

**PROPOSED MODEL PROGRAMME STRUCTURE FOR
UNDERGRADUATE PROGRAMME IN**

BIOCHEMISTRY

**SUBMITTED TO
KARNATAKA STATE HIGHER EDUCATION COUNCIL
BENGALURU**

SEMESTER -1

COURSE TITLE	CHEMICAL FOUNDATION OF BIOCHEMISTRY -1
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	02
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

Course Outcome:

This will inculcate confidence and clarity of mind in students to understand the chemistry of Biomolecules, and Biological reactions.

Course Outcomes /Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude	X	X										
Critical thinking		X										
Subject clarity	X	X										X
Analytical Skill	X				X	X						

UNIT -1: Scope of Biochemistry and units of measurement

15hrs

Origin of life, types of organisms, prokaryotes, eukaryotes, unicellular, multicellular, compartmentation of functions in lower and higher organisms, and common physiological events of organisms, chemical composition of living organisms, subcellular organelles, SI units, mass, volume, temperature, amount, length and time. An overview on the metric system, atomic weight, molecular weight, equivalent weight, basicity of acids, acidity of bases, Avogadro's number, molarity, normality, molality, Dalton concept, mole concept, concentration, mole to molar conversion, oxidation number and its significance, density and specific gravity, their significances.

UNIT - 2: Atomic structure and chemical bonds

15 hrs

Structure of an atom, , electrons and Quantum numbers, orbitals, shapes of orbitals, s, p, d, and f subshells, K, L, M, N, O, P, and Q shells. Illustration of Pauli's exclusion principle, Aufbau

principle, and Hund's rule, electron configuration, octet rule. Formation and properties of non-covalent and covalent bonds, hydrogen bonds, ionic bonds, van der Waals interactions, London forces, dipole-dipole interactions, electrostatic interactions, and hydrophobic interactions. Sigma, pi and co-ordinate bonds, back bonding. Corresponding energy associated, outline of theories of bonding.

UNIT -3: Buffers and colligative properties

15 hrs

Acids, bases, Arrhenius concept, proton transfer theory, Lewis concept, Lowry and Bronsted concepts. Buffers, composition, pH, pH scale, Henderson-Hasselbalch equation, titration curve of H_3PO_4 , pK value, isoelectric pH, ionization of HCl , HNO_3 , H_2SO_4 . Colligative properties and anomalous colligative properties of solutions, structure of water, phase diagram of pure water, ionic product of water, special properties of water, buffers in animal system. Solutions and types, ionizable solutes, non-ionizable solutes, vapor pressure and its application in distillation, Vant Hoff law, Rault's law, boiling point, freezing point, de-icing, osmosis and osmotic pressure determination, reverse osmosis, surface tension.

UNIT – 4 : Electrochemistry and redox reactions

15 hrs

Scope of electrochemistry, electrochemical cells, Daniel cell, galvanic cell, electrode potential and its measurement, electrolysis, types of electrolytes, primary and secondary batteries, electrodes, half cell reaction, standard electrodes. Laws of thermodynamics, entropy and enthalpy, their relation, Gibb's energy, free energy change, Lewis concept, ions, redox reactions, redox potential, application of redox potential, energy linked to redox reactions, reduction of oxygen, oxidation and reduction of iron in hemoglobin, biological active forms of zinc, calcium, nickel, molybdenum, selenium, and cobalt, NAD^+/NADH , $\text{NADP}^+/\text{NADPH}$, FAD/FADH_2 , FMN/FMNH_2 . Molecularity and order of a reaction.

REFERENCES:

1. Advanced Inorganic Chemistry: A comprehensive Text, 1999, Cotton A and Geoffrey Wilkinson, 6th edition, Wiley publication
2. Inorganic Chemistry, 2014, Miessler GL, Paul Fischer PJ, and Tarr DA, 5th edition, Pearson Publication
3. Inorganic Chemistry, 2004, Catherine E and Sharpe AG, ACS publication
4. Inorganic Chemistry, 2015, Overton, Rourke, Weller, Armstrong and Hagerman, Oxford Press
5. Physical Chemistry: A molecular approach, 2019, Donald A, McQuarrie and Simon JD, Viva Books Publication
6. Physical chemistry 2019, Atkins P, Paula JD, Keeler J, 11th edition, Oxford press

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TESTS)	30
SEMINARS / CLASS WORK	05
ASSIGNMENT/ OPEN DISCUSSION	05
TOTAL	40

SEMESTER -1
PRACTICALS - 1

COURSE TITLE	VOLUMETRIC ANALYSIS – PRACTICALS-1
COURSE CREDITS	02
TOTAL CONTACT HOURS	4 Hours/ Week
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	15
SUMMATIVE ASSESSMENT MARKS	35

Course Outcome:

This course aims to familiarize students with the principles of analytical chemistry and basic analytical techniques such as volumetric analysis. Course Objective is to provide experimental practice of quantitative volumetric analysis. Upon successful completion students should be able to make solutions of various molar, normal concentrations and determine the amount of a substance in a given sample.

