B.Sc.Part-II (2012-13) Prospectus No. 2013122
(Semester-III & IV)

संत गाडगे बाबा अमरावती विद्यापीठ
SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान स्नातक भाग-२
(सत्र ३, परीक्षा हिवाळी-२०१२ व सत्र-४ परीक्षा उन्हाळी-२०१३)

PROSPECTUS
OF
B.SC.PART-II
(SEMESTER-III, EXAMINATION WINTER-2012 AND
SEMESTER-IV, EXAMINATIONS SUMMER-2013)

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I N D E X
B.Sc.Part-II (Semester-III & IV)
(Prospectus No.2013122)

SANT GADGE BABA AMRAVATI UNIVERSITY
SPECIAL NOTE FOR INFORMATION OF THE STUDENTS

(1) Notwithstanding anything to the contrary, it is notified for general information and guidance of all concerned that a person, who has passed the qualifying examination and is eligible for admission only to the corresponding next higher examination as an ex-student or an external candidate, shall be examined in accordance with the syllabus of such next higher examination in force at the time of such examination in such subjects, papers or combination of papers in which students from University Departments or Colleges are to be examined by the University.

(2) Be it known to all the students desirous to take examination/s for which this prospectus has been prescribed should, if found necessary for any other information regarding examinations etc. refer the University OrdinanceBooklet the various conditions/provisions pertaining to examinations as prescribed in the following Ordinances-

Ordinance No. 1	:	Enrolment of Students.
Ordinance No.2	:	Admission of Students
Ordinance No. 4	:	National Cadet Corps
Ordinance No. 6	:	Examination in General (relevant extracts)
Ordinance No. 18/2001	:	An Ordinance to provide grace marks for passing in a Head of passing and Inprovement of Division (Higher Class) and getting Distinction in the subject and condonation of defficiency of marks in a subject in all the faculties prescribed by the statute NO.18, Ordinance 2001.
Ordinance No.9	:	Conduct of Examinations (Relevant extracts)
Ordinance No.10	:	Providing for Exemptions and Compartments
Ordinance No. 19	:	Admission Candidates to Degrees

Ordinance No.109	:	Recording of a change of name of a University Student in the records of the University
Ordinance No.19/2001	:	An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001.

Dineshkumar Joshi
Registrar
Sant Gadge Baba Amravati University

SYLLABUS PRESCRIBED FOR B.Sc. PART-II
SEMESTER-III & IV
(Implemented from the Session 2011-2012)

1. MATHEMATICS

3S-Mathematics – Paper-V
(Advanced Calculus)

Unit. I : Sequence : Theorems on limits of sequences, bounded and monotonic sequences, Cauchy's convergence criterion.

Unit II : Series : Series of non negative terms, convergence of geometric series and the series $\sum \frac{1}{n^p}$. Comparison tests, Cauchy's integral test, Ratio test, Root test.

Unit III : Limit and continuity of functions of two variables, Algebra of limits and continuity, Taylor's theorem for function of two variables. Maxima and minima, Lagrange's multipliers method. Jacobians.

Unit IV : Properties of Beta and Gamma functions. Double integral : Definition and Evaluations of double integral.

Unit V : Change of order of integration in double integral, triple integral (evaluation technique only). Double integral by transforming it into polar coordinates.

Reference Books :

1) T. M. Karade, M. S. Bendre :Lectures on Vector Analysis and Geometry, Sonu-Nilu Publication, Nagpur.
2) T. M. Karade, J. N. Salunke, A. G. Deshmukh, M. S. Bendre: Lectures on Advanced Calculus, Sonu-Nilu Publication, Nagpur.
3) Gorakh Prasad : Differential Calculus, Pothishala Pvt. Ltd., Allahabad.
4) Gorakh Prasad : Integral Calculus, Pothishala Pvt. Ltd., Allahabad.
5) Murray R. Spiegel :Theory and Problems of Advanced Calculus, Schaum Outline Series.
6) S. C. Malik and Arora : Mathematical Analysis, Wiley Estern Ltd., New Delhi.

7) O. E. Stanaitis : An Introduction to Sequences, Series and improper Integrals, Holden-Dey , Inc. San Francisco, California.
8) Earl D. Rainville : Infinite series, The Macmillan Co., New York.
9) N. Piskunov : Differential and Integral Calculus, Peace publishers, Noscow.
10) Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
11) D. Somasundaram and B. Choudhary: A First course in Mathematical Analysis, Narosa Publ. House.

3S-Mathematics – Paper-VI
(Partial Differential Equations)

Unit I : Partial differential equations of first order. Lagrange's solutions. Some special types of equations which can be solved easily by methods other than general method. Charpit's general method of solutions. Jacobi's Method.

Unit II : Partial differential equations of second and higher orders. Homogeneous and non- homogeneous equations with constant coefficients. Partial differential equations reducible to equations with constant coefficients.

Unit III : Classifications of linear partial differential equations of second order.
Monge's methods.

Unit IV : Calculus of Variation : Functional, continuity of functional, variational problems with fixed boundaries, Extremum of a functional.

Unit V : Method of separation of variables, method of separation of variable for wave equations and heat equation in one dimension.

Reference Books :

1) T. M. Karade : Lectures on Differential Equations, Sonu-Nilu Publication, Nagpur.
2) J. N. Sharma : Differential Equations, Krishna Prakashan Mandir, Meerut.
3) Ian N. Sneddon : Elements of Partial Differential Equations, McGraw Hill Book Company, 1988.
4) D. A. Murray : Introductory course on Differential Equations. Orient Longman (India), 1967.
5) Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.

6) A. R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd. , London.
7) Frank Ayres : Theory and Problems of Differential Equations. McGraw Hill Book Company, 1972.
8) B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.
9) A. S. Gupta : Calculus of Variations with Applications, Prentice-Hall of India, 1997.
10) I. M. Gelfand and S. V. Fomin : Calculus of Variations, Prentice-Hill Englewood Cliffs (New Jersey), 1963.
11) J. I. Oden and J. N. Reddy : Variational Methods in Theoretical mechanics, Springer Verlag, 1976.
12) Jane Cronin : Differential Equations, Marcel Dekkar, 1994.
13) G.S.Sharma, I.J.S. Saran, Engineering Mathematics, P.B.H. Publishing, New Delhi.
14) Rajsinghaniya M.D. : Ordinary and Partial Differential Equations, S.Chand and Co., New Delhi.
15) K.Shaukatrao Rao, Partial Differential Equations.

4S-Mathematics – Paper-VII
(Laplace Transforms and Fourier Series)

Unit I : Laplace transform. Linearity of Laplace transform. Existance theorem for Laplace transform, Shifting Theorem, Change of scale property, Laplace transform of derivatives. Multiplication by power of t.

Unit II : Inverse Laplace transform, Shifting Theorem, Change of scale property, Inverse Laplace transform of derivative, division by s. Convolution theorem.

Unit III : Solution of integral equations and system of ordinary and partial differential equations using the Laplace transform. Solutions of simultaneous ordinary differential Equations using Laplace transform

Unit IV : Fourier Series, Fourier expansion of picecewise monotonic functions, Fourier series of Even and odd function. Half-range series..

Unit V : Bessel and Legendre functions and their Properties, recurrences relations and generating functions. Sturm-Liouville problem. Eigen Function, Orthogonality of eigen functions.

Reference Books :

1) T. M. Karade : Lectures on Differential Equations, Sonu-Nilu Publication, Nagpur.
2) Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons, Inc. New York, 1999.
3) A. R. Forsyth : A Treatise on Differential Equations, Macmillan and Co. Ltd. , London.
4) Frank Ayres : Theory and Problems of Differential Equations. McGraw Hill Book Company, 1972.

5) B. Courant and D. Hilbert : Methods of Mathematical Physics, Vol. I & II, Wiley-interscience, 1953.
6) I. N. Sneddon : Fourier Transforms, McGrow Hill Book Co.
7) Goel and Gupta : Integral Transforms, Pragati Prakashan , Merut.
8) Raisinghaniya,M.D., Integral Transform, S.Chand & Co., N.D.

4S-Mathematics – Paper-VIII
(Mechanics)

Statics :

Unit I : Coplanar forces : Forces acting at a point, Triangle law of forces. Parallel forces.
Equilibrium of forces, Lami's theorem.
Analytical conditions of equilibrium of coplanar forces.

Unit II : Virtual work. Uniform Catenary .

Dynamics :

Unit III : Velocities and accelerations along the coordinate axes, radial and transverse directions, tangential an normal directions. Projectile.

Unit IV : Constraints. Generalised Coordinates D'Alembert's principle and Lagrange's equations of motion.

Unit V : Central force motion : Areal velocity. Equivalent one body problem. Central Orbit . Virial theorem. Kepler's laws of motions (Statement Only).

Reference Books :

1) T. M. Karade, M. S. Bendre :Lectures on Mechanics, Sonu-Nilu Publication, Nagpur.
2) H. Goldstein : Classical Mechanics (2nd edition), Narosa Publishing House, New Delhi.
3) S. L. Loney : Statics, Mc-Millan and co., London.
4) R. S. Verma : A Text Book on Statics, Pothishala Pvt. Ltd. , Allahabad.
5) S. L. Loney : An Elementary Treatise on the Dynamics of a particle and of rigid bodies, Cambridge University Press, 1956.
6) D. K. Daftari, V. N. Indurkar : Elements of Statics, Published by Dattsons, J. Neharu Marg, Nagpur.
7) M. A. Pathan : A modern Text Book of Statics, Pragati Prakashan, Nagpur.

