



MODIFIED CBCS CURRICULUM OF

CHEMISTRY GENERAL PROGRAMME

SUBJECT CODE = 00

FOR UNDER GRADUATE COURSES UNDER RANCHI UNIVERSITY



Implemented from Academic Session 2017-2020

Members of Board of Studies of CBCS Under- Graduate Syllabus as per Guidelines of the Ranchi University, Ranchi.

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COURSE STUCTURE FOR UNDERGRADUATE 'GENERAL' PROGRAMME

Fable A -1: Distribution of 120 Crew	${f lits}$ [*wherever there is a practical	there will be no tutorial and vice -versa.]
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	Course	Papers	Credits Theory + Practical	Credits Theory + Tutorial
I.	Core Course	(DSC A to D)		
	04 Courses from each of the 03 discipline of choice			
	Theory	4x3=12 Papers	12X4=48	12X5=60
	Practical/Tutorial*	4x3=12 Papers	12X2=24	12X1=12
II.	Elective Course (EC)			
	A. Discipline Specific Elective 02 Courses from each of the 03 discipline of choice	(DSE A & B)		
	Theory	2X3=6 Papers	6X4=24	6X5=30
	Practical/ Tutorial*	2X3=6 Papers	6X2=12	6X1=6
III	. Ability Enhancement Compulsory (Courses (AECC)		
	1. English/ Hindi Communication/ NH+MB/ Business Communication for Commerce	1 Paper	1X2=2	1X2=2
	2. Environmental Science	1 Paper	1x2=2	1x2=2
	3. Skill Enhancement Course	(SEC 1, 2, 3 & 4)		
	of the Core Course opted	4 Papers	4X2=8	4X2=8
		Total Credit	= 120	= 120

Table A-2: Course structure for B.Sc./ B.A./ B.Com. (Undergraduate Programme)

Semester	Course (Core Courses) 12 Papers	Allied (Elective Courses) 6 Papers	Ability Enhancement Total (Compulsory Courses) 6 Papers	Credits
Sem-I	DSC-1A, DSC-2A, DSC- (6+6+6=18 Credits)	3A	Eng /Hindi Comm/ NH+MB (02 Credits)	20 Credits
Sem-II	DSC-1B, DSC-2B, DSC- (6+6+6=18 Credits)	3B	EVS (02 Credits)	20 Credits
Sem-III	DSC-1C, DSC-2C, DSC- (6+6+6=18 Credits)	3C	SEC-1 (02 Credits)	20 Credits
Sem-IV	DSC-1D, DSC-2D, DSC- (6+6+6=18 Credits)	3D	SEC-2 (02 Credits)	20 Credits
Sem-V		DSE-1A, DSE-2A, DSE-3A (6+6+6=18 Credits)	SEC-3 (02 Credits)	20 Credits
Sem-VI		DSE-1B, DSE-2B, DSE-3B (6+6+6=18 Credits)	SEC-4 (02 Credits)	20 Credits

Total = 120 Credits

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COURSES OF STUDY FOR UNDERGRADUATE 'B. Sc. General' PROGRAMME

Table A-3: Basic Course structure for SCIENCE (Undergraduate Programme)

Total:120 Credits

Com	Course (Core Courses)		Allied (Elective Courses)		Ability Enhancement (Compulsory Courses)	
Sem	Code	4 x 3 = 12 Papers	Code	2 x 3 = 6 Papers	Code	1 + 1 + 4 = 6 Papers
Ι	DSC1A DSC2A DSC3A	Core Subject 1; Paper A Core Subject 2; Paper A Core Subject 3; Paper A			Compulsory Language Communication ENG/ Hindi/ NH + MB	
п	DSC1B DSC2B DSC3B	Core Subject 1; Paper B Core Subject 2; Paper B Core Subject 3; Paper B			EVS	Environmental Science
ш	DSC1C DSC2C DSC3C	Core Subject 1; Paper C Core Subject 2; Paper C Core Subject 3; Paper C			SEC1	SEC1: Elementary Computer Application Softwares +Lab
IV	DSC1D DSC2D DSC3D	Core Subject 1; Paper D Core Subject 2; Paper D Core Subject 3; Paper D			SEC2	SEC2 of Either Core Subject 1,2 or 3
v			DSE1A DSE2A DSE3A	Core Subject 1 Core Subject 2 Core Subject 3	SEC3	SEC3 of same subject opted in Sem III
v			DSE1B DSE2B DSE3B	Core Subject 1 Core Subject 2 Core Subject 3	SEC4	SEC4 of same subject opted in Sem III

Table A -4: Course structure for CHEMISTRY (Undergraduate Programme)

Total:120 Credits

G		Course (Core Courses)		Allied (Elective Courses)		Ability Enhancement (Compulsory Courses)	
Sem	Code	4 Papers	Code	2 Papers	Code	4 Papers	
I	DSC-A	Atomic Str., Bonding, General Organic Chem.& Aliphatic Hydrocarbons +Lab				Compulsory Language Communication	
п	DSC-B	Chemical Energetics, Equilibria & Functional Gp Organic Chemistry-I + Lab			EVS	Environmental Science	
ш	DSC-C	Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Gp Organic Chemistry-II + Lab			SEC1	Elementary Computer Application Softwares +Lab	
IV	DSC-D	Coordination chemistry, States of Matter and Chemical Kinetics +Lab			SEC2	Fuel Chemistry	
v			DSE-A	Polymer Chemistry +Lab	SEC3	Basic Analytical Chemistry	
VI			DSE-B	Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy +Lab	SEC4	Pharmaceutical Chemistry	

Table A-5: Subject Combinations allowed for B. Sc. General Programme:

	Subject 1	Subject 2	Subject 3
1	Mathematics	Physics	Chemistry/ Geology
2	Mathematics	Chemistry	Geology
3	Botany	Zoology	Chemistry/ Geology

Table A-6: Semester wise Structure for Mid Sem & End Sem Examinations:

	(Core Honours, Allied DSE, Compulsory AECC Courses	Examination Structure			
Sem	Code	Papers	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)	
Ι	DSC-A	Atomic Str., Bonding, General Organic Chem. & Aliphatic Hydrocarbons +Lab		75	25	
	AECC	Language Communication		100		
II	DSC-B	Chemical Energetics, Equilibria & Functional Gp Organic Chemistry-I + Lab		75	25	
	AECC	EVS		100		
ш	DSC-C	Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Gp Organic Chemistry-II +Lab		75	25	
IV	DSC-D	Coordination chemistry, States of Matter and Chemical Kinetics +Lab		75	25	
V	DSE-A	Polymer Chemistry +Lab		75	25	
VI	DSE-B	Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy +Lab		75	25	

Table A-7: Semester wise Structure for End Sem Examination of Skill Enhancement Course:

		Skill Enhancement Course SEC	Examination Structure				
Sem	Code	Papers	Mid Semester Theory (F.M.)	End Semester Theory (F.M.)	End Semester Practical/ Viva (F.M.)		
III	SEC 1	Elementary Computer Application Software +Lab		100			
IV	SEC 2	Fuel Chemistry		100			
V	SEC 3	Basic Analytical Chemistry		100			
VI	SEC 4	Pharmaceutical Chemistry		100			

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SEMESTER I

4 Papers

Total 100 x 4 = 400 Marks

I. <u>ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)</u>

(Credits: Theory-02)

Any One Compulsory Language Communication Prescribed by Ranchi University: English Communication/ Hindi Communication / NH + MB Communication (**Refer AECC Curriculum of Ranchi University**)

II. <u>CORE COURSE –DSC-A:</u>

(Credits: Theory-04, Practicals-02)

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100 Pass Marks: Th ESE = 30 + Pr ESE = 10

Instruction to Question Setter for

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS Theory: 60 Lectures

Section A: Inorganic Chemistry-1 (30 Periods):

Atomic Structure:

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_1 and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of halffilled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

(14 Lectures)

Chemical Bonding and Molecular Structure

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding,

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lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approaches.