Experiments:

1. Concept of molarity, molality and normality. Calculation and preparation of molar solutions. (Problems to be given in exams). Calculation and preparation of normal solutions and percent solutions and dilute solutions.
2. Calibration of volumetric glassware's (Burette, pipette).
3. Preparation of standard Sodium carbonate solution, standardization of HCl (Methyl orange) and estimation of NaOH in the given solution. (methyl orange or phenolphthalein).
4. Preparation of standard Oxalic acid. Standardization of NaOH and estimation of H₂SO₄ in the given solution (phenolphthalein).
5. Preparation of standard Oxalic acid. Standardization of KMnO₄ and estimation of H₂O₂ in the given solution.
6. Preparation of standard K₂Cr₂O₇. Standardization of Na₂S₂O₃ and estimation of CuSO₄ in the given solution.
7. Preparation of ZnSO₄. Standardization of EDTA and estimation of total hardness of water using Eriochrome black-T indicator.

8. Preparation of standard potassium biphthalate. Standardization of NaOH and estimation of HCl in the given solution. (Phenolphthalein).
9. Estimation of sulphuric acid and oxalic acid in a mixture using standard sodium hydroxide solution and standard potassium permanganate solution.
10. Preparation of standard Potassium dichromate and estimation of ferrous/ferric mixture using diphenylamine indicator (Demonstration).
11. Preparation of standard oxalic acid solution. Standardization of NaOH solution and estimation of acidity in vinegar.
12. Preparation of standard potassium biphthalate solution, standardization of sodium hydroxide solution and estimation of alkalinity of antacids.
13. Preparation of standard Oxalic acid solution. Standardization of KMnO_4 solution and estimation of calcium in milk.

REFERENCES:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
4. Principles of Practical Chemistry- M. Viswanathan
5. Instrumental Methods of chemical Analysis B.K Sharma.
6. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
7. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
8. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
9. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
10. General Chemistry experiment – Anil J Elias (University press).
11. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
12. Quantitative chemical analysis S. Sahay (S. Chand & Co.).
13. Practical Chemistry Dr O P Pandey, D N Bajpai, Dr S Giri. S. Chand Publication
14. College Practical Chemistry. V K Ahluwalia, Sunitha Dingra, Adarsh Gulati
15. Practical Physical Chemistry- B. Viswanathan, P S Raghavan. MV Learning Publication

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING/ ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CONTINUOUS EVALUATION AND CLASS TEST	10
RECORD / VIVA VOCE	05
TOTAL	15

SEMESTER - II

COURSE TITLE	CHEMICAL FOUNDATION OF BIOCHEMISTRY -2
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

Course Outcome: These topics will enable students to understand the fundamentals of chemical processes in biological systems

Course Outcomes /Program Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude	X	X	X									
Critical thinking	X	X										
Subject clarity	X	X										X
Analytical Skill	X	X			X	X						

COURSE CONTENT:

UNIT- 1: Chemical Catalysis:

15 Hours

Definition, characteristics, types, intermolecular, multifunctional, theories of catalysis, properties, characteristics of enzyme catalysis, autocatalysis, industrial catalysis and their role in biological systems (brief). Colloids: true solutions, classification, peptisation, purification, ultrafiltration, Brownian movements, electric properties, coagulation, mutual, lyophilic sols, boiling, dialysis, electro and peristent dialysis, addition of electrolytes, colloids in daily life and applications. Emulsion, types, micelles with biomolecules and its biological applications.

UNIT- 2: Nomenclature of Organic Compounds:

15 Hours

Classification, naming- IUPAC nomenclature, compounds containing one, two functional groups with chains, homologous series. Stereochemistry, geometrical and structural Isomerism, conformation and free rotation. Optical isomerism, symmetry of elements, plane polarized light and optical purity. Nomenclature of enantiomers, epimers, racemic mixture,

resolution. Fischer and Newmann projection formulae, molecule with one and two chiral and achiral centers. Priority rules; E and Z (CIP rules), R and S, D and L notations, absolute (r and s) and relative (d and l) configuration. Role of stereochemistry in biological systems.