2. PHYSICS

3S PHY

Unit I : Mathematical background and Elecrostatics (12)

Gradient, divergence and curl of a vector fields and their physical significance, line surface and volume integral. Gauss divergence theorem , Stocks theorem.Work done on charge in electrostatic field, flux of electric field, force on moving charge, Lorentz force equation and definition of B. Ampere's force law, Ampere's Law and its applications.

Unit II : Magnetostatics and Maxwell's Equations (12)

Faraday's Law, Integral and differential form of faraday's law, displacement current and Maxwell's Equation , wave Equation satisfied by E and B. Plane electromagnetic wave in vacuum, Poynting vector and Poynting theorem.

Unit-III : Solid State Electronics Devices-I – (12)

Physics of semiconductors : Introduction to semiconductors ; Charge carriers & electrical conduction through semiconductors ; Doping , extrinsic semiconductors ; Fermi level & energy level diagrams ; Drift current in semiconductor , mobility, conductivity ; Hall effect, Hall coefficient, Semiconductor diode & its biasing, LED, Varactor diode.

Unit-IV : Solid State Electronics Devices-II – (12)

Introduction to BJT ; working of BJT ; modes of operation ; Current gains α and β, their relation ; CB & CE characteristics ; JFET- construction & working , characteristics of FET ; Basic concept of Difference amplifier, IC-OP AMP , electrical parameters of OP AMP, inverting & noninverting modes ; OP AMP as adder, subtractor, differentiator & integrator.

Unit: V : Special Theory of Relativity (12)

Postulates of Special Theory of Relativity, Lorentz transformations, Length contraction, Time dilation, relativistic addition of velocities, relativity of mass, Einstein's Mass - energy relation, Numericals.

Unit: VI : Atmosphere and Geophysicss (12)

Structure of earth – The crust, mantle, core.

Part of the earth – As a planet; The Atmosphere, The lithosphere, The Hydrosphere Composition of Atmosphere

Earthquakes – Causes, terminologies associated with earthquakes. Type of earthquakes scale of intensity, recording of earthquakes.

Radiation in the atmosphere, Propagation of energy through vacuum,Intensity of radiation,Scattering, absorption and reflection of solar radiation by the atmosphere. Moisture and clouds: mechanism that produces clouds ,Cloud produced by mixing and by cooling.

Practical : The distribution of marks for practical examination will be as follows:

Record Book	10 marks
Viva-voce	10 marks
Experiment	20 marks
Assignment	10 marks
Total	50 marks

a) A student will have to perform at least ten experiments per semester.

b) The semester examination will be of Four Hour duration and student will have to perform one experiment in the semester examination.

c) In assignment, every student should be asked to submit the detailed report on one of experiments he or she has performed. The detailed report should include the theoretical background of the experiment..

Evaluation of the student during the semester:

The teacher should explain, discuss and demonstrate one experiment per turn in the first twelve turns of the semester. At the same time in every turn, a teacher will have to conduct a test in the first period of the turn, based on the experiment; he or she has explained in the previous turn. The test is to be carried out with the interest to make the student aware of the basics of the experiments. This will enhance the viva voce competence of the student. A record of these tests is to be maintained in the department duly signed by the teacher in-charge and head of the department. The record is to be maintained in the following format. Each assignment should be of at least 15 marks. Find the average and assign it in the end Semester practical examination.

Record of Marks scored in the assignments during the semester

Date											
S.No.	Name of the student	Expt 1	Expt 2	Expt 3	Expt 4	Expt 5	Expt 6	Expt 7	Expt 8	Expt 9	Expt 10
1	ABC										
2	DEF										
3	GHI										
4	JKL										
Signature of the teacher incharge											

Once this part is over, actual experimentation work should begin. The date-wise record is to be maintained in the following format.

Date-wise Record of the experiments

S.No.	Name of the student	Expt 1	Expt 2	Expt 3	Expt 4	Expt 5	Expt 6	Expt 7	Expt 8	Expt 9	Expt 10
1	ABC										
2	DEF										
3	GHI										
4	JKL										
Signature of the teacher in-charge											

a. Completion Certificate: is must for practical record book.

b. The semester examination will be of Four Hour duration and the student will have to perform one experiment in the semester examination

Experiments:-

1. To determine characteristics of CB transistor
2. To determine characteristics of CE transistor
3. Measurement of magnetic field by Hall probe method
4. To study variation of gain of CE amplifier with load
5. To study Zener regulated power supply
6. To determine characteristics of FET
7. To study FET as a voltmeter
8. To study Weins bridge oscillator
9. To study phase shift oscillator
10. To study Wein's bridge oscillator
11. To study p-n diode as a rectifier
12. To determine characteristics of p-n junction.
13. Study of OP AMP as an inverting amplifier
14. Study of OP AMP as noninverting amplifier
15. Study of OP AMP as an adder
16. Study of OP AMP as subtractor
17. Study of OP AMP as differentiator
18. Study of OP AMP as an integrator
19. To determine characteristics of Phototransistor
20. Measurement of field strength its variation in a solenoid.
21. To draw the BH curve of iron by using a Solenoid and to determine the energy loss due to Hysteresis.

Reference Books:--

1. Solid state Electronics Devices- B.G.Streetman (PHI)
2. Electronics Devices & Circuits – A. Mottershead (PHI)
3. Integrated Electronics—J.Millman ; C.Halkias (TMH)

4. Electronics Devices & circuits – Sanjeev Gupta (Dhanpat Rai Pub.)
5. Electronics Devices & circuits-I & II – Godse & Bakshi (Tech. Pub. , Pune)
6. Solid State Devices & Electronics—Kamal Singh & S.P.Singh (S. Chand & Co.)
7. Electromagnetic theory and holography – satya parakash
8. A text book of geology – G.B. mahapatra
9. Engineering and general geology – parbin singh.
10. The atmosphere – Richard A. Anthes, Hans A. Panotsky, Jhon J Cahir, Albert Rango.
11. Relativity—Goyal and Gupta
12. Text book of Physics --- V. K. Sewane
13. Elements of Special theory of relativity—S.P.Singh and M.K.Bagde
14. A course in Electromagnetic field by S.W.Anwane, B.P.B. Publication, New Delhi.

4SPHY

Unit I : Geometrical optics and interference (12)

Cardinal points of an optical system, equivalent focal length and power of coaxial lens system, Interference in thin films due to reflected and transmitted light, interference in wedge shaped thin film, Newton's ring by reflected light, measurement of wavelength of monochromatic light by Newton's, ring, determination of refractive index of liquid by Newton's rings.

Unit II : Diffraction (12)

Fresnel and Fraunhofer Diffraction, Fresnel half period zone, zone plate construction and theory. Double slit diffraction, Plane diffraction grating; construction and elementary theory, determination of wavelength of monochromatic light by using grating. Resolution of images, Rayleigh's criteria for resolution,R. P. of grating.

Unit III : Polarization (12)

Concept of polarization, optic axis, double refraction, polarization by double refraction, phase retardation plate :-Quarter wave plate, half wave plate, (Nicol prism-production and analysis of polarized light). Theory of production of elliptically and circularly polarized light, production and detection of elliptically and circularly polarized light. Half shade polarimeter, blue of the sky.

Unit IV : Laser (12)

Introduction to Maser, Absorption, spontaneous and stimulated emission, population inversion, pumping characteristics of laser beam. Main components of laser system, three level and four level laser system. Ruby laser, He-Ne laser, semiconductor laser, application of laser. Holography-principle .

Unit V : Fiber optics (12)

introduction of fiber optics, total internal reflection, structure and classification of optical fiber. Propagation of light wave in an optical fiber, Acceptance angle and
numerical aperture, dispersion, fiber losses, fiber optic communication. Advantages and Disadvantages of optic fibers, application of fiber optics.

Unit VI : Renewable Energy Sources (12)

Introduction to various renewable energy sources – Solar energy, Wind energy, ocean energy- Waves & tides, geothermal energy, Hybrid Systems, Hydrogen energy systems, Fuel cells.

Solar energy - Solar radiations on earth - availability and seasonal variations, Solar constant, Spectral distribution, Measurement of solar radiation and sun shine.

Solar Energy Storage :- Methods of storage, properties of storage materials. Principle of Solar Thermal Applications, Solar water heater, Solar concentrating collectors - Types , applications.

Solar Photovoltaic systems -- Operating principle, Photovoltaic cell concepts , power of a solar cell and solar PV panel ; Applications.

Practical : The distribution of marks for practical examination will be as follows:

Record Book	10 marks
Viva-voce	10 marks
Experiment	20 marks
Assignment	10 marks
Total	50 marks

a) A student will have to perform at least ten experiments per semester.
b) The semester examination will be of Four Hour duration and student will have to perform one experiment in the semester examination.
c) In assignment, every student should be asked to submit the detailed report on one of experiments he or she has performed. The detailed report should include the theoretical background of the experiment..

Evaluation of the student during the semester:

The teacher should explain, discuss and demonstrate one experiment per turn in the first twelve turns of the semester. At the same time in every turn; a teacher will have to conduct a test in the first period of the turn, based on the experiment; he or she has

explained in the previous turn. The test is to be carried out with the interest to make the student aware of the basics of the experiments. This will enhance the viva voce competence of the student. A record of these tests is to be maintained in the department duly signed by the teacher in-charge and head of the department. The record is to be maintained in the following format. Each assignment should be of at least 15 marks. Find the average and assign it in the end Semester practical examination.