(16 Lectures)

Section B: Organic Chemistry-1 (30 Periods)

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

(10 Lectures)

(8 Lectures)

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons).

Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons)

Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's

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(12 Lectures)

and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons)

Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alk. KMnO₄.

Reference Books:

□ Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.

Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.

Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.

□ Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.

Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).

- □ McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
- Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
- □ Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
- □ Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
- Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010

CHEMISTRY LAB- DSC-A LAB:

60 Lectures

Section A: Inorganic Chemistry - Volumetric Analysis

- 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
- 2. Estimation of oxalic acid by titrating it with KMnO₄.
- 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO₄.
- 4. Estimation of Fe (II) ions by titrating it with K₂Cr₂O₇ using internal indicator.
- 5. Estimation of Cu (II) ions iodometrically using Na₂S₂O₃.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)

2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)

(a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid,

glutamic acid, tyrosine or any other amino acid) by paper chromatography

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Reference text:

- Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
- Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
- □ Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960

SEMESTER II

Total 100 x 4 = 400 Marks

I. ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)

(Credits: Theory-02)

Pass Marks Th ESE = 40

Instruction to Question Setter for

Marks : 100 (ESE: 3Hrs) =100

End Semester Examination (ESE):

There will be objective type test consisting of hundred questions of 1 mark each. Examinees are required to mark their answer on **OMR Sheet** provided by the University.

AECC – ENVIRONMENT STUDIES

Unit 1: Introduction to environmental studies

Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Unit 2 : Ecosystems

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

Forest ecosystem Grassland ecosystem Desert ecosystem Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3 : Natural Resources : Renewable and Non--renewable Resources

Land resources and landuse change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

Water : Use and over--exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter--state).

Energy resources : Renewable and non renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4 : Biodiversity and Conservation

Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots India as a mega--biodiversity nation; Endangered and endemic species of India Threats to biodiversity : Habitat loss, poaching of wildlife, man--wildlife conflicts, biological invasions; Conservation of biodiversity : In--situ and Ex--situ conservation of biodiversity.

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Theory: 30 Lectures

(2 lectures)

(2 lectures)

(5 lectures)

4 Papers

Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5 : Environmental Pollution

Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution Nuclear hazards and human health risks

Solid waste management : Control measures of urban and industrial waste. Pollution case studies.

Unit 6 : Environmental Policies & Practices

Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture

Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(4 lectures)

Unit 7 : Human Communities and the Environment

Human population growth: Impacts on environment, human health and welfare.

Resettlement and rehabilitation of project affected persons; case studies.

Disaster management : floods, earthquake, cyclones and landslides.

Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.

Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.

Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

(3 lectures)

Unit 8 : Field work

Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Visit to a local polluted site--Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems--pond, river, Delhi Ridge, etc.

(Equal to 4 lectures)

Suggested Readings:

- Carson, R. 2002. *Silent Spring*. Houghton Mifflin Harcourt.
- Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
- Gleeson, B. and Low, N. (eds.) 1999. *Global Ethics and Environment*, London, Routledge.
- □ Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
- Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
- Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science*, 339: 36--37.

(5 lectures)

(5 lectures)

- □ McCully, P. 1996. *Rivers no more: the environmental effects of dams*(pp. 29--64). Zed Books.
- □ McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
- Odum, E.P., Odum, H.T. & Andrews, J. 1971. *Fundamentals of Ecology*. Philadelphia: Saunders.
- Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
- Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
- Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. *Environment*. 8th edition. John Wiley & Sons.
- □ Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
- Sengupta, R. 2003. *Ecology and economics*: An approach to sustainable development. OUP.
- □ Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi.
- □ Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. *Conservation Biology: Voices from the Tropics*. John Wiley & Sons.
- □ Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
- □ Warren, C. E. 1971. *Biology and Water Pollution Control*. WB Saunders.
- □ Wilson, E. O. 2006.*The Creation: An appeal to save life on earth*. New York: Norton.
- □ World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University

II. <u>CORE COURSE – DSC-B:</u>

(Credits: Theory-04, Practicals-02)

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100

Pass Marks: Th ESE = 30 + Pr ESE =10

Instruction to Question Setter for

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I Theory: 60 Lectures

Section A: Physical Chemistry-1 (30 Lectures)

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

(10 Lectures)

Chemical Equilibrium:

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔGo , Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

(8 Lectures)

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Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of

Section B: Organic Chemistry-2 (30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons

solubility product principle.

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by -OH group) and effect of nitro substituent. Benzyne Mechanism: KNH₂/NH₃ (or NaNH₂/NH₃). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols, Phenols and Ethers (Upto 5 Carbons)

Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. KMnO₄, acidic dichromate, conc. HNO₃). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. ReimerTiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten - Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO₃, NH₂-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

(14 Lectures)

CBCS CURRICULUM

(8 Lectures)

(8 Lectures)

(12 Lectures)

Reference Books:

- Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
- □ McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
- □ Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
- □ Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
- □ Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
- □ Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- □ Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- □ Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
- □ Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- □ Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
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CHEMISTRY LAB-DSC-B LAB

60 Lectures

Section A: Physical Chemistry

Thermochemistry

- 1. Determination of heat capacity of calorimeter for different volumes.
- 2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
- 3. Determination of enthalpy of ionization of acetic acid.
- 4. Determination of integral enthalpy of solution of salts (KNO₃, NH₄Cl).
- 5. Determination of enthalpy of hydration of copper sulphate.
- 6. Study of the solubility of benzoic acid in water and determination of ΔH .

Ionic equilibria

1. pH measurements

a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

- b) Preparation of buffer solutions:
 - (i) Sodium acetate-acetic acid
 - (ii) Ammonium chloride-ammonium hydroxide

2. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

- 1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
- 2. Criteria of Purity: Determination of melting and boiling points.
- 3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.
 - (a) Bromination of Phenol/Aniline
 - (b) Benzoylation of amines/phenols
 - (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Reference Books

- □ Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
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SEMESTER III

CBCS CURRICULUM

4 Papers

Total 100 x 4 = 400 Marks

I. SKILL ENHANCEMENT COURSE SEC 1:

All Four Papers (One paper to be studied in each semester) of any One Subject to be opted from either of the Core Subjects opted for General Courses of Study. Refer Content from the Syllabus of opted Skill Enhancement Course Subject.

II. **CORE COURSE – DSC-C:**

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100	Pass Marks: Th ESE = 30 + Pr ESE =10

Instruction to Question Setter for

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY & FUNCTIONAL GROUP ORGANIC CHEMISTRY-II **Theory: 60 Lectures**

Section A: Physical Chemistry-2 (30 Lectures)

Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.

Phase Equilibrium

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius - Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl₃-H₂O and Na-K only).

Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

(Credits: Theory-02)

(Credits: Theory-04, Practicals-02)

(8 Lectures)

(8 Lectures)

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations(only acid base).

Electrochemistry

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG , ΔH and ΔS from EMF data.

Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidationreduction only).

Section B: Organic Chemistry-3 (30 Lectures)

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Carboxylic acids and their derivatives Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell - Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons)

Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

(6 Lectures)

(6 Lectures)

Amines and Diazonium Salts Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO₂, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.

Amino Acids, Peptides and Proteins:

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of -COOH group, acetylation of -NH₂ group, complexation with Cu²⁺ ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

Determination of Primary structure of Peptides by degradation Edmann degradation (Nterminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & Cactivating groups and Merrifield solid-phase synthesis.

(10 Lectures)

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(8 Lectures)

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(6 Lectures)

(8 Lectures)

Carbohydrates:

Classification, and General Properties, Glucose and Fructose (open chain and cyclicstructure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Reference Books:

- Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- □ Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- □ Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
- Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- □ Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.