UNIT- 3: Organometallic Compounds:

15 Hours

Metal atom linked organic compounds. Preparation of Grignard reagents and structure, limitations, protonolysis and reactions. Organolithium compounds, preparation and reactions. Organozinc compounds. Organoboranes its mechanisms. Ferrocenes.

Introduction to mineral and ores, classification, concentration, extraction, refining, uses of minerals and metals and its importance.

Porphyrins and Metal ions: Role of metal ions in biological systems, Fe, Cu, Zn, structure and functions of porphyrins, metalloporphyrins and iron-sulphur clusters with suitable examples and their role in biological systems.

UNIT- 4: Inorganic Chemistry:

15 Hours

Nomenclature of inorganic molecules and coordination compounds, formula. IUPAC nomenclature. Central metal ion, ligand, coordination number, sphere, complex ion, oxidation number of central atom, homoleptic and heteroleptic complexes. Isomerism in complexes, structural, ionisation, solvate, linkage and coordination, Stereoisomerism, geometrical, optical isomerism with simple inorganic complexes. Applications of qualitative, quantitative analysis, photographic, metallurgy, medicine, catalysis and biosystems.

Heavy Metal Poisons: Introduction, poisons, lead, mercury, aluminium, arsenic, corrosives, cyanide, irritants, phosphorus, CO₂, SO₂, SO₃, NO₂, halides and acid fumes, poisoning, sources, signs and symptoms. Free radicals: introduction, definition, generation and scavenger systems. Redox reactions, types, stock notations, change in oxidation number and combination. Endergonic and exergonic reactions with examples. The Importance in biological systems.

REFERENCES

1. Physical Chemistry 2006, Peter Atkins. 8th edition, W.H. Freeman and Company
2. Inorganic Chemistry: Principles of structure and Reactivity, 2006, Huheey JE, Keiter EA, Keiter RL, Pearson Education India

3. Stereochemistry: Conformation and Mechanism, 2009, Kalsi PS, New Age International Publications
 4. Introduction to Stereochemistry 2012, Kurt Mislow, Dover Publications
 5. A text book of Organic Chemistry 2016, Raj K Bansal, 6th edition, New Age International Publications
 6. Advanced Inorganic Chemistry 1999, Cotton et al , 6th edition, A Wiley - International
 7. Principles of physical Chemistry by Puri, Sharma and Pathania.
 8. Physical Chemistry by R. L. Madan, G. D. Tuli. S. Chand and Co.
 9. A Text Book of Physical Chemistry by K. L. Kapoor. Vol. 2. Mc. Millan Publisher, India Ltd.
 10. Advanced Organic Chemistry by Bahl and Bahl.
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PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING/ ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TESTS)	20
SEMINARS / CLASS WORK	05
ASSIGNMENT/ OPEN DISCUSSION	05
TOTAL	30

SEMESTER - II

PRACTICALS - 2

COURSE TITLE	QUALITATIVE AND QUANTITATIVE ANALYSIS – PRACTICALS – 2
COURSE CREDITS	02
TOTAL CONTACT HOURS	4 Hours/ Week
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	15
SUMMATIVE ASSESSMENT MARKS	35

Course Outcome: The Course Objective is to provide experimental practice of quantitative and qualitative analysis. Also it provides training in physical chemistry laboratory techniques. Upon successful completion, students should develop skills in handling instruments and understand its application in research work.

Experiments:

1. Systematic Semi micro Qualitative Analysis of Inorganic salt Mixtures

Systematic semi micro qualitative analysis of two acid and two basic radicals in the given inorganic salt mixture. The constituent ions in the mixture to be restricted to the following. (Any four binary mixtures shall be given)

Anions: HCO^- , CO^{2-} , Cl^- , Br^- , NO^- , BO^{3-} , SO^{2-} and PO_4^{3-} . 4

Cations: Pb^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+} , Mn^{2+} , Zn^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , K^+ , Na^+ and NH^+ . 4

2. Determination of density and viscosity of the given liquid using specific gravity bottle and Ostwald's viscometer.
3. Determination of density and surface tension of the given liquid using specific gravity bottle and stalagnometer.
4. Determination of molecular weight of non-volatile solute by Walker-Lumsden method.
5. Determination of rate constant of decomposition of H_2O_2 using KMnO_4 by volumetric analysis method using ferric chloride as catalyst.
6. Determination of distribution coefficient of benzoic acid between water and benzene or iodine between water and carbon tetrachloride.