Record of Marks scored in the assignments during the semester:-

Date											
S.No.	Name of the student	Expt 1	Expt 2	Expt 3	Expt 4	Expt 5	Expt 6	Expt 7	Expt 8	Expt 9	Expt 10
1	ABC										
2	DEF										
3	OHI										
4	JKL										
Signature of the teacher incharge											

Once this part is over, actual experimentation work should begin. The date-wise record is to be maintained in the following format.

Date-wise Record of the exoeriments performed

S.No.	Name of the student	Expt 1	Expt 2	Expt 3	Expt 4	Expt 5	Expt 6	Expt 7	Expt 8	Expt 9	Expt 10
1	ABC										
2	DEF										
3	OHI										
4	JKL										
Signature of the teacher in-charge											

a. Completion Certificate: is must for practical record book.
b. The semester examination will be of Four Hour duration and the student will have to perform one experiment in the semester examination

Practicals :

1. To determine the wavelength of monochromatic light by Newton's rings.
2. To verify the Brewster's law.

3. To determine the refractive indices for ordinary and extra-ordinary rays using double image prism.
4. To determine the Concentration of sugar solution by half shade polarimeter.
5. To determine the wavelength of monochromatic light by plane diffraction grating.
6. To find the number of lines per centimeter of the given grating.
7. To determine the resolving power of plane diffraction grating.
8. To determine the resolving power of telescope.
9. To determine the wavelength of laser light.
10. Determination of refractive index of a prism by spectrometer.
11. Determination of dispersive power of prism material
12. To determine the resolving power of prism.
13. study of interference of light by bi-prism experiment and find the wavelength of sodium light.
14. To verify the law of Malus of plane polarized light.
15. Polarplots of solarpanel
16. Measurement of direct radiation using Pyrheliometer .
17. Measurement of global & diffuse radiation using pyranometer
18. Determination of solar constant
19. To determine frequency and phase of signal using CRO.
20. To determine capacitance by Scherring bridge method.
21. To determine self inductance by bridge rectifier method.
22. To determine frequency of AC mains by Sonometer.
23. To study and plot I-V characteristics of solar cell.
24. To study time constant of an RC circuit experimentally and verify the result theoretically.
25. Verification of Stefan's law of radiation by using an incandescent lamp as black body Radiator.
26. To study (a) Half-wave Rectifier and (b) Full-wave Bridge Rectifier and investigate the effect of C, L and π filters.

REFFERENCE BOOKS:

1. Laser and non-linear optics – B B Laud.
2. Optoelectronics and fiber optics communication – C.K Sarkar, D.C. Sarkar.
3. An introduction to fiber optics – R. Allen Shotwell
4. Optics – Ajoy Ghatak.
5. Optical fiber Communication – John M. Senior
6. Principles of optics – B.K.Mathur
7. Optics and laser – V.K. Sewane
8. Optics and atomic physics – D.P.Khandelwal.
9. Non Conventional Energy Sources, G. D. RAI(4th edition), Khanna Publishers, Delhi.
10. Solar Energy, S.P. Sukhatme (second edition), Tata Mc. Graw Hill Ltd, New Delhi.

11. Solar Energy Utilisation, G. D. RAI (5th edition), Khanna Publishers,Delhi.
12. Principles of Solar Energy - Kreith Kreider.
13. Renewable Energy - BentSarensen.

3. CHEMISTRY
3S Chemistry

The examination in Chemistry of Third semester shall comprise of one theory paper, internal assessment and practical examination. Theory paper will be of 3 Hrs. duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of 6 to 8 hours duration and carry 50 marks.

The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question in every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-III (8 marks).

3S Chemistry

Total Lectures: 84 ***Marks: 80***

Note: Figures to the right hand side indicate number of lectures.

Unit I **14L**

(A) Covalent Bonding:

Limitations of valence bond theory. Molecular Orbital Theory. Postulates of MO theory. LCAO approximation. Formation of bonding and antibonding MOs. Rules for LCAO. MO energy level diagram. Concept of bond order. MO structure of homonuclear diatomic molecules of namely He_2, H_2, N_2 and O_2. Stability sequence of species of O_2 i.e. O_2, O_2^+, O_2^{2+}, $O_2^-$and O_2^{2-}. Paramagnetic nature of O_2. Nonbonding MOs. MO structure of heteronuclear diatomic molecules viz. NO, HF and CO (Coulson's structure). Explanation of important properties of CO viz. - triple bond, almost nonpolar nature, electron donor and acceptor behaviour. Comparison of VB and MO theories. **[6]**

(B) Metallic Bonding:

Free electron theory and properties of metals such as electrical and thermal conduction, malleability, ductility and metallic lusture. VB theory or Resonance theory of metals. Band theory to explain nature of conductors, insulators and semiconductors (both intrinsic and extrinsic). **[3]**

(C) VSEPR Theory:

Various rules under VSEPR theory to explain molecular geometry (following examples may be taken to explain various rules- $BeCl_2$, BF_3, CH_4 , NH_4^+, PCl_5 , SF_6, IF_7, $SnCl_2$, NH_3, H_2O, SF_4, ClF_3, ICl_2^- , ICl_4, BrF_5, XeF_6, SOF_4, COF_2, PCl_3, PBr_3, PI_3, F_2O, H_2S). Limitations of VSEPR theory. **[5]**

Unit II - Theory of Quantitative Inorganic Analysis 14L

(A) Volumetric Analysis:

(a) Introduction:-Volumetric analysis, titrant, titrate, end point, equivalence point, indicator etc. Requirements of volumetric analysis. Definition of standard solution, primary standard substance. Requirements of primary standard substance. Terms to express concentrations namely- molarity, normality, molality, mole fraction and percentage. (Simple numericals expected).

(b) Acid-Base titrations:- Types of acid base titrations. pH variations during acid base titration. Acid base indicators. Modern theory (Quinoniod theory) of acid base indicators. Choice of suitable indicators for different acid base titrations.

(c) Redox Titrations:-General principles involved in redox titrations (redox reactions, redox potentials, oxidant, reductant, oxidation number). Brief idea about use of $KMnO_4$,$K_2Cr_2O_7$as oxidants in acidic medium in redox titrations. Use of I_2 in iodometry and iodimetry. Redox indicators-external and internal indicators. Use of starch as an indicator. Iodometric estimation of Cu (II). **[8]**

(B) Gravimetric Analysis:

Definition. Theoretical principles underlying various steps involved in gravimetric analysis with reference to estimation of barium as barium sulphate. Co-precipitation and post precipitation. (Definition, types and factors affecting). **[6]**

Unit III 14L

(A) Aldehydes and Ketones:

Aliphatic and Aromatic aldehydes and ketones (Acetaldehyde, Benzaldehyde, Acetone, Acetophenone) Introduction, Structure of carbonyl group, acidity of α-hydrogen in carbonyl compounds. Methods of preparation of aldehydes: From alcohols, Calcium salts of acids, Acid chlorides, Gatterman-Koch synthesis.

Reactions of aldehydes: Cannizaro's, Reformatsky, (Perkin with mechanism), Mannich reaction, (Benzoin and Aldol condensation with mechanism). Methods of preparation of ketones: oxidation, catalytic decomposition of acids, dry distillation of Ca salt, Friedel-Craft's reaction, hydration of alkynes. Reaction of ketones: MPV, Wolff-Kishner, $LiAlH_4$ reductions. **[9]**

(B) Carboxylic acids:

Introduction, Structure and reactivity of carboxylic groups.

Acidity of carboxylic acids, effects of substituents on acids strength. Methods of synthesis and chemical reactions of oxalic, lactic, benzoic and salicylic acid.

Oxalic acid: Preparation from ethylene glycol and cyanogens. Chemical reactions: oxidation, reduction, esterification, reaction with ammonia, glycerol and action of heat.

Lactic acid: Preparation from acetaldehyde, pyruvic acid. Chemical reactions: Ester formation, action of PCl_5, heat, oxidation and reduction.

Benzoic acid: Preparation from benzene, toluene, benzyl alcohol, phenyl cyanide, benzamide. Chemical reactions : Reaction with PCl_5, ammonia and ester formation.

Salicylic acid: Preparation by Reimer-Tiemann reaction. Chemical reactions: acetylation and esterification. **[5]**

UnitIV–Stereochemistry 14L

A) Introduction to different types of isomerism, Structural isomerism and Stereoisomerism, conformation, configuration and Geometrical isomerism. **[2]**

B) Optical isomerism:

Element of symmetry, chirality, Assymetric carbon atom, enantiomers, diastereoisomers, relative and absolute configurations, Fischer projection formula, R-S nomenclature,Inversion and retension, racemisation and resolution of racemic mixture. **[3]**

C) Geometrical isomerism:

Cis-trans nomenclature, *E-Z* nomenclature, Methods of structure determination. **[3]**

D) Bayer's Strain theory and its limitations. Stability of cycloalkanes, conformations and conformational isomers of ethane, n-butane and cyclohexane, their energy level diagrams. Newman, Sawhorse, Fischer and Flying wedge projection formulae. **[6]**

Unit V 14L

(A) Thermodynamics and Equilibrium: [10]

(i) Definition and physical significance of Helmholtz work function (A) and Gibbs free energy. Change in free energy (ΔG) as a criteria of spontaneity and equilibrium. Variation of 'A' with 'V' & 'T'. Change in 'G' due to change in

'P' and 'T'. Gibbs-Helmholtz equation and its applications.