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CHEMISTRY LAB-DSC-C LAB

60 Lectures

Section A: Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method: $I_2(aq) + I^-(aq) I_3^-(aq) Cu^{2+}(aq) + xNH_2(aq) [Cu(NH_3)_x]^{2+}$

Phase equilibria

a) Construction of the phase diagram of a binary system (simple eutectic) using cooling curves. b) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it. c) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

Conductance

- I. Determination of cell constant
- II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- III. Perform the following conductometric titrations:i. Strong acid vs. strong baseii. Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:

- i. Strong acid vs. strong base
- ii. Weak acid vs. strong base iii. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

II.

- 1. Separation of amino acids by paper chromatography
- 2. Determination of the concentration of glycine solution by formylation method.
- 3. Titration curve of glycine
- 4. Action of salivary amylase on starch
- 5. Effect of temperature on the action of salivary amylase on starch.
- 6. Differentiation between a reducing and a nonreducing sugar.

Reference Books:

- □ Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
- Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
- Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press

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SEMESTER IV

Total 100 x 4 = 400 Marks

(Credits: Theory-02)

I. **SKILL ENHANCEMENT COURSE SEC 2:**

1. All Four Papers (One paper to be studied in each semester) of any One Subject to be opted from either of the Core Subjects opted for General Courses of Study. Refer Content from the Syllabus of opted Skill Enhancement Course Subject.

II. **CORE COURSE – DSC-D:**

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100	Pass Marks: Th ESE = 30 + Pr ESE = 10

Instruction to Question Setter for

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

COORDINATION CHEMISTRY, STATES OF MATTER & CHEMICAL KINETICS Theory: 60 Lectures

Section A: Inorganic Chemistry-3 (30 Lectures)

Transition Elements (3d series)

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu.

Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

Coordination Chemistry

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6.

Drawbacks of VBT. IUPAC system of nomenclature.

Crystal Field Theory

Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for Oh and Td complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.

(10 Lectures)



(8 Lectures)

(12 Lectures)



(Credits: Theory-04, Practicals-02)

Section B: Physical Chemistry-3 (30 Lectures)

Kinetic Theory of Gases

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO₂.

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Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only).

Liquids

Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

(6 Lectures)

Solids

Forms of solids. Symmetry elements, 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. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals.

Chemical Kinetics

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Reference Books:

- Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- □ Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
- □ Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).
- Petrucci, R.H. General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985).
- Cotton, F.A. & Wilkinson, G. Basic Inorganic Chemistry, Wiley.
- □ Shriver, D.F. & Atkins, P.W. Inorganic Chemistry, Oxford University Press.
- □ Wulfsberg, G. Inorganic Chemistry, Viva Books Pvt. Ltd.
- □ Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008.

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(8 Lectures)

(8 Lectures)

(8 Lectures)

CHEMISTRY LAB –DSC-D LAB

60 Lectures

Section A: Inorganic Chemistry

Semi-micro qualitative analysis using H_2S of mixtures - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following: Cations :

NH4⁺, Pb²⁺, Ag⁺, Bi³⁺, Cu²⁺, Cd²⁺, Sn²⁺, Fe³⁺, Al³⁺, Co²⁺, Cr³⁺, Ni²⁺, Mn²⁺, Zn²⁺, Ba²⁺, Sr²⁺, Ca²⁺, K⁺

Anions :

CO3²⁻, S²⁻, SO3²⁻, S2O3²⁻, NO3⁻, CH3COO⁻, Cl⁻, Br⁻, I⁻, NO3⁻, SO4²⁻, PO4³⁻, BO3³⁻, C2O4²⁻, F⁻

(Spot tests should be carried out wherever feasible)

- 1. Estimate the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.
- Draw calibration curve (absorbance at λmax vs. concentration) for various concentrations of a given coloured compound (KMnO₄/ CuSO₄) and estimate the concentration of the same in a given solution.
- 3. Determine the composition of the Fe3+-salicylic acid complex solution by Job's method.
- 4. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
- 5. Estimation of total hardness of a given sample of water by complexometric titration.
- 6. Determination of concentration of Na+ and K+ using Flame Photometry.

Section B: Physical Chemistry

(I) Surface tension measurement (use of organic solvents excluded).

- a) Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
- b) Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

a) Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.

b) Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

- 1. Initial rate method: Iodide-persulphate reaction
- 2. Integrated rate method:
 - a. Acid hydrolysis of methyl acetate with hydrochloric acid.
 - b. Saponification of ethyl acetate.
 - c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Book:

□ Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.

□ Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

□ Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

SEMESTER V

CBCS CURRICULUM

Total 100 x 4 = 400 Marks

I. SKILL ENHANCEMENT COURSE SEC 3:

1. All Four Papers (One paper to be studied in each semester) of any One Subject to be opted from either of the Core Subjects opted for General Courses of Study. Refer Content from the Syllabus of opted Skill Enhancement Course Subject

II. **CHEMISTRY SPECIFIC- DSE A:**

Instruction to Question Setter for

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

POLYMER CHEMISTRY

Introduction and history of polymeric materials:

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.

Functionality and its importance:

Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Polyfunctional systems.

Kinetics of Polymerization:

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

Crystallization and crystallinity:

Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

(4 Lectures)

Nature and structure of polymers-Structure Property relationships.

(Credits: Theory-02)

(Credits: Theory-04, Practicals-02)

Pass Marks: Th ESE = 30 + Pr ESE = 10

(4 Lectures)

(8 Lectures)

(8 lectures)

(2 Lectures)

Theory: 60 Lectures

4 Papers

CHEMISTRY GENERAL

CHEMISTRY GENERAL

CBCS CURRICULUM

Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance.

Polydispersity index.

Glass transition temperature (Tg) and determination of Tg, Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

(8 Lectures)

Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory-Huggins theory, Lower and Upper critical solution temperatures.

(8 Lectures)

(10 Lectures)

Properties of Polymers (Physical, thermal, Flow & Mechanical Properties).

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes.

Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

Reference Books:

□ Seymour, R.B. & Carraher, C.E. Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981. □ Odian, G. Principles of Polymerization, 4th Ed. Wiley, 2004.

- Billmeyer, F.W. Textbook of Polymer Science, 2nd Ed. Wiley Interscience, 1971.
- Ghosh, P. Polymer Science & Technology, Tata McGraw-Hill Education, 1991.
- Lenz, R.W. Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967.

(8 Lectures)

CHEMISTRY LAB-DSE-A LAB

Polymer synthesis

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).

- a.Purification of monomer
- b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)
- 2. Preparation of nylon 66/6

3. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

- a. Preparation of IPC
- b. Purification of IPC
- c. Interfacial polymerization
- 4. Redox polymerization of acrylamide
- 5. Precipitation polymerization of acrylonitrile
- 6. Preparation of urea-formaldehyde resin
- 7. Preparations of novalac resin/resold resin.
- 8. Microscale Emulsion Polymerization of Poly(methylacrylate).

Polymer characterization

- 1. Determination of molecular weight by viscometry:
 - (a) Polyacrylamide-aq.NaNO2 solution
 - (b) (Poly vinyl proplylidine (PVP) in water

2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.

- 3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
- 4. Testing of mechanical properties of polymers.
- 5. Determination of hydroxyl number of a polymer using colorimetric method.

Polymer analysis

- 1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
- 2. Instrumental Techniques
- 3. IR studies of polymers
- 4. DSC analysis of polymers
- 5. Preparation of polyacrylamide and its electrophoresis

*at least 7 experiments to be carried out.

