J. Mendhm and R.C. Denney ELBS 5thedition (1998).

04. Quantitative Chemical Analysis: D.C Harris W.M. Freeman and Co, NY, USA, Ed, (1995).

05. Introduction to Instrumental Analysis – R.D Brun, McGraw Hill Book company (1982).

06. Physical Methods in Inorganic Chemistry- R. Drago, Affiliated to East west Pvt, (1968).

07. Introduction to chromatography- theory and practice-V.K. Srivastava and K.K.Srivastava, S. chand Company Ltd., IV Ed (1991).

08. Basic Concepts of analytical Chemistry- S.M Khopkar, New Age Intentional Publishers, IIEd.,(1998).

09. Analytical chromatography- G.R Chatwal, Himalaya Publishing House, VII Ed., (1998).

10. Principle Instrumental Analysis- Skoog, Hollar and Nieman, , Harcourt, Asia pvt Ltd., Indian New Delhi, VEd, (1998).

11. Fundamentals of Analytical Chemistry- Skoog, West and Hollar, Harcourt, Asia pvt Ltd., Indian New Delhi, VEd, (1998).

RANI CHANNAMMA UNIVERSITY, BELGAVI

DEPARTMENT OF POST-GRADUATE STUDIES IN CHEMISTRY
(I TO II SEMESTERS)
SCHOOL OF BASIC SCIENCES

UNDER
CHOICE BASED CREDIT SYSTEM(CBCS)

WITH EFFECT FROM
ACADEMIC YEAR 2017-18 AND ONWARDS

QUESTION PAPER PATTERN

HARD CORE CHEMISTRY
(Regular AND Repeater)

Duration: 03 Hours **Maximum Marks: 80**

Instructions:
01) Answer all questions.
02) Figures to the right indicate marks.

01. Answer any EIGHT of the following questions. (08x02=16)
a.
b.
c.
d.
e.
f.
g.
h.
i.
j.

02. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**

03. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR

d) **06 Marks**

04. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**

05. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**

RANI CHANNAMMA UNIVERSITY, BELGAVI

DEPARTMENT OF POST-GRADUATE STUDIES IN CHEMISTRY
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WITH EFFECT FROM
ACADEMIC YEAR 2017-18 AND ONWARDS

QUESTION PAPER PATTERN

SOFT CORE CHEMISTRY:Spectroscopy
(Regular AND Repeater)

Duration: 02 Hours **Maximum Marks: 40**

Instructions:
01) Answer all questions.
02) Figures to the right indicate marks.

01. Answer any FOUR of the following questions. (04x02=08)
a.
b.
c.
d.
e.
f.

02. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**

03. a) **05 Marks**
b) **05 Marks**
c) **06 Marks**
OR
d) **06 Marks**