(ii) Chemical potential. Derivation of Gibbs-Duhem equation. Chemical potential of an ideal gas in a gaseous mixture. Derivation of Van't Hoff reaction of isotherm and its application to equilibrium state. Derivation of Van't Hoff equation and its applications.

(iii) Numericals.

(B) Phase rule: [4]

Statement of Phase rule. Explaination of Phase, number of components and degrees of freedom. Application of phase rule to water and suphur systems.

Unit VI 14L

(A) Phase Equilibrium: [6]

(i) Raoult's Law and it's limitations. Ideal and non ideal solution. Classification of binary solutions of completely miscible liquids (I, II and III) on the basis of Raoult's Law.

(ii) Phase diagrams of Phenol-Water, Triethylamine-Water and Nocotine-Water system.

(iii) Nerst distribution law and its applications to association and dissociation of solute in one of the immiscible solvents. Process of extraction. Derivation of the formula for the amounts of the solute left unextracted after n^{th} extraction.

(iv) Numericals.

(B) Electrochemistry: [8]

(i) Conductance of electrolyte solutions. Specific, equivalent and molar conductance. Determination of conductance of electrolyte solution. Variation of specific and equivalent conductance with dilution. Conductometric titrations. Advantages of conductometric titrations.

(ii) Migration of ions under the influence of electric field. Hittorf's theoretical device (Hittorf's rule). Transport number of ions.

(iii) Kohlrausch's law of independent migration of ions. Determination of λ_∞ and the degree of dissociation of a week electrolyte. Determination of ionization (or dissociation) constant of week acid. Determination of solubility and solubility product of a sparingly soluble salt.

(iv) Numericals

Semester- III

3S Chemistry Practicals

Total Laboratory sessions: 21 Marks:50

Unit I : Inorganic Chemistry Practicals 7 Laboratory sessions

1. Calibration of volumetric apparatus (Burette, pipette and volumetric flask) and fractional weight box. (Atleast one experiment to be done by using analytical balance and calibrated fractional weight box).
2. Following volumetric exercises— (standard solutions to be prepared by students)
   (a) To determine acid neutralising capacity of an antacid.
   (b) To determine the strength of oxalic acid by titration with $KMnO_4$.
   (c) To determine percentage purity of Ferrous Ammonium Sulphate by titration with $KMnO_4$.
   (d) To determine strength of FAS by titration with $K_2Cr_2O_7$ using internal indicator.
   (e) Estimation of copper (II) in commercial copper sulphate sample by iodometric titration.
   (f) To determine amount of iodine in iodized common salt.

Unit II : Organic Chemistry Practicals 7 Laboratory sessions

Complete analysis of simple organic compounds containing one or two functional groups and involving following steps:

1) Preliminary examinations
2) Detection of the elements
3) Detection of functional groups
4) Determination of m.p./ b.p.
5) Preparation of derivative and its m.p./ b.p.
6) Performance of spot test if any.

Minimum 7-8 compounds containing different groups should be identified by student.

1) Acids : Oxalic acid, Benzoic acid, Salicylic acid, Phthalic acid and Sulphanilic acid.
2) Phenols : Resorcinol, α-naphthol, β-naphthol.
3) Aldehydes : Benzaldehyde, Glucose, Lactose.
4) Base : Aniline, *p*-Toluidine.

5) Nitro compounds: Nitrobenzene, *m*-dinitrobenzene.
6) Amides : Benzamide, Urea, Thiourea.
7) Hydrocarbons: Naphthalene, Anthracene.
8) Halogen compounds : Chloroform, Chlorobenzene.

Unit III : Physical Chemistry Practicals 7Laboratory sessions

Expt. No.1 : To determine partition coefficient of iodine between water and organic solvents (e.g. $CHCl_3$/ CCl_4).

Expt. No.2 : To study distribution of benzoic acid between water and benzene and from this determination of molecular state of benzoic acid in benzene.

Expt. No.3 : To construct mutual stability curve for phenol-water system and determine the consulate temperature for the system.

Expt.No.4 : To determine solubility of benzoic acid at different temperature and from that ΔH solution.

Distribution of Marks for Practical Examination.

Time: 6 – 8 hours (One Day Examination) Marks: 50

Unit – I	:	Inorganic Chemistry (Exercise)	……..	12
Unit – II	:	Organic Chemistry (Exercise)	……..	12
Unit – III	:	Physical Chemistry (Exercise)	……..	12
		Viva-Voce	…….....	07
		Record	…….	07
				Total: 50

4S Chemistry

Total Lectures: 84 ***Marks: 80***

Note: Figures to the right hand side indicate number of lectures.

UnitI **14L**

(A) Chemistry of elements of transition series:

Definition of transition elements. General characteristics of transition elements. Comparative study of first transition series elements (3d) with reference to following properties:

(i) Electronic configuration (ii) Atomic and ionic size (iii) Ionization energy (iv) Metallic nature (v) Oxidation states (vi) Magnetic properties (vii) Color of salts (viii) Catalytic properties (ix) Complex formation behaviour.

Study of 4d and 5d series elements-Electronic configuration. Comparison of 3d series elements with

4d and 5d series elements with respect to size, oxidation states, magnetic properties and color. [**11]**

(B) Extraction of elements:

Principles involved in extraction of elements. Major methods of extraction of elements. Factors affecting choice of extraction method. Thermodynamics of reduction processes-Ellingham diagrams for oxides and importance of this diagram (only preliminary ideas). **[3]**

Unit II **14L**

(A) Inner transition elements:

Definition, Lanthanides and Actinides. Comparative study of Lanthanides with respect to following properties:

(i) Electronic configuration (ii) Atomic and ionic radii-lanthanide contraction-definition, cause and effect of lanthanide contraction (iii) Oxidation states (iv) Magnetic properties (v) Color of salts (vi) Complex formation behavior.

Occurrence of lanthanides. Isolation of lanthanides by ion exchange method.

Actinides- Electronic configuration and oxidation states. Comparison of lanthanides and actinides. Applications of Lanthanides and Actinides in high technology in brief. **[11]**

(B) General Principles of Metallurgy:

Definition of metallurgy, steps in metallurgy. Ore dressing by gravity separation, froath floatation and electromagnetic separation. Calcination, roasting, smelting and refining of metals. Meaning of terms-hydrometallurgy and pyrometallurgy. **[3]**

Unit III **14L**

(A) Polynuclear hydrocarbons:

Introduction, orbital picture of naphthalene. Preparation and reactions of α-naphthol and β- naphthol, α-naphthylamine and β- naphthylamine. **[4]**

(B) Organic synthesis via enolates:

Defination of reactive methylene group, synthesis and applications of malonic ester and acetoacetic ester, keto-enol tautomerism.

Malonic Ester: Synthetic applications- Synthesis of Acetic acid , Succinic acid, Glutaric acid, Adipic acid, Crotonic acid, Acetone, Malonyl urea.

Acetoacetic ester: Synthetic applications- Synthesis of Acetic acid, Propionic acid, isobutyric acid, Succinic acid, Glutaric acid, Crotonic acid, Acetone, Acetyl acetone, 4-methyl uracil. **[6]**

(C) Carbohydrates:

Introduction, Constitution of glucose, cyclic structure, Pyranose and Furanose structure, Epimerization, Chain lengthening and chain shortening in aldose. Interconversion of glucose and fructose, Introduction to fructose, ribose, 2- deoxyribose, maltose, sucrose. (Their structure only determination not expected) **[4]**

Unit IV **14L**

(A) Aromatic nitro compounds:

Nitration and different nitrating agents. Reduction of Nitrobenzene under different conditions. **[2]**

(B) Amino Compounds:

Introduction, Basicity and effect of substituents. Methods of preparation of aniline, Reactions of aniline: Carbylamine reaction, alkylation, reaction with aldehyde, benzoylation, Hoffmann's Exhaustive Methylation and its mechanism. **[5]**

(C) Diazonium Salts:

Diazotization, Preparation and synthetic applications of benzene diazonium chloride. **[3]**

(D) Amino acids and Proteins:

Classification of amino acids, methods of synthesis and reactions of amino acids.

Zwitterion structure, Isoelectric point, peptide synthesis, Structure determination of Polypeptides by end group analysis. **[4]**

Unit V- Colligative Properties of Dilute Solutions 14L

(i) Definition and examples of colligative properties. Importance of colligative properties.

(ii) Elevation of boiling point. Thermodynamic derivation of the relationship between elevation of boiling point and the molar mass of non-volatile solute. Cottrell's method for the determination of elevation of boiling point and hence the molar mass of solute.

(iii) Depression of freezing point. Thermodynamic derivation of the relationship between depression of freezing point and the molar mass of non-volatile solute. Rast's method for the determination of molar mass of solute.

(iv) Abnormal behaviour of solution. Van't Hoff's factor 'i'. Determination of degrees of association and degree of dissociation from Van't Hoff's factor.

(v) Numericals.

Unit VI- Physical Properties and Molecular Structure 14L

(A) Electrical Properties : [7]

(i) Polar and non-polar molecules. Dipole moment.

(ii) Induced polarization and orientation polarization. Clausius-Mossotti equation (only qualitative treatment).

(iii) Measurement of dipole moment by temperature and refractivity methods.

(iv) Applications of dipole moment for the determination of molecular structure. (molecular geometry, % ionic character of a covalent bond, cis-trans isomers and ortho, meta and para isomers of a disubstituted benzene).

(v) Numericals.

(B) Magnetic Properties: [7]

(i) Paramagnetic and diamagnetic substances. Origin of paramagnetism and diamagnetism.

(ii) Volume, specific and molar magnetic susceptibility. Relationship between molar magnetic susceptibility and magnetic moment.

(iii) Relationship between magnetic moment (spin only) and the number of unpaired electrons.

(iv) Applications of magnetic moment in the determination of molecular structure.

(v) Numericals.

4S Chemistry Practicals

Total Laboratory sessions: 21 **Marks: 50**

Unit I : Inorganic Chemistry Practicals 7 Laboratorysessions

Gravimetric estimation of Ba^{2+} as $BaSO_4$, Fe^{3+}as Fe_2O_3 using china or silica crucible and Ni^{2+} as Ni-DMG using sintered glass crucible.

Unit II : Organic Chemistry Practicals 7 Laboratory sessions

1. Determination of acetic acid in commercial vinegar using NaOH.
2. Estimation of the amino group.
3. Estimation of phenol by bromination method.
4. Estimation of urea by hypobromide method.
5. Estimation of unsaturation.

6. Isolation of Caffine from tea leaves.
7. Isolation of Casein from milk.
8. Isolation of lactose from milk.

Unit III : Physical Chemistry Practicals 7 Laboratory sessions

Expt. No. 1: To determine molar mass of non-volatile solute by Rast's method.

Expt. No. 2: To study conductometric titration of a strong acid against a strong base.
(Standard oxalic acid solution to be prepared by the student).

Expt. No. 3: To determine rate constant for the saponification of ethyl acetate (second order reaction with equal initial concentration of both the reactants) by Conductometry.

Expt. No. 4: To study variation of specific and equivalent conductance with dilution for a strong electrolyte.

Expt. No. 5: To determine equivalent conductance of acetic acid at infinite dilution by Kohlrausch's law.

Distribution of Marks for Practical Examination.

Time: 6 – 8 hours (One Day Examination) Marks: 50

Unit – I	:	Inorganic Chemistry (Exercise) ……..	12
Unit – II	:	Organic Chemistry (Exercise) ……..	12
Unit – III	:	Physical Chemistry (Exercise) ……..	12
		Viva-Voce …….....	07
		Record …….	07

		Total :	**50**

Books Recommended: (Common for Semester III and Semester IV)

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia- S. Naginchand & Co., Delhi.
2. Text book of Inorganic Chemistry by A.K. De, Wiley East Ltd.
3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan- S. Chand & Co.
4. Modern Inorganic Chemistry by R.C. Agrawal, Kitab Mahal.
5. Instrumental Methods of analysis by Chatwal and Anand, Himalaya Publishing House.
6. Concise Inorganic Chemistry by J.D. Lee, ELBS.
7. Inorganic Chemistry by J.E. Huheey- Harper & Row.
8. Fundamental concepts of Inorganic Chemistry by E.S. Gilreath, McGraw Hill book Co.
9. Modern Inorganic Chemistry by W.L. Jolly, McGraw Hill Int.

10. Chemistry Facts, Patterns & Principles by Kneen, Rogers and Simpson, ELBS.
11. Theoretical Principles of Inorganic Chemistry by G.S. Manku, Tata McGraw Hill.
12. Inorganic complex compounds by Murmann, Chapman & Hall.
13. Text book of Inorganic Chemistry by K.N. Upadhyaya, Vikas Publishing House, Delhi.
14. Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Pulishing House, Meerut.
15. Co-ordination Chemistry by D. Banerjee, TMH Publication.
16. Text book of Inorganic Chemistry by Nema, Agrawal, Solanki, Morkhade, Meshram, Berad.
17. Text book of Inorganic Chemistry by Bhadange, Pagariya, Deshmukh, Joshi, Bombatkar, Mandlik, Bokey Prakashan, Amravati.
18. Organic Chemistry by R.T. Morrison & R.T. Boyd, 6th edition, PHI.
19. Organic Chemistry by Pine, 5th edition.
20. Organic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor- Wiley Eastern.
21. Organic Chemistry by S.K. Ghosh.
22. Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.
23. Spectroscopy of Organic Compounds by P.S. Kalsi.
24. Stereochemistry and mechanism through solved problems by P.S. Kalsi.
25. Organic Chemistry by TWG Solomons, 4th edition, John Wiley.
26. Hand Book of Organic Analysis by H.J. Clarke, Arnold Heinmen.
27. Text book of Practical Organic Chemistry by A. I. Vogel.
28. Text book of Organic Chemistry by Wadodkar, Raut, Dighade, Thakare, Kale, Kadu, Chincholkar.
29. Text book of Organic Chemistry by P.S. Kalsi published by Macmilllan India Ltd., 1999, Delhi.
30. Practical Organic Chemistry by F.G. Mann, B.C. Saunders, Orient Longman.
31. Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dhingra, Orient Longman.
32. Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.

33. Text book of Organic Chemistry by Deshmukh, Awinashe, Tayade, Wadekar, Meshram, Parhate, Bokey Prakashan, Amravati.
34. Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.
35. Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
36. Principles of Physical Chemistry: Maron and Prutton.
37. Principles of Physical Chemistry: Puri, Sharma and Pathaniya.
38. Physical Chemistry: P.W. Atkins, 4th Edn.
39. Text book of Physical Chemistry: P.L. Sony, O.P. Dharma.
40. Physical Chemistry: Levine.
41. Practical Physical Chemistry: Palit and De.
42. Practical Physical Chemistry: Yadao.
43. Practical Physical Chemistry: Khosla.
44. Laboratory Mannual of Physical Chemistry: W.J. Popiel.
45. Practical Chemistry: Dr. S.B. Lohiya, Bajaj publication, Amravati.
46. Text book of Physical Chemistry: Satpute, Kabra, Raghuwanshi, Wankhade, Jumle and Murarka.

List of equipments/apparatus required for the Chemistry Practicals for B.Sc.

1.	Abbe's Refractometer	02 nos./batch
2.	Viscometer	10 nos./batch
3.	Stalagmometer	10 nos./batch
4.	Melting Point Apparatus	10 nos./batch
5.	Thermometer 0-360^{o}C	20 nos./batch
6.	Thermometer 0-110^{o}C	20 nos./batch
7.	Analytical balance	15 nos./batch
8.	Weight box	15 nos./batch
9.	Density Bottles	20 nos./batch
10.	Kipp's Apparatus	02 nos./batch
11.	Quick fit Distillation Assembly/ Multipurpose assembly	10 nos./batch
12.	Sintered Glass Crucible	20 nos./batch
13.	Silica Crucible	20 nos./batch
14.	Vacuum Suction Pump	02 nos./lab.
15.	Potentiometer	02 nos./batch
16.	Metzer Electronic one pan balance	01 nos./lab.
17.	Filtration flask with Buckner Funnels	
	100ml	10 nos./batch
	250ml	05 nos./batch
	500ml	02 nos./batch
18.	Desiccators	10 nos./batch
19.	Magnetic Stirrer	10 nos./batch
20.	Water Suction	10 nos./batch

21.	Conductometer with Conductivity Cell	04 nos./batch
22.	Colorimeter	02 nos./batch
23.	pH Meter	02 nos./batch
24.	Chromatographic Jar	05 nos./batch
25.	Separating funnels 250ml, 500ml	05 nos./batch
26.	Hot Air Oven	02 nos./lab.
27.	Hot-Cold Air Blower	01 no./lab.
28.	Centrifuge machine (Electrically Operated)	02 nos./lab.
29.	Deioniser Water Still (Electrically Operated)	01 no./lab.
30.	Hot Plate/ Heating Mantle	05 nos./batch
31.	Models of Elements (Seven Crystal types and their symmetry)	01 no./batch
32.	Flame Photometer	02 nos./batch
33.	Spectrophotometer	02 nos./batch
34.	Shaking Machine	01 no./batch
35.	Polarimeter	02 nos./batch

4. INDUSTIRAL CHEMISTRY (REGULAR/VOCATIONAL)

The examination in Industrial Chemistry (Regular/ Vocational) of Third semester shall comprise of one theory paper, internal assessment and practical examination. Theory paper will be of 3 Hrs. duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of 6 to 8 hours duration and carry 50 marks.

The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question in every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-III (8 marks).

3S Industrial Chemistry (Regular/ Vocational)
Unit Processes and Process Equipments

Total Lectures: 84 **Marks: 80**

Note: Figures to the right hand side indicate number of lectures.

Unit I **[14]**

A) Nitration – Introduction, nitrating agents, nitration of i) Benzene to nitrobenzene and m-dinitrobenzene. ii) Chlorobenzene to *o* and *p*- nitrochlorobenzenes. iii) Acetanilide to p-nitroacetanilide. Contineous and batch nitration.

B) Amination by Reduction – Introduction, methods of reduction, Bechamp. Reduction (Iron and Acid Reduction), sulphide reduction, alkali sulphite

reduction, metal hydrides, cathodic reduction. Factors affecting amination. Manufacturing of aniline, m-nitroaniline, p-aminophenol.

C) Alkylation – Introduction, alkylating agents, mechanism of alkylation. Manufacturing of alkyabenzene, ethylbenzene.

Unit II **[14]**

A) Sulphonation – Introduction, sulphonating agents, factors affecting sulphonation. Sulphonation of benzene, naphthalein. Batch and Contineous sulphonation.

B) Halogenation – Introduction, halogenating agents, nuclear and side chain aromatic halogenation. Manufacturing of chlorobenzene, chloral,monochloro acetic acid.

C) Hydrolysis - Introduction, mechanism and thermodynamics of hydrolysis,various hydrolyzing agents.

Unit III **[14]**

A) Oxidation – Introduction, various hydrolyzing agents, types of oxidative reactions, mechanism of oxidation, liquid and vapour phase oxidation. Manufacturing of benzoic acid, acetaldehyde and acetic acid.

B) Hydrogenation - Introduction, various catalysts used for hydrogenation, Manufacturing of methanol from carbon monoxide and hydrogen, hydrogenation of vegetable oil.

C) Esterification - Introduction, esterification of organic acids using unsaturated compounds. Manufacturing of ethyl acetate, vinyl acetate, cellulose acetate.

Unit IV: Process Equipments **[14]**

A) Thermometer – Glass, bimetallic, pressure spring, resistance and radiation pyrometer.

B) Pressure – Manometer, barometer, pressure gauge, diaphragm, Macleon and Pirani gauge.

C) Liquid level – Direct and indirect liquid level, measurement, float type liquid level gauge, ultrasonic level gauge, and bell type liquid level gauge.

Unit V **[14]**

A) Corrosion- Introduction, types of corrosion (galvanic, open air, underwater & underground). Mechanism of corrosion. Factors affecting corrosion.

a. **Passivity –** Introduction, chemical and mechanical passivity, oxide film

b. theory of passivity.

B) Methods adopted for preventing corrosion (metal coating processes)

a. i) Galvanizations of iron (ii) Electro plating (iii) Painting (iv) Plastic

b. coating. Corrosion inhibitor.

C) Oil Paints and Varnishes - Introduction, manufacture and their applications in preventing Corrosion.

UNIT VI: Industrial solid waste and Treatment processes **[14]**

A) Introductions, types of solid wastes, methods of industrial solid waste treatment & disposal.

i) Composting, ii) Sanitary Land-fills, iii) Thermal process (Incineration & pyrolysis) iv) Recycling & reuse.

B) Hazards waste –

Types, radioactive waste, biomedical waste and non radioactive waste containing toxic and heavy metals. Methods of their disposal.

3S Industrial Chemistry Practical
List of Experiments

Unit I

1) Preparation of Benzoic acid from Benzaldehyde by Oxidation Method.
2) Preparation of Benzoic acid from Benzamide by Hydrolysis Method.
3) Preparation of m- nitroaniline from m-dinitrobenzene. (Reduction Method).
4) Preparation of Iodoform from Ethanol.
5) Preparation of p- bromoacetanilide from Acetanilide by Halogenation Method.
6) Preparation of Sulphanlic acid from Anlineby Sulphonation Process.
7) Preparation of p- nitroacetanilide from Acetanilide by Nitration Method.

Unit II

1) Preparation of m-dinitrobenzene from Benzene by Nitration Method.
2) Preparation of Acetanilide from Aniline.
3) Preparation of Acetylsalicylic acid (aspirin) from Salicylic acid.
4) Determination of free Chlorine in Water sample.
5) Determination of permanent hardness by alkali mixture ($NaOH + Na_2CO_3$) method.
6) Estimation of Calcium in Dolomite or Lime stone.

7) Determination of Iron in water sample by colorimetry.

Distribution of Marks for Practical Examination

Time: 6 – 8 hours		**(One Day Examination)**		**Marks: 50**
1. Unit – I	:	(Exercise No. 1)	……..	15
2. Unit – II	:	(Exercise No. 2)	……..	15
3. Viva-Voce			…….....	10
4. Record			…….	10
			Total:	**50**

Books Recommended:

1) Unit processes in Organic Synthesis – P.H.Groggins.
2) Industrial Organic Chemistry - Peter Weismann (Elsevier publication)
3) Environmental Chemistry – S.S. Dara
4) Environmental Chemistry- A. K. De
5) Environmental Chemistry- Tyagi & Mehara
6) Industrial Chemistry – B. K. Sharma
7) Environmental Chemistry- S.S.Dara
8) Environmental Chemistry- Shashi Chawala, Dhanpat Rai, co.
9) Process instrumentation & control- A.P. Kulkarni
10) Industrial Chemistry – D. P. Eckman , Jon- Wiley & Sons.
11) Instrumentation and Control for the process Industries – S. Sorer, Elsevier applied Science.

4S Industrial Chemistry (Regular/ Vocational)
Material Science and Industrial Pollution

Total Lectures: 84 **Marks: 80**

Note: Figures to the right hand side indicate number of lectures.

Unit I **A) Ceramics –** Introduction, types, raw materials, manufacturing processes. Properties and applications.

B) Refractories – Introduction, classification, manufacture, properties and applications of fire clay bricks, and high alumina bricks.

C) Glasses – Introduction, types, compositions, manufacturing process. Properties and applications. **[14]**

Unit II **Cement-** Introduction, types of cement, raw materials, manufacturing processes- Wet, dry and semidry process. Setting and hardening of cement. Properties of cement. Specifications and testing of cement (tensile, compression, fineness, specific gravity). Additives for cement. Major engineering problems in cement manufacturing. **[14]**

Unit III **Polymers –** Introduction, classification (natural, artificial, inorganic, organic, thermosetting, thermoplastic). Classification of polymerization processes (addition and condensation polymerization without mechanism).

Manufacturing processes, properties and applications of – polyethylene, polystyrene, polyvinyl chloride (PVC), polyester (PET), nylon, teflon, phenol, phenol formaldehyde and urea formaldehyde resins. **[14]**

UnitIV: **Water pollution due to Industrial Effluents**

A) Classification of water - sea water, surface water (river, lake, pond) and ground water (well, tube well, stream); their properties in brief.

B) Water quality parameters – pH, hardness, alkalinity, acidity, TDS, DO, COD, BOD. IS and WHO standards of water quality.

C)Inorganic Pollutants – Heavy metals, Pb, Hg, As, Cd, Cr, Ni, Cu, mineral acids, alkalis and their sources (inorganic based industries)

D) Organic pollutants – Phenols, detergents, dyes, plastics, oils, greases etc. and their sources (organic based industries). Effects of these pollutants on water quality. Water pollution due to paper and sugar industries. **[14]**

Unit V: **Water and Waste Water Treatment** **[14]**

A) Water Treatment – Methods for water treatment - Sedimentation, filtration, coagulation and sterilization.

B) Waste Water Treatment – Industrial and sewage water treatments: Primary, secondary and tertiary treatment.

C) Biological Methods - Aerobic, anaerobic, trickling filter and activated sludge.

D) Chemical Methods For Inorganic Chemicals- Precipitation, electrolysis, ion – exchange, evaporation and adsorption.

Unit VI: **Air Pollution due to Industries** **[14]**

A) Classification of Air Pollutants – Primary and secondary pollutants e.g. oxides of carbon, sulphur, nitrogen, hydrocarbon and particulates.

B) Industries as Source of Air Pollution – Steel Industries, Fertilizer Industries, Thermal Power Plants, Refineries, paper and pulp industries, metallurgical and mining operations.

C) Methods of Control of Air Pollution – Electrostatic precipitators, scrubbing, filters mist eliminator. Harmful Effects of Air Pollutants on human being, plants and materials. Green House Effect (Global Warming).

D) Air Pollution Monitoring – Methods of collection of air samples, SPM and determination of air pollutants like SO_2, NO_X, and solid particulate matter (SPM). Sources of noise pollution, units of noise level and control.

4S Industrial Chemistry Practical

List of Experiments

Unit I 1) To determine temporary and permanent hardens of water sample.
2) To determine total dissolved solids, (TDS) of water sample.
3) To determine acidity of water sample.
4) To determine alkalinity of given water sample.
5) To find out dissolved oxygen (DO) of given water sample.
6) To find biological oxygen demand (BOD) of given water sample.
7) To find out chemical oxygen demand (COD) of given water sample.

Unit II 1) To determine Ca in cement by sample complexometric method.
2) To determine SiO_2 in cement by gravimetric method.
3) To determine Fe in cement gravimetrically.
4) Determination of SO_2 in air sample by colorimetry.
5) Determination of SPM in a sample using high volume sampler.
6) Determination of Acid value of a Plastic material.
7) Preparation of Urea formaldehyde Resin.
8) Preparation of Phenol formaldehyde Resin.

Distribution of Marks for Practical Examination

Time: 6 – 8 hours (One Day Examination)		**Marks: 50**
1. Unit – I : (Exercise No. 1)	……..	15
2. Unit – II: (Exercise No. 2)	……..	15
3. Viva-Voce .	…….....	10
4. Record	…….	10

	Total:	**50**

Books Recommended:

1) Engineering Materials – Rangwala
2) Material Science and Metallurgy – O.P.Khanna
3) Unit Process in Organic Synthesis – P.H. Groggins
4) A Text Book of Engineering Chemistry – Shashi Chawala, Dhanpat Rai and Co.

5) A Text Book of Engineering Chemistry – S.S. Dara, S. Chand and Co.
6) Industrial Chemistry – B.K. Sharma
7) Dryden's Outline of Chemical Technology – M. Gopalrao and Marshall Sittig
8) Environmental Chemistry – S.S. Dara, S. Chand and Co.
9) Environmental Chemistry – Moor and Moor
10) Pollution Monitoring and Control – Dr. Priyaranjan Trivedi
11) Systems Approach to Air pollution Control – R.J. Bibbero and J.G. Young
12) Air Pollution Vol. I- IV – A.C. Stern
13) NEERI Manual.
14) A Text Book of Environmental Chemistry – O.D. Tyagi and M. Mehara, Anmol Publication Pvt. Ltd.

5. PETROCHEMICAL SCIENCE

3S Petrochemical Science

The examination in Petrochemical Science of Third semester shall comprise of one theory paper, internal assessment and practical examination. Theory paper will be of 3 Hrs. duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of 6 to 8 hours duration and carry 50 marks.

The following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question in every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-III (8 marks).

Semester-III

3S Petrochemical Science

Total Lectures: 84 **Marks: 80**

Note: Figures to the right hand side indicate number of lectures.

Unit-I : Thermal Cracking **[14]**

- Introduction to thermal cracking
- Thermal Cracking reactions
- Mechanism for thermal cracking
- Effect of operating variables on cracking
- Properties of cracked material

Unit-II: Thermal Cracking Processes **[14]**

- Vis-breaking: operation and description operating conditions and products
- Coking: Delayed and fluid coking
- Steam naphtha cracking: Various routes Chemistry, Process parameters, flow scheme.

- Physical, storage, and safety properties of ethylene
- Composition of pyrolysis products
- Break up of ethylene market
- Ethylene product tree

Unit-III: Catalytic Cracking [14]

- Introduction to catalytic cracking
- Reactions in catalytic cracking
- Mechanism for catalytic cracking
- Feed stocks and catalytic cracking conditions
- Composition and structure of cracking catalysts (Zeolites)
- Difference between amorphous silica-alumina and zeolites

UNIT IV: Catalytic cracking processes [14]

- Various cracking processes
- Type and working of catalytic processes
- Reaction variables
- Impact of catalyst to oil contact time on selectivity
- Houdray fixed bed cracking unit
- Modern fluid bed cracking unit
- Product profile of catalytic crackers
- Recovery of propane and propylene from cracked gases
- Relative yields of propylene and ethylene from various hydrocarbon feed stocks
- Market for propylene
- Tree diagram of propylene products

UNIT V: Manufacture and recovery of butadiene [14]

- Recovery of butadiene from naphtha steam cracking effluent stream
- Dehydrogenation of butane (Houdray process)
- Dehaydration of ethyl alcohol
- Separation of butadiene using technique :selective extraction
- Separation of butadiene using techniques :extractive distillation
- Production of butanol through conventional (Oxo-process) process and BASF process
- Relative comparison based on operating parameters catalysts and its uses

UNIT VI: Reforming process: recovery and manufacture of aromatics [14]

- Introduction to thermal reforming
- Catalytic reforming reactions process flow and description
- Reaction conditions: effect of temperature and pressure
- Reforming catalysts
- Separation of aromatics from reformate gasoline
- Udex process for separation of BTX aromatics
- Separation of Benzene, Toluene, Xylene and ethyl benzene from mixed aromatic stream
- Separation of mixed xylenes into their individual isomers

Semester -III
3S Petrochemical Science Practical

List of Experiments:

1. Simple distillation
2. Binary distillation
3. Steam distillation
4. Vacuum distillation
5. ASTM distillation of Petroleum Sample
6. Reid vapor pressure of volatile petroleum sample
7. Copper corrosion test for petroleum sample
8. Oil in wax determination in given oil sample
9. Water determination in given oil sample
10. Solubility diagram for acetic acid-water-benzene system

Distribution of Marks for Practical Examination

Time: 6 hours (One Day Exmination) Marks : 50

Exercise No. I: (Practical Expt.)	…… 15 Marks
Exercise No. II: (Practical Expt.)	…… 15 Marks
Viva-Voce	…… 10 marks
Record	…… 10 Marks

	Total: 50

Semester –IV

4S Petrochemical Science

UNIT I: Ethylene Derivatives-I [14]

- Vinyl Chloride Monomer by direct chlorination of ethylene
- Vinyl chloride monomer by oxy-chlorination of ethylene
- Market for Vinyl chloride monomer
- Manufacture of Vinyl acetate monomer form ethylene and other sources
- Role of $PdCl_2$ and $CuCl_2$ in VAM synthesis
- Application and uses of VAM
- Acetaldehyde manufacture through oxidation of ethyl alcohol (Wacker's Process)
- Market for acetaldehyde
- Ehanol manufacture by direction of ethylene (Shell process)
- Market for ethanol

UNIT II: Ethylene Derivatives –II

[14]

- Ethylene oxide by direct oxidation of ethylene
- Ethylene oxide through chlorohydrin process
- Comparison between direct oxidation and chlorohydrin routes for ethylene oxide manufacture
- Uses of ethylene oxide
- Production aspects of ethylene glycol
- Market for ethylene glycol
- Manufacture , chemistry , properties and uses of ethanol amine

UNIT III: Propylene Derivatives [14]

- Production of propylene through direct oxidation
- Production of propylene oxide by chlorohydrin process
- Halcon and oxirane process for propylene oxide manufacture
- Properties of propylene oxide like molecular formula, molecular weight, melting point, boiling point, density, solubility, flash point, ignition temperature, explosive limits
- Production aspects of Isopropyl alcohol by direct and catalytic hydration of propylene

- Sulfuric acid, Veba process ,Tokayama , ICI , Taxaco process for Isopropyl alcohol
- Market for Isopropyl alcohol
- Manufacture of acetone from Isopropyl alcohol
- Acrylonitrile manufacture by amoxidation of propylene(Sohio process and other routes)
- Market for acrylonitrile
- Acrylamiade manufacture with respect to chemistry catalyst and optimum conditions and market

UNIT IV : Butadiene derivatives [14]

- Synthesis of isoprene by various routes
- Good-Year Scientific design process, dehydrogenation of tert-amylenes (Shell prosess) /dehydrogenation of C_5 stream, acetone-acetylene route
- Manufacture of adipic acid, sulpholane, chloroprene from butadiene
- Chemistry process flow and market for above products

UNIT V: Benzene derivatives [14]

- Chemistry, operating conditions, flow scheme, description and market for the benzene derivatives
- Production of phenol by cumene route
- Phenol manufacture through chlorobenzene
- Aniline manufacture
- Caprolactum preparation

UNIT VI: Xylene derivatives [14]

- Chemistry, operating conditions, flow scheme, description and market for the xylene derivatives
- Terepthalic acid: para-xylene oxidation route, Toray industries process, Lummus process
- Di-methyl Terapthalete through para-xylene
- Phthalic anhydride from o-xylene and naphthalene
- Comparision of the o-xylene and naphthalene routes

Semester IV

4S Petrochemical Science Practical

List of experiments:

1. Viscosity index determination
2. Ductility of bitumen determination
3. Cone penetration index of grease
4. Needle penetration index of bitumen
5. Melting point determination of wax by various method
6. Viscosity determination of petroleum sample by Redwood method I

7. Viscosity determination of petroleum sample by Redwood method II
8. Proximate analysis of coal
9. Determination of carbon residue of lubricating oil using Conradson's apparatus
10. Determination of cloud and pour point of given petroleum sample

Distribution of Marks for Practical Examination

Time: 6 hours (One Day Exmination) Marks : 50

Exercise No. I: (Practical Expt.)	……	15 Marks
Exercise No. II: (Practical Expt.)	……	15 Marks
Viva-Voce	……	10 marks
Record	……	10 Marks
		Total: 50

Books Recommended:

1. Petroleum Refining and Petrochemicals, N.K. Sinha, Umesh Publications, Delhi
2. Advance Petrochemicals , Dr. G. N. Sarkar, Khanna Publications, Delhi
3. A Text on Petrochemicals , B.K. B Rao, Khanna Publications, Delhi
4. Introduction to Petrochemicals, S. K. Maiti, Oxford-IBH Publications
5. Fuels and Combustions, Sameer Sarkar, Orient- Longman Ltd. Hyderabad
6. Catalysis and Chemical Processes , Ronald Pearce and William Patterson, Leonad-Hill Publication, Glasgow
7. Systematic Experimental Physical Chemistry, S.W. Rajabhoj, Dr. T. K. Chondhekar, Anjali publications Aurangabad
8. Advanced Petroleum Refining, G.N.Sarkar, Khanna Publications, Delhi
9. Petroleum Refining Technology, Dr. Ram Prasad, Khanna Publications, Delhi
10. Unit Operations II , K.A. Gavane, Nirali prakashan, Pune
11. Modern Petroleum Refining Processes, Dr. B. K. Bhaskarrao, Oxford-IBH Publication New Delhi
12. Chemicals from Petroleum, A.L. Waddams, Murray, London
13. An Introduction to Industrial Organic Chemistry, P. Wiseman, Applied Science, London
14. Modern Petroleum Technology, J.D. Hobson, Jon-Wiley Chester

15. Chemicals form Synthesis Gas, R.A. Sheldon, B. Reidel Publishing Company. Dordrecht
16. Text book of Polymer, Volume I, II, III , M.S. Bhatnagar, S.Chand Publi., Delhi
17. Dryden's outline of Chemical Technology, M. Gopalrao, Marshall Stings, East-west Publications
18. Shreve's Chemical Process Industries, J. Austin, Mc. Grow Hill, New Delhi.

LIST OF APPARATUS AND EQUIPMENTS FOR A BATCH OF 20 STUDENTS FOR B.SC. I, II, III PETROCHEMICAL SCIENCE

Sr No.	Item	Quantity
1.	Burette	20 Nos.
2.	Pipette 10ml, 25ml	20 Nos. each
3.	Mohr pipette 2ml, 5ml	10 Nos. each
4.	Conical flask with stopper	50 Nos.
5.	Standard volumetric flask	20 Nos.
6.	Density Bottle	20 Nos.
7.	Balance (Electronic/Digital)	02 Nos.
8.	Aniline Point Apparatus	01 No
9.	U-tube viscometer of different capillary size	02 Nos.
10.	Thermometer (0 to 110^{o}C I P Grade)	10 Nos.
11.	Thermometer (0 to 360^{o}C I P Grade)	10 Nos.
12.	Test tube (20 and 50 ml with rubber cork)	50 Nos.
13.	Smoke Point Apparatus (I P Grade)	01 No.
14.	Abel Flash Pont apparatus (I P Grade)	01 No.
15.	Pensky Marten's Flash Point apparatus	01 No.
16.	Clevaland Open Cup Flash point Apparatus	01 No.
17.	Porceline dish	10 Nos.
18.	Constant Temprature bath	02 Nos.
19.	Hot Plate	01 No.
20.	Air condenser	20 Nos.
21.	Glass tubing 6mm, 10mm	20ft. Each
22.	Glass rod 4mm, 8mm	20 ft. Each
23.	Stop watches	04 Nos.
24 .	LPG Cylinder with regulator	01 No.
25.	Refractometer	01 No.
26 .	Refrigerator	01 No.
27.	Water Distillation Plant	01 No.
28 .	Beaker 250 ml	20 Nos.
29.	Beaker 50, 100, 500, 1000 ml	07 Nos.
30.	Hot Air Oven	01 No.
31.	Heating Furnace	01 No.
32.	Karl Fisher Auto Titrator	01 No.
33.	Dean and Stark Apparatus	01 No.
34.	Flame Photometer	01 No.
35.	Colorimeter	01 No.
36.	Bomb Calorimeter	01 No.
37.	Spectrophotometer	01 No.
38.	Oxygen Cylinder with pressure regulating valve	01 No.
39.	Vacuum Pump	01 No.

40.	Air source	01 No.
41.	Air Flow meter	01 No.
42.	Dessicators	06 Nos.
43.	Water Suction	04 Nos.
44.	Filtration Flask with Buckner Funnel 100,250ml, 500ml	20 Nos.
45.	Heating Mental	06 Nos.
46.	ASTM Distillation apparatus	01 No.
47.	Viscometr and Constant temperature bath	01 Set of viscometer
48.	Apparatus for oil determination in given sample as per I P norm	01 No.
49.	Reid Vapor Pressure Apparatus with const. temp. Bath	01 No.
50.	Ductility measuring meter	01 No.
51.	Penetrometer	01 No.
52.	Copper Corrosion Test Apparatus	01 No.
53.	Crankcase Oil Dilution Apparatus	01 No.
54.	Redwood Viscometer No. I & II	01 No. each

6. GEOLOGY

B.Sc. II
3S- Geology

UNIT I : Ore forming minerals: Metallic and Nonmetallic, Ore, Ore minerals, Gangue, Tenor of Ore. Classification of Mineral Deposits. Metallogentic epochs and provinces. Processes of ore formation: Magmatic concentration deposits, Hydrothermal Deposits.

UNIT II : Processes of ore formation: Contact metasomatism, Sedimentary deposits, Oxidation and supergene sulphide enrichment, Mechanical concentration deposits, Residual concentration deposits, Evaporites and Metamorphism as a process of ore formation.

UNIT III : Concept of Phase, Component and System. Phase Rule. One Component System – Quartz and Augite, Two Component System – Mixed Crystal-Plagioclase Feldspar, Eutectic- K-Feldspar, Three Component System – Diopside -Albite-Anorthite.

UNIT IV : Distribution of igneous rocks in time and space. Consanguinity, Variation Diagram, kindred's of igneous rock, Granite-Granodiorite-Diorite, Syenite-Nepheline Syenite-Alkaline Rocks, Gabrro-Anorthosite-Peridotite, Dolerite – Lamprophyre and their equivalents, Petrographic provinces and periods.

UNIT V : Classification, diagnostic morphological characters, environment and geological distribution of Phylum Echinodermata and Foraminifera. Basic ideas about Micropaleontology and Microfossils.

UNIT VI : Classification, diagnostic morphological characters, environment and geological distribution of Phylum

Anthozoa and Trilobita. Applications of palaeontologic data in Evolution, Stratigraphy and Palaeogeographic and Palaeoclimatic reconstruction.

PRACTICALS:

1. Physical and Optical properties of rocks and rock forming minerals.(20 slides/specimens)
2. Morphological characters and Identification fossils listed in theory.
3. Identification of ore and industrial minerals.(20 specimens)
4. Field Work.

PRACTICAL EXAMINATION:

The Practical Examination will be four hour duration and carries 50 marks. The distribution of marks will be as follows-

A.	I. Megascopic Identification of Igneous rocks	10 Marks.
	II. Microscopic Identification of Igneous rocks	06 Marks
	III. Identification of Ore Minerals and Industrial Minerals	10 Marks
	IV. Identification of Fossils	10 Marks
B.	Field work	04 Marks
C.	Practical Record and Viva Voce	10 Marks
	Total :	50 Marks.

B.Sc. II
4S- Geology

UNIT I : Mineralogy Uses, Geological occurrences, origin and geographical distribution in India of the mineral deposits like Iron, Manganese, Copper, Lead, Zinc and Aluminum

UNIT II : Mineralogy Uses, Geological occurrences, origin and geographical distribution in India of the non-metal like Asbestos, Mica, Gypsum, Magnesite and Lime Stone.
Origin, classification and geographical distribution of Coal Deposits in India.
Origin, Traps and distribution of Petroleum Deposits in India

UNIT III : Environment of depositions: Aeolean, glacial, fluvial, lacustrine, near-shore and deep-sea environments.
Composition and paragenetic diagrams. Projective Analysis.

UNIT IV : Cataclastic, Thermal, Dynamothermal and Plutonic Metamorphism and their products. Metasomatism-types and additive processes. Pneumatolytic metamorphism, Injection metamorphism and Autometamorphism.

UNIT V : Classification, geographic distribution, lithological characteristics, fossil contents and economic importance of Gondwana Supergroup and Deccan Traps. Intertrappean and Infra-trappean .

UNIT VI : Jurrassic of Kutch, Triassic of Spiti. Creataceous of Narmada Valley and Trichanpally. Lameta Formation. Classification, geographic distribution, lithological characteristics, fossil contents and economic importance of Siwalik Supergroup.

PRACTICALS:

1. Physical and Optical properties of Sedimentary and Metamorphic rock.
2. Exercises showing the major stratigraphic and litho tectonic units of India.
3. Laboratory exercises in graphic plots for petrochemistry and interpretation of petrogenetic diagrams.
4. Field Work.

PRACTICAL EXAMINATION:

The Practical Examination will be four hour duration and carries 50 marks. The distribution of marks will be as follows-

A. I. Megascopic Identification of Sedimentary and metamorphic rocks 12 Marks.
II. Microscopic Identification of Sedimentary and metamorphic rocks 08 Marks
III. Exercises in showing the major stratigraphic and litho tectonic units of India. 10 Marks
IV. Laboratory exercises in graphic plots for petrochemistry and interpretation of petrogenetic diagrams 06 Marks.

B. Field work 04 Marks
C. Practical Record and Viva Voce 10 Marks
Total : 50 Marks.

Text Books for Sem III & IV :

1. Text Book of Engineering Geology - Parbin Singh, Katson Publishing, Ludhina.
2. Text Book of Geology - P.K. Mukerjee - World Press Pub., Calcutta.
3. Text Book of Geology - Santosh Garg - Khanna Publ., Delhi.
4. G. W. Tyrell (1998) Principles of Petrology B.I. Publications Pvt. Ltd., New Delhi.
5. F.H. Hatch, A.K. Wells and M.K. Wells (1984) petrology of Igneous Rocks. CBS Publishers, New Delhi.

6. F. J. Turner & J. Verhoogen (1987) Igneous and Metamorphic Petrology, CBS.
7. E.G. Ehlers and H. Blatt (1981) Petrology : Igneous, Sedimentary and Metamorphic. CBS Publishers, New Delhi.
8. N.W. Gokhale (1998) Fundamentals of Sedimentary Rocks. CBS Publishers.
9. W.W. Moorhouse (1985) The study of Rocks in Thin Sections. CBS Publishers.
10. H. Williams, F.J. Turner and C.M. Gilbert (1985) Petrography: An Introduction to the Study of Rocks in Thin Sections. CBS Publishers.
11. Jensen, M.L. and Bateman, A.M. (1981) Economic Mineral Deposits. John Wiley and Sons, New York.
12. Sharma, N.L .and Ram, K.S.V. (1964) Introduction to India's Economic Minerals, Dhanbad Publishers.
13. Prasad U. Economic Deposits of India. C.B S Publisher, New Delhi.
14. Deb, S. (1980) Industrial Minerals and Rocks of India. Allied Publishers, New Delhi.
15. Krishnaswamy, S. (1979) India's Mineral Resources. Oxford and IBH Pub. Co., New Delhi.
16. R.R. Shrock & W.H. Twenhofel (1999) Principles of Palaeontology. CBS Publishers.
17. Henry Woods (1985) Invertebrate Palaeontoogy. CBS Publishers.
18. R.C. Moore, C.G. Lalicker & A.G. Fisher (1997) Invertebrate Fossils. CBS Publishers.
19. R.M. Black (1970) The Elements of Invertebrate Palaeontology