Reference Books:

- □ M.P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed., Oxford University Press, 1999.
- □ H.R. Allcock, F.W. Lampe & J.E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall (2003)
- □ F.W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984)
- □ J.R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)
- □ P. Munk & T.M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)
- L. H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
- □ M.P. Stevens, Polymer Chemistry: An Introduction 3rd ed. Oxford University Press (2005).
- □ Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

SEMESTER VI

CBCS CURRICULUM

RANCHI UNIVERSITY

4 Papers

Total 100 x 4 = 400 Marks

(Credits: Theory-04, Practicals-02)

Pass Marks: Th ESE = 30 + Pr ESE = 10

(Credits: Theory-02)

I. SKILL ENHANCEMENT COURSE SEC 4:

All Four Papers (One paper to be studied in each semester) of any One Subject to be opted from either of the Core Subjects opted for General Courses of Study. Refer Content from the Syllabus of opted Skill Enhancement Course Subject

II. **CHEMISTRY SPECIFIC- DSE-B:**

Instruction to Question Setter for

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY

Theory: 60 Lectures

Section A: Inorganic Chemistry-4 (30 Lectures)

Chemistry of 3d metals

Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, K₂Cr₂O₇, KMnO₄, K₄[Fe(CN)₆], sodium nitroprusside, [Co(NH₃)₆]Cl₃, $Na_3[Co(NO_2)_6].$

Organometallic Compounds

Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)-(MO diagram of CO can be referred to for synergic effect to IR frequencies).

(12 Lectures)

A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na⁺, K⁺ and Mg²⁺ ions: Na/K pump; Role of Mg²⁺ ions in energy production and chlorophyll. Role of Ca²⁺ in blood clotting, stabilization of protein structures and structural role (bones). (12 Lectures)

Bio-Inorganic Chemistry

(6 Lectures)

Section B: Organic Chemistry-4 (30 Lectures)

Polynuclear and heteronuclear aromatic compounds:

Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

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Active methylene compounds:

Preparation: Claisen ester condensation. Keto-enol tautomerism.

Reactions: Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).

Application of Spectroscopy to Simple Organic Molecules

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, \lambdamax & \varepsilonmax, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating 1 max of conjugated dienes and α,β – unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).

(18 Lectures)

Reference Books:

□ James E. Huheey, Ellen Keiter & Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.

- G.L. Miessler & Donald A. Tarr: Inorganic Chemistry, Pearson Publication.
- □ J.D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
- □ F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley & Sons.
- □ I.L. Finar: Organic Chemistry (Vol. I & II), E.L.B.S.
- □ John R. Dyer: Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall.

R.M. Silverstein, G.C. Bassler & T.C. Morrill: Spectroscopic Identification of Organic Compounds, John Wiley & Sons.

- R.T. Morrison & R.N. Boyd: Organic Chemistry, Prentice Hall.
- □ Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.

Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

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(6 Lectures)

(6 Lectures)

CHEMISTRY PRACTICAL – DSE-B LAB:

Section A: Inorganic Chemistry

- Separation of mixtures by chromatography: Measure the Rf value in each case. (Combination of two ions to be given) Paper chromatographic separation of Fe³⁺, A1³⁺ and Cr³⁺ or Paper chromatographic separation of Ni²⁺, Co²⁺, Mn²⁺ and Zn²⁺
- 2. Preparation of any two of the following complexes and measurement of their conductivity:
 - (i) tetraamminecarbonatocobalt (III) nitrate
 - (ii) tetraamminecopper (II) sulphate
 - (iii) potassium trioxalatoferrate (III) trihydrate
- 3. Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl₂ and LiCl₃.

Section B: Organic Chemistry

Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative

Reference Books:

- □ A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- □ A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- □ Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
- □ Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

60 Lectures

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COURSES OF STUDY FOR **SKILL ENHANCEMENT COURSE 'B. Sc. General'** PROGRAMME IN **"CHEMISTRY"**

SEMESTER III SKILL ENHANCEMENT COURSE 1 Paper

Total 100 x 1 = 100 Marks

III. <u>SKILL ENHANCEMENT COURSE SEC 1:</u>

Marks : 100 (ESE: 3Hrs) =100

Instruction to Question Setter for End Semester Examination (ESE):

There will be **objective type test** consisting of hundred questions of 1 mark each. Students are required to mark their answer on **OMR Sheet** provided by the University.

ELEMENTARY COMPUTER APPLICATION SOFTWARES:

A Common Syllabus Prescribed by Ranchi University

Theory: 30 Lectures

Objective of the Course

The objective of the course is to generate qualified manpower in the area of Information Technology (IT) and Graphic designing which will enable such person to work seamlessly at any Offices, whether Govt. or Private or for future entrepreneurs in the field of IT.

A. INTRODUCTION TO COMPUTER SYSTEM

Basic Computer Concept

Computer Appreciation - Characteristics of Computers, Input, Output, Storage units, CPU, Computer System. (1 Lecture)

Input and Output Devices

Input Devices - Keyboard, Mouse, joystick, Scanner, web cam,

Output Devices- Soft copy devices, monitors, projectors, speakers, Hard copy devices, Printers – Dot matrix, inkjet, laser, Plotters. (4 lectures)

Computer Memory and Processors

Memory hierarchy, Processor registers, Cache memory, Primary memory- RAM, ROM, Secondary storage devices, Magnetic tapes, Floppy disks, hard disks, Optical Drives- CD-ROM, DVD-ROM, CD-R, CD-RW, USB Flash drive, Mass storage devices: USB thumb drive. Managing disk Partitions, File System. Basic Processor Architecture, Processor speed, Types of processor.

(5 lectures)

Numbers Systems and Logic Gates

Decimal number system, Binary number system, Octal number system, Hexadecimal number system, Inter-conversion between the number systems. Basic Logic gates-AND, OR, NOT, Universal logic gates- NAND, NOR (3 lectures)

Computer Software

Computer Software- Relationship between Hardware and Software, System Software, Application Software, Compiler, Names of some high level languages, Free domain software. (2 Lectures)

Pass Marks Th ESE = 40

(Credits: Theory-02)

CHEMISTRY GENERAL Internet & its uses

History of Internet, WWW and Web Browsers: Web Browsing software, Surfing the Internet, Chatting on Internet, Basic of electronic mail, Using Emails, Document handling, Network definition, Common terminologies: LAN, WAN, MAN, Node, Host, Workstation, Bandwidth, Network Components: Severs, Clients, Communication Media. Wireless network

Operating system-Windows

Operating system and basics of Windows, The User Interface, Using Mouse and Moving Icons on the screen, The My Computer Icon, The Recycle Bin, Status Bar, Start and Menu & Menu-selection, Running an Application, Windows Explorer Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows, Windows Setting, Control Panels, Wall paper and Screen Savers, Setting the date and Sound, Concept of menu Using Help, Advanced Windows, Using right Button of the Mouse, Creating Short cuts, Basics of Window Setup, Notepad, Window Accessories

B. MICROSOFT OFFICE 2007 AND LATEST VERSIONS

Word Processing

Word processing concepts: saving, closing, Opening an existing document, Selecting text, Editing text, Finding and replacing text, printing documents, Creating and Printing Merged Documents, Character and Paragraph Formatting, Page Design and Layout. Editing and Checking. Correcting spellings. Handling Graphics, Creating Tables and Charts, Document Templates and Wizards, Mail merge and Macros.