7. Separation of Two Components from given Binary Mixture of Organic Compounds Qualitatively. (Types of binary mixtures- Solid – Solid, Solid – Liquid, Liquid – Liquid)
8. Verification of Beer's Law. Estimation of unknown concentration of a biomolecule by using colorimeter
9. Calibration of pH meter and determination of pH of aerated soft drinks.

REFERENCES:

0. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
2. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
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PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CONTINUOUS EVALUATION AND CLASS TEST	10
RECORD / VIVA VOCE	05
TOTAL	15

SEMESTER – I OPEN ELECTIVE – 1

COURSE TITLE	BIOCHEMISTRY IN HEALTH AND DISEASE
COURSE CREDITS	03
TOTAL CONTACT HOURS	42
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

Course Outcome: This open elective course offering to students of various streams gives knowledge about health and various terminologies used in health and disease conditions; Difference between communicable and non-communicable diseases; Health promotion and treatments for various diseases and disorders.

UNIT - 1 Introduction:

15 hours

WHO definition of health, Health and hygiene, General health care, Factors affecting health, Indices and evaluation of health, Disease patterns in developed and developing world; Classification of diseases - Endemic, Epidemic, Pandemic; Professional health hazards.

Disease conditions: Acute disease, Chronic disease, Incurable disease, Terminal disease, Illness, disorders, Syndrome, Pre-disease.

Treatment: Psychotherapy, Medications, Surgery, Medical devices, and Self-care. Dimensions of Health: Physical, Mental, Spiritual, Emotional, Environmental, and Philosophical.

UNIT – 2 Communicable diseases

15 hours

Tuberculosis, Cholera, Typhoid, Conjunctivitis.

Sexually transmitted diseases (*STD*): Information, statistics, and treatment guidelines for *STD*, Prevention: Syphilis, Gonorrhoea, AIDS, etc.

Non-communicable diseases: Malnutrition- Under nutrition, Over nutrition, Nutritional deficiencies; Anemia, Stroke, Rheumatic heart disease, Coronary heart disease, Cancer, blindness, accidents, mental illness, Iodine deficiency, Fluorosis, Epilepsy, Asthma.

Genetic disorders: Down's syndrome, Klinefelter's syndrome, Turner's syndrome, Thalassemia, Sickle cell anemia.

Lifestyle disorders: Obesity, Liver cirrhosis, Diabetes mellitus, Hypertension (Causative agents, symptoms, diagnosis, treatment, prognosis, prevention)

UNIT – 3 Health promotions:**14 hours**

Preventing drug abuse, Oral health promotion by tobacco control.

Mental hygiene and mental health: Concepts of mental hygiene and mental health, Characteristics of mentally healthy person, Warning signs of poor mental health, Promotive mental health, strategies and services, Ego defense mechanisms and implications, Personal and social adjustments, Guidance and Counseling.

Infection control: Nature of infection, Chain of infection transmission, Defenses against infection transmission

REFERENCES

1. Modern Nutrition in Health and Disease 2006 10th Edition by Maurice E. Shils, Moshe Shike, A Catharine Ross.
2. Clinical Biochemistry and Metabolic Medicine , 2012 Eighth Edition by Martin Andrew Crook, CRC Press,
3. Nutrition & Health in Developing Countries, 2000, Editors: R. Semba and M.W. Bloem, Humana Press

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TESTS)	20
SEMINARS / CLASS WORK	05
ASSIGNMENT/ OPEN DISCUSSION	05
TOTAL	30

SEMESTER - II OPEN ELECTIVE- 2

COURSE TITLE	NUTRITION AND DIETETICS
COURSE CREDITS	03
TOTAL CONTACT HOURS	42
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

Course outcomes:

- The student will gain knowledge about energy requirements and the Recommended Dietary Allowances.
- The student will understand the functions and role of macronutrients, their requirements and the effect of deficiency and excess
- The student learns the impact of various functional foods on our health
- The student will be able to apply basic nutrition knowledge in making foods choices and obtaining an adequate diet.
- The student gains competence in connecting the role of various nutrients in maintaining health and learn to enhance traditional recipes.