Microsoft Excel (Spreadsheet)

Spreadsheet Concepts, Creating, Saving and Editing a Workbook, Inserting, Deleting Work Sheets, entering data in a cell / formula Copying and Moving from selected cells, handling operators in Formulae, Functions: Mathematical, Logical, statistical, text, financial, Date and Time functions, Using Function Wizard. Formatting a Worksheet: Formatting Cells changing data alignment, changing date, number, character or currency format, changing font, adding borders and colors, Printing worksheets, Charts and Graphs – Creating, Previewing, Modifying Charts. Integrating word processor, spread sheets, web pages. Pivot table, goal seek, Data filter and scenario manager (4 Lectures)

Microsoft Power Point (Presentation Package)

Creating, Opening and Saving Presentations, Creating the Look of Your Presentation, Working in Different Views, Working with Slides, Adding and Formatting Text, Formatting Paragraphs, Drawing and Working with Objects, Adding Clip Art and other pictures, Designing Slide Shows, Running and Controlling a Slide Show, Printing Presentations. Creating photo album, Rehearse timing and record narration. Master slides. (3 Lectures)

Reference Books

- □ Nishit Mathur, Fundamentals of Computer , Aph publishing corporation(2010)
- ☐ Misty E. Vermaat,.Microsoft word 2013 1st Edition (2013).
- Satish Jain, M.Geeta, MS- Office 2010 Training Guide, BPB publication (2010)
- Joan Preppernau, Microsoft PowerPoint 2016 step by step, Microsoft press(2015)
- Douglas E Corner, The Internet Book 4th Edition, prentice –Hall(2009)
- \Box Faithe wempen, word 2016 in depth 1st edition, que publishing(2015)

Steven welkler, Office 2016 for beginners, Create Space Independent publishing Plateform (2016)

(3 Lectures)

(2 Lectures)

(3 Lectures)

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SKILL ENHANCEMENT LAB- SEC 1 LAB

A. MS-WORD LAB ASSIGNMENT

1. Write down the following Paragraph OR any one provided by your teacher;

Without a doubt, the Internet is one of the most important inventions of modern times. The Internet is a global interconnected computer networks which allow each connected computer to share and exchange information with each other. The origins of the Internet can be traced to the creation of Advanced Research Projects Agency Network (ARPANET) as a network of computers under the auspices of the U.S. Department of Defense in 1969.

Apply following effects on The paragraph:

- i. Paragraph **font-size** and **font-type** must be 12 Verdana.
- ii. Paragraph **alignment** must be justified and double line spacing.
- iii. **Highlight** the "(ARPANET)" with green color.
- iv. Make the "Internet" keywords **Bold and Italic**.
- v. Insert any "WordArt" and a symbol to your document.
- vi. Insert a **clipart** to your document.
- vii. Add following lines to your document: Internet, Intranet, Extranet, URL, WWW, Networking, Protocols, HTTP, TCP/IP
- 2. Create a Table of following fields:

Name, Surname, Age, Gender, Job and apply the following effects

- i. Insert 10 records
- ii. Font size should be 12
- iii. Title size should be 14
- iv. Font type should be Times new Roman
- v. Title color should be blue
- vi. Text color should be black
- vii. Table border should be 2

3. Write a letter on 'Road Safety' and send to 'Multiple Recipients' using mail merge.

4. Type the paragraph given below:

Today, the Internet is a public, cooperative and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/Internet Protocol). Two recent adaptations of Internet is a public, cooperative and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is a fully, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/ Internet Protocol). Two recent adaptations of Internet technology, the internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (for Transmission Control Protocol/ Internet Protocol). Two recent adaptations of Internet technology, the intranet and the extranet, also make use of the TCP/IP protocol.

Apply the following:

- i. Change Internet into Internets at a time
- ii. Heilight TCP/IP in red color
- iii. Replace protocol into protocols
- iv. Find the word "Public"

B. MICROSOFT EXCEL LAB ASSIGNMENT

Basic Formatting and Spreadsheet Manipulation

- 1. Add rows and columns to an existing spreadsheet
- 2. Reformat data (center, comma and currency styles, bold, text color)
- 3. Work with a simple formula (product) and function (sum)

Assignment

- 1. Create a workbook as shown below.
- 2. To enter new rows or columns, simply click on the row or column header to select the whole row or column. Then right click with the mouse and choose insert.
- Add the new row for S Spade with the data that's shown below (between the original rows 7 and 8).
- 4. Add a column for gender and the data as shown below (between the original columns A and B). Enter the appropriate gender for yourself in the last row.

Α	В	С	D
Name	Male/Female	Genre	Number of Songs
J Smith	F	Blues	50
B Doe	М	Country	110
S Spade	F	Country	200
F Zappa	М	Blues	1400
F Zappa	М	Alternative	2300
J Smith	F	Alternative	150
S Spade	F	Blues	1000
B Doe	М	Blues	75
yourname	М	Blues	800

- 5. Center the data in columns B and C. Do this by selecting the whole column and click the center icon on the ribbon.
- 6. Bold the data in row 1, the column headings (ensure that the data all remains visible within the column boundaries).
- 7. Change the font color for row 1 to Blue.
- 8. Change the format of the data in column D to comma style <u>(no decimal places showing)</u>. There is an icon on the home tab that sets it to comma style easily.
- 9. Add two new column labels to the right of the current columns; **Unit Price** and **Total Cost**. (They will be in columns E and F.) These two columns of data should be currency type so that the dollar sign is shown. There is an icon to quickly format the selected column as currency type.
- 10. All tunes are \$.99, so enter that value for all rows in Column E. You can copy quickly by using the **Auto Fill** handle and drag that amount down. When you over your mouse over the tiny square in

the bottom right hand corner of the active cell, your mouse shape will become a skinny plus sign, and you can click and drag that cell to make a copy.



- 11. Calculate Total Cost (column F) as *column D times Column E*. You will type in a formula like this into cell F2: <u>=D2*E2</u> (Be sure to begin the formula with an equal sign)
- 12. Use the AutoFill (skinny plus sign) again to copy the formula down column F; down to F10. Double check the picture below to make sure yours has the correct values
- 13. Add a border to all of the cells (A1-f10) using the Borders tool in the Fonts group on the Home Tab.
- 14. Change the page layout to landscape. Do this by clicking the Page Layout tab on the ribbon and then to Orientation to Landscape.
- 15. Save the file.
- 16. Click in cell F11 and Use the sum function or the shortcut icon that looks like \sum to get the total of the Total Cost column.
- 17. Ensure that the data is all visible within the column boundaries. Make the columns wider if needed.
- 18. Save the workbook. Your final spreadsheet should look like the following when printed.

Name	Male/Female	Genre	Number of Songs	Unit Price	Total Cost
J Smith	F	Blues	50	\$ 0.99	\$ 49.50
B Doe	М	Country	110	\$ 0.99	\$ 108.90
S Spade	F	Country	200	\$ 0.99	\$ 198.00
F Zappa	М	Blues	1,400	\$ 0.99	\$ 1,386.00
F Zappa	М	Alternative	2,300	\$ 0.99	\$ 2,277.00
S Spade	F	Blues	1,000	\$ 0.99	\$ 990.00
J Smith	F	Alternative	150	\$ 0.99	\$ 148.50
B Doe	М	Blues	75	\$ 0.99	\$ 74.25
yourname	М	Blues	800	\$ 0.99	\$ 792.00

\$ 6,024.15

Create a sample table given below in Excel

- Using formula find Total
- ▶ Find the maximum value using MAX function from the **Units** column
- Find minimum value from Total column

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Order Date	Region	Rep	Item	Units	Unit Cost	Total
1/6/2016	East	Jones	Pencil	95	1.99	189.05
1/23/2016	Central	Kivell	Binder	50	19.99	999.50
2/9/2016	Central	Jardine	Pencil	36	4.99	179.64
2/26/2016	Central	Gill	Pen	27	19.99	539.73
3/15/2016	West	Sorvino	Pencil	56	2.99	167.44
4/1/2016	East	Jones	Binder	60	4.99	299.40
4/18/2016	Central	Andrews	Pencil	75	1.99	149.25
5/5/2016	Central	Jardine	Pencil	90	4.99	449.10
5/22/2016	West	Thompson	Pencil	32	1.99	63.68
6/8/2016	East	Jones	Binder	60	8.99	539.40
6/25/2016	Central	Morgan	Pencil	90	4.99	449.10
7/12/2016	East	Howard	Binder	29	1.99	57.71
7/29/2016	East	Parent	Binder	81	19.99	1,619.19
8/15/2016	East	Jones	Pencil	35	4.99	174.65
9/1/2016	Central	Smith	Desk	2	125.00	250.00
9/18/2016	East	Jones	Pen Set	16	15.99	255.84
10/5/2016	Central	Morgan	Binder	28	8.99	251.72
10/22/2016	East	Jones	Pen	64	8.99	575.36
11/8/2016	East	Parent	Pen	15	19.99	299.85
11/25/2016	Central	Kivell	Pen Set	96	4.99	479.04
12/12/2016	Central	Smith	Pencil	67	1.29	86.43
12/29/2016	East	Parent	Pen Set	74	15.99	1,183.26

C. MS-POWERPOINT LAB ASSIGNMENT

Activity 1 : Using Text & Background/Themes

- i. Create one new slide and insert any text.
- ii. To make your slide more attractive, use the themes or background.
- **iii.** Make sure it apply for every slide not only one slide.

Activity 2 : Apply Custom Animation On Text

- i. Use the custom animation to add effects on your text. Set the text move after you click the mouse.
- ii. If you have more than one text, add effects for each of text.

Activity 3 : Insert Image & WordArt

- i. Insert one new blank slide.
- ii. Choose one pictures or clip art from any source and insert in your new slide.
- iii. Using the WordArt, make a note or title on your picture.
- iv. Use the custom animation again to add effects on your picture and WordArt.

Activity 4 : Insert Text Box

- i. Insert one new blank slide.
- ii. Use the text box to insert one paragraph of text and adjust your text.

Activity 5 : Insert Smart Art

- i. Insert one new blank slide.
- ii. Insert the Smart Art and put your text on the Smart Art.

Activity 6 : Insert Audio

- i. Back to your first slide and insert one audio on that slide. The audio must play automatically when you show your slide.
- ii. Make sure the speaker also not appear when you show your slide. (the icon).
- iii. The audio must play when you show alls your slide, not only one slide.

Activity 7 : inserting Video

i. Insert one new slide and insert one short video

Activity 8 : Save File

i. Save your file

Activity 9 : Create Photo Album & Hyperlink

- i. Insert one new slide and put a text ex: "My Photo Album"
- ii. Create one photo album and adjust your text and your photos
- iii. Save your photo album with a new file
- iv. Make a hyperlink to your photo using the text "My Photo Album"

Reference Books:

- \Box Faithe wempen, word 2016 in depth 1st edition, que publishing(2015)
- steven welkler, Office 2016 for bignners, Create Space Independent publishing plateform(2016)
- Elaine Marmel, office 2016 simplified, 1st Edition, John wiley and sons Inc(2016)
- □ Patrice-Anne Rutledge, Easy office 2016 1st edition, Que publishing(2016)

SEMESTER IV

SKILL ENHANCEMENT COURSE

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I. **SKILL ENHANCEMENT COURSE SEC 2:**

Marks : 100 (ESE 3Hrs) =100

Instruction to Question Setter for

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain three questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 & 3 will be short answer type of 5 marks. Group B will contain descriptive type six questions of 20 marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

FUEL CHEMISTRY

Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas-composition and uses. Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications.

Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.

Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

Lubricants : Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants.

Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Reference Books:

- E. Stocchi: *Industrial Chemistry*, Vol -I, Ellis Horwood Ltd. UK.
- P.C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- B.K. Sharma: *Industrial Chemistry*, Goel Publishing House, Meerut.

(Credits: Theory-02)

Total 100 x 1 = 100 Marks

Pass Marks Th ESE = 40

30 Lectures



1 Paper

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SEMESTER V

SKILL ENHANCEMENT COURSE

1 Paper

Total 100 x 1 = 100 Marks

Theory + Practical: 30 Lectures

III. <u>SKILL ENHANCEMENT COURSE SEC 3:</u>

Marks : 75 (ESE: 3Hrs) + 25 (Pr 3Hrs)=100

Pass Marks: Th ESE = 30 + Pr ESE =10

(Credits: Theory-02)

Instruction to Question Setter for End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain two questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 will be short answer type of 5 marks. Group B will contain descriptive type six questions of fifteen marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

BASIC ANALYTICAL CHEMISTRY

Introduction:

Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil:

Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators

- a. Determination of pH of soil samples.
- b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water:

Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

- a. Determination of pH, acidity and alkalinity of a water sample.
- b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products:

Nutritional value of foods, idea about food processing and food preservations and adulteration.

- a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
- b. Analysis of preservatives and colouring matter.

Chromatography:

Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

- a. Paper chromatographic separation of mixture of metal ion (Fe3+ and Al3+).
 - b. To compare paint samples by TLC method.

Ion-exchange:

Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of cosmetics:

Major and minor constituents and their function

- a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
- b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Reference Books:

- □ Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*. 7th Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
- Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
- □ Skoog, D.A.; West, D.M. & Holler, F.J. *Fundamentals of Analytical Chemistry* 6th *Ed.*, Saunders College Publishing, Fort Worth (1992).
- □ Harris, D. C. *Quantitative Chemical Analysis*, W. H. Freeman.
- Dean, J. A. Analytical Chemistry Notebook, McGraw Hill.
- Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India.
- □ Freifelder, D. Physical Biochemistry 2nd Ed., W.H. Freeman and Co., N.Y. USA (1982).
- □ Cooper, T.G. *The Tools of Biochemistry*, John Wiley and Sons, N.Y. USA. 16 (1977).
- □ Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
- □ Vogel, A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.*, Prentice Hall.
- □ Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

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(Credits: Theory-02)

Pass Marks Th ESE = 40

SEMESTER VI

SKILL ENHANCEMENT COURSE

1 Paper

Total 100 x 1 = 100 Marks

II. <u>SKILL ENHANCEMENT COURSE SEC 4:</u>

Marks : 100 (ESE 3Hrs) =100

Instruction to Question Setter for

End Semester Examination (ESE):

There will be two group of questions. Group A is compulsory and will contain three questions. Question No.1 will be very short answer type consisting of ten questions of 1 mark each. Question No.2 & 3 will be short answer type of 5 marks. Group B will contain descriptive type six questions of 20 marks each, out of which any four are to answer.

Note: There may be subdivisions in each question asked in Theory Examinations.

PHARMACEUTICAL CHEMISTRY

Theory: 30 Lectures

Drugs & Pharmaceuticals

Drug discovery, design and development; Basic Retrosynthetic approach.

Synthesis of the representative drugs of the following classes:

Analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen);
Antibiotics (Chloramphenicol);
Antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim);
Antiviral agents (Acyclovir),
Central Nervous System agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate),
Antilaprosy (Dapsone),
HIV-AIDS related drugs (AZT- Zidovudine).

Fermentation

Aerobic and anaerobic fermentation.

Production of

(i) Ethyl alcohol and citric acid,
(ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin,
(iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Reference Books:

- G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, UK.65
- Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
- William O. Foye, Thomas L., Lemke , David A. William: Principles of Medicinal Chemistry, B.I. Waverly Pvt. Ltd. New Delhi.

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CBCS CURRICULUM

SAMPLE CALCULATION FOR SGPA & CGPA FOR UNDERGRADUATE 'B.Sc./B.A./B.Com Honours & General' PROGRAMME

Distribution of Credits Semester wise for Undergraduate Honours Courses

Table B-1: UG (B.A./ B.Sc./B.Com. Hons. Programme)

Semester wise distribution of 140 Credits

	C.C	AECC	GE	SEC	DSE	Total credits
Semester I	12	02	06			20
Semester II	12	02	06			20
Semester III	18		06	02		26
Semester IV	18		06	02		26
Semester V	12				12	24
Semester VI	12				12	24
	84	04	24	04	24	140

CC=Core Course; AECC=Ability Enhancement Compulsory Course; GE=Generic Elective; SEC=Skill Enhancement Course; DSE=Discipline Specific Elective

Table B-2: UG (B.A./ B.Sc./B.Com. Programme)

Semester wise distribution of 120 Credits

	C.C	AECC	GE	SEC	DSE	Total credits
Semester I	18	02				20
Semester II	18	02				20
Semester III	18			02		20
Semester IV	18			02		20
Semester V				02	18	20
Semester VI				02	18	20
	72	04		08	36	120

CC=Core Course; AECC=Ability Enhancement Compulsory Course; GE=Generic Elective; SEC=Skill Enhancement Course; DSE=Discipline Specific Elective

Course	Credit	Grade Letter	er Grade Point Credit Point (Credit X Grade)		SGPA (Credit Point/Credit)
Semester I					
C-1	06	A	8	48	
C-2	06	B+	7	42	
AECC-1	02	В	6	12	
GE-1	06	В	6	36	
Total	20			138	6.9 (138/20)
Semester II					
C-3	06	В	6	36	
C-4	06	C	5	30	
AECC-2	02	B+	7	14	
GE-2	06	A+	9	54	
Total	20			134	6.7 (134/20)
Semester III					
C-5	06	A+	9	54	
C-6	06	0	10	60	
C-7	06	A	8	48	
SEC-1	02	A	8	16	
GE-3	06	0	10	60	
Total	26			238	9.15 (238/26)
Semester IV					
C-8	06	В	6	36	
C-9	06	A+	9	54	
C-10	06	В	6	36	
SEC-2	02	A+	9	18	
GE-4	06	A	8	48	
Total	26			192	7.38 (192/26)
Semester V					
C-11	06	B	6	36	
C-12	06	B+	7	42	
DSE-1	06	0	10	60	
DSE-2	06	A	8	48	
Total	24			186	7.75 (186/24)
Semester VI					
C-13	06	A+	9	54	
C-14	06	A	8	48	
DSE-3	06	B+	7	42	
DSE-4	06	A	8	48	
Total	24			192	8.0 (192/24)
CGPA					
🗆 Grand Total	140			1080	$\pm 7.71 (1080/140)$

Table B-3: Sample calculation for SGPA for B.Sc./B.A./B.Com Honours Programme

Table B-4: Sample calculation for CGPA for B.Sc./B.A./B.Com Honours Programme

Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI
Credit:20;	Credit:20;	Credit:26;	Credit:26;	Credit:24;	Credit:24;
SGPA:6.9	SGPA: 6.7	SGPA: 9.15	SGPA: 7.38	SGPA: 7.75	SGPA: 8.0

Thus CGPA= (20x6.9+20x6.7+26x9.15+26x7.38+24x7.75+24x8.0)/140=7.71

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit X Grade)	SGPA (Credit Point/Credit)
Semester I					
DSC - 1A	06	В	6	36	
DSC - 2A	06	B+	7	42	
DSC - 3A	06	С	5	30	
AECC – 1	02	В	6	12	
Total	20			120	6.0 (120/20)
Semester II					
DSC - 1B	06	В	6	36	
DSC - 2B	06	В	6	36	
DSC - 3B	06	С	5	30	
AECC – 2	02	A+	9	18	
Total	20			120	6.0 (120/20)
Semester III					
DSC - 1C	06	А	8	48	
DSC - 2C	06	A+	9	54	
DSC - 3C	06	А	8	48	
SEC – 1	02	A	8	16	
Total	20			166	8.3 (166/20)
Semester IV					
DSC - 1D	06	C	5	30	
DSC - 2D	06	В	6	36	
DSC - 3D	06	B+	7	42	
SEC - 2	02	A+	9	18	
Total	20			126	6.3 (126/20)
Semester V					
DSE - 1A	06	В	6	36	
DSE - 2A	06	A+	9	54	
DSE - 3A	06	A	8	48	
SEC – 3	02	В	6	12	
Total	20			150	7.5 (150/20)
Semester VI					
DSE - 1B	06	B+	7	42	
DSE - 1B	06	В	6	36	
DSE - 1B	06	С	5	30	
SEC - 4	02	C	5	10	
Total	20			118	5.9 (118/20)
CGPA					
Grand Total	120			800	6.67 (800/120)

Table B-5: Sample calculation for SGPA for B.A./B.Sc./B.Com. Program

Table B- 6: Sample calculation for CGPA for B.A./B.Sc./B.Com. Program

Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI
Credit:20;	Credit:20;	Credit:20;	Credit:20;	Credit:20;	Credit:20;
SGPA: 6.0	SGPA: 6.0	SGPA: 8.3	SGPA: 6.3	SGPA: 7.5	SGPA: 5.9

Thus CGPA= (20x6.0+20x6.0+20x8.3+20x6.3+20x7.5+20x5.9)/120**=6.67**

MARKS DISTRIBUTION FOR EXAMINATIONS AND FORMAT OF QUESTION PAPERS

Marks Distribution of Mid Semester Theory Examinations:

			Group-A (Very short Group-B		Total No. o to	f Questions Set		
Торіс	Code	Full Marks	Pass Marks	Time	answer type Compulsory Questions) No. of Questions x Marks = F.M.	(Descriptive Questions with Choices) No. of Questions x Marks = F.M.	Group A	Group B
Mid	T15	15	6	1 Hr	5 x1 =5	2 (out of 3) x5 =10	5	3
Sem*	T25	25	10	1 Hr	5 x1 =5	4 (out of 6) x5 =20	5	6

Table No. 15: Marks	distribution of Theory	y Examinations	of Mid Semester
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Marks Distribution of End Semester Theory Examinations:

Table No. 16: Marks distribution of Theory Examinations of End Semester

		Full Marks	Pass Marks	Time	Group-A [#]	Group-B (Descriptive	Total No. of Questions to Set	
Торіс	Code				Compulsory Questions) No. of Questions x Marks = F.M.	Questions with Choices) No. of Questions x Marks = F.M.	Group A [#]	Group B
End Sem	T60	60	24	3 Hrs	Q.No.1 (10x1) + 1x5 =15	3 (out of 5) x15 =45	2	5
	T75	75	30	3 Hrs	Q.No.1 (10x1) + 1x5 =15	4 (out of 6) x15 =60	2	6
	T100	100	40	3 Hrs	Q.No.1 (10x1) + 2x5 = 20	4 (out of 6) x20 =80	3	6
	T50 +T50	50X2=100	20	3 Hrs	2 x5 =10	2 (out of 3) x20 =40	2	3

Question No.1 in Group-A carries 10 very short answer type 1 Mark Questions.

Marks Distribution of Mid/End Semester Practical Examinations:

Table No. 17: Marks distribution of Practical Examinations of End Semester

T	Code	Full Marks	Pass Marks	T *	Distribution of Marks			Tradal Nacial Occurrent and a State
горіс				Time	Experiment Record V		Viva	Total No. of Questions to Set
	P25	25 10 3 Hrs 15 5 5		5				
End Sem	P50	50	20	3 Hrs	30	10	10	Pr. with components of both papers
	P75	75	30	3 Hrs	45	15	15	Pr. with components of all three papers
	P100	100	40	3 Hrs	60	20	20	Pr. with components of all four papers

Abbreviations : **T**= Theory Examination, **P**= Practical Examination.

Mid Sem*: There will be 15 Marks Theory Examination in Practical Subjects and 25 Marks Theory
Examination in Non-Practical Subjects/ Papers. 25 Marks Theory Examination may include 10
Marks questions from Assignment/ Project/ Tutorial where ever applicable.

Note : There may be subdivisions in each question asked in Theory Examinations.

OF

SUBJECTS WITH PRACTICAL

	Ranchi University, Ranchi				
1id S	em <u>No.</u>	Exam <u>Year</u>			
	Subject/ Code				
'.M. =	=15	Time =1Hr.			
lener	al Instructions:				
मान्य वि	नेर्देश :				
i	Group A carries very short answer type compulsory questions				
1.	(खंड 'A' में अत्यंत लघु उत्तरीय अनिवार्य प्रश्न हैं।)				
ii.	Answer 2 out of 3 subjective/ descriptive questions given in Grou	р В.			
	(खंड 'B' के तीन में से किन्हीं दो विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।)				
iii.	Answer in your own words as far as practicable.				
	(यथासंभव अपने शब्दों में उत्तर दें।)				
iv.	Answer all sub parts of a question at one place.				
	(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)				
v.	Numbers in right indicate full marks of the question. (पर्णांक दायीं ओर लिखे गये हैं।)				
	<u>Group A</u>				
1.	-	[5x1=5]			
1. 2.		[5x1=5]			
1. 2. 3.		[5x1=5]			
1. 2. 3. 4.		[5x1=5]			
1. 2. 3. 4. 5.		[5x1=5]			
1. 2. 3. 4. 5.	 Group B	[5x1=5]			
1. 2. 3. 4. 5.		[5x1=5]			
1. 2. 3. 4. 5. 6. 7.		[5x1=5] [5] [5]			
1. 2. 3. 4. 5. 6. 7. 8.	<u>Group B</u>	[5x1=5] [5] [5] [5]			

OF

SUBJECTS WITHOUT PRACTICAL

	kanchi University, Kanchi	
Aid Se	em <u>No.</u>	Exam <u>Yea</u>
лл	Subject/ Code	
<u>.</u> [VI. =	25	11me=1Hr
Genera	l Instructions:	
ामान्य नि	र्देश :	
i.	Group A carries very short answer type compulsory questions.	
ii	(खड A म अत्यत लघु उत्तराय आनवाय प्रश्न ह।) Answer 4 out of 6 subjective/ descriptive questions given in Group 1	R
	(खंड 'B' के छः में से किन्हीं चार विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।)	D.
iii.	Answer in your own words as far as practicable.	
	(यथासंभव अपने शब्दों में उत्तर दें।)	
iv.	Answer all sub parts of a question at one place.	
• 7	(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखे।) Numbers in right indicate full merks of the question	
v.	(पर्णांक दायीं ओर लिखे गये हैं।)	
	Group A	
1.		[5x1=5]
2.		<u> </u>
3.		
4.		
5.		
	<u>Group B</u>	
6.		[5]
7.		[5]
8.		[5]
9.		[5]
1/1		[5]
10.		

OF

AECC NH + MB COMMUNICATION

	Ranchi University, Ranchi	Ĺ				
End Sem <u>N</u>	<u>lo.</u>	Exam <u>Year</u>				
l	Subject/ Code					
<u>F.M.</u> =50	P.M. =20	Time=1.5Hrs.				
General Ins i. Gro (खंड ii. Ans (खंड iii. Ans (यथा iv. Ans (एक v. Nu (पूर्णा	structions: oup A carries short answer type compulsory questions. 5 'A' में लघु उत्तरीय अनिवार्य प्रश्न हैं।) swer 2 out of 3 subjective/ descriptive questions given in ('B' के तीन में से किन्हीं दो विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।) swer in your own words as far as practicable. Iसंभव अपने शब्दों में उत्तर दें।) swer all sub parts of a question at one place. ' प्रश्न के सभी भागों के उत्तर एक साथ लिखें।) mbers in right indicate full marks of the question. क दायीं ओर लिखे गये हैं।)	Group B.				
	<u>Group A</u>					
1		[5]				
2		[5]				
	Group B					
3		[20]				
4		[20]				
5		[20]				
Note: There	e may be subdivisions in each question asked in Theory Ex	xamination.				

OF

SUBJECTS WITH PRACTICAL

Ranchi University, Ranchi					
End Se	em <u>No.</u>	Exam <u>Year</u>			
	Subject/ Code				
<u>F.M.</u> =	=60 P.M. =30 (Including Mid Sem)	Time=3Hrs.			
Genera	al Instructions:				
i. 	Group A carries very short answer type compulsory questions.	D			
11.	Answer 3 out of 5 subjective/ descriptive questions given in Group (खंड 'B' के पाँच में से किन्हीं तीन विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।)	В.			
iii.	Answer in your own words as far as practicable.				
iv.	(यथासभव अपने शब्दों में उत्तर दें।) Answer all sub parts of a question at one place.				
1.1	(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)				
v.	Numbers in right indicate full marks of the question.				
	Crown A				
1	<u>Group A</u>	$[10_{\rm w}1 - 10]$			
1.		[10x1-10]			
	1 ii	[10x1=10]			
	iii				
	iv				
	V				
	V1				
	V11 viii				
	ix				
	X				
2.		[5]			
	<u>Group B</u>				
3.		[15]			
4.		[15]			
5.		[15]			
6.		[15]			
7.		[15]			
Note:	Note: There may be subdivisions in each question asked in Theory Examination.				

OF

SUBJECTS WITHOUT PRACTICAL

Ranchi University, Ranchi					
End S	em <u>No.</u>	Exam <u>Year</u>			
	Subject/ Code				
<u>F.M.</u> =	=75 P.M.=40 (Including Mid Sem)	Time=3Hrs.			
Genera	al Instructions:				
i.	Group A carries very short answer type compulsory questions.				
ii.	Answer 4 out of 6 subjective/ descriptive questions given in Group (खंड 'B' के छः में से किन्हीं चार विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।)	B .			
iii.	Answer in your own words as far as practicable.				
•	(यथासंभव अपने शब्दों में उत्तर दें।)				
1V.	Answer all sub parts of a question at one place.				
v.	Numbers in right indicate full marks of the question.				
	(पूर्णांक दायीं ओर लिखे गये हैं।)				
	<u>Group A</u>				
1.		[10x1=10]			
	i				
	ii				
	iii				
	iv				
	V				
	vi				
	vii				
	V111				
	1X				
2	х	[5]			
2.	~ ~	[5]			
	<u>Group B</u>				
3.		[15]			
4.		[15]			
5.		[15]			
6.		[15]			
7.		[15]			
8.		[15]			
Note: There may be subdivisions in each question asked in Theory Examination.					

OF

GE, SEC, GENERAL & AECC HINDI/ ENGLISH COMMUNICATION

	Ranchi University, Ranchi						
End Se	em <u>No.</u>	Exam <u>Year</u>					
	Subject/ Code						
<u>F.M.</u> =	100 P.M. =40	Time=3Hrs.					
Genera	Instructions						
i. ii.	Group A carries very short answer type compulsory questions. Answer 4 out of 6 subjective/ descriptive questions given in Group B. (vic / y/ à w: ji ji do final and						
iii.	Answer in your own words as far as practicable. (यथासंभव अपने शब्दों में उत्तर दें।)						
iv.	Answer all sub parts of a question at one place.						
v.	(एक प्रश्न के समा मांग के उत्तर एक साथ लिखा) Numbers in right indicate full marks of the question. (पूर्णांक दायीं ओर लिखे गये हैं।)						
	<u>Group A</u>						
1.		[10x1=10]					
	i						
	ii						
	iii						
	iv						
	V						
	V1						
	V11						
	vIIIiv						
	X						
2.		[5]					
3.		[5]					
	Group R						
4		[20]					
ч. с		[20]					
5.		[20]					
6.		[20]					
7.		[20]					
8.		[20]					
9.		[20]					

Note: There may be subdivisions in each question asked in Theory Examination.