UNIT – 1 Basic concepts of Nutrition:

15Hrs

Introduction, Basic principles of a balanced diet to provide energy and nutrients. Composition of foods and proximate analysis of foods. Calorific value of foods and Basal metabolism. Basal Metabolic Rate (BMR), Factors affecting BMR, Energy requirements for different physical activities, Specific dynamic action of food, Nutritive value of proteins. Energy requirements and recommended dietary allowance (RDA) for infants, children and pregnant women. Protein calorie malnutrition.

UNIT – 2 Macronutrients and Micronutrients:

15 Hrs

Carbohydrates- Digestible and non-digestible, Dietary fibres, Essential fatty acids, lipoproteins and cholesterol. Essential amino acids, Fortification of foods, Protein requirement for different categories. Vitamins-Sources, requirements, functions and deficiency symptoms of Vitamin-C, Thiamine, Riboflavin, Pyridoxine, Folic acid, Vitamin B₁₂. Absorption of fat soluble vitamins- A, D, E and K. Micronutrients: Source, Daily requirement, functions and deficiency disease symptoms of Macro minerals (Ca, P, and Cl) and micro minerals/trace elements (I, Fe, Zn and Se).

UNIT - 3 Dietetics and Diet Therapy:

15 Hrs

Introduction. Food pyramid. Diet planning and introduction to diet therapy. Nutritional requirements for different age groups, anemic child, expectant women, and lactating women. Diet planning for prevention and cure of nutritional deficiency disorders.

Diet therapy: Functional foods, Anthropometric measurements, dietary considerations during fever, malaria, and tuberculosis. Prevention and correction of obesity, underweight, and metabolic diseases by diet therapy. Dietary interventions to correct and or manage the gastrointestinal diseases (indigestion, peptic ulcer, constipation, diarrhoea, steatorrhea, irritable bowel syndrome. Functional foods based diet therapy for diabetes, cardiovascular disease and cancer.

REFERENCES:

1. Clinical Dietetics and Nutrition, 2002, Antia FP and Abraham P. Oxford University Press; 4th Edition. ISBN-10: 9780195664157.
2. Oxford Handbook of Nutrition and Dietetics, 2011, Webster-Gandy J, Madden A and Holdsworth M. Oxford University Press, Print ISBN-13: 9780199585823.
3. Krause's Food, Nutrition and Diet therapy, 2003, Mahan KL and Escott-Stump S. Elsevier, ISBN: 9780721697840.
4. Human Nutrition and Dietetics. 1986, Passmore R. and Davidson S. Churchill Livingstone Publications, ISBN-10: 0443024863.
5. Rosemary Stanton's Complete Book of Food & Nutrition, 2007, Simon & Schuster Publishers, Australia, ISBN 10: 0731812999
6. Food Science and Nutrition, 2018, Roday S. Oxford University Press Publishers, ISBN: 9780199489084/0199489084.
7. Food Science, 2007, Srilakshmi S. New Age International (P) Limited Publishers, ISBN: 9788122420227/ 8122420222.

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TESTS)	20
SEMINARS / CLASS WORK	05
ASSIGNMENT/ OPEN DISCUSSION	05
TOTAL	30

B.Sc I & II SEMESTERS MODEL QUESTION PAPER
BIOCHEMISTRY

TIME : 3 h

MAX. MARKS : 60

NOTE: ALL SECTIONS ARE COMPULSORY

SECTION – A

1. Answer any FIVE of the following

5 x 2 = 10

- a.
- b.
- c.
- d.
- e.
- f.
- g.

SECTION – B

Answer any SIX of the following

6 x 5 = 30

- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

SECTION – C

Answer any THREE Questions

3 x 10 = 30

9. .
- 10.
- 11.
- 12.
- 13.

Note: Section C may include sub questions a, b

B.Sc I & II SEMESTERS MODEL QUESTION PAPER
BIOCHEMISTRY

TIME : 3 h

OPEN ELECTIVE

MAX. MARKS : 60

NOTE : ALL SECTIONS ARE COMPULSORY

SECTION – A

1. Answer any FIVE of the following

5 x 2 =

10a.

b.

c.

d.

e.

f.

g.

SECTION – B

Answer any SIX of the following

6 x 5 = 30

2.

3.

4.

5.

6.

7.

8.

SECTION – C

Answer any THREE Questions

3 x 10 = 30

9.

10.

11.

12.

13.

Note: section C may include sub questions a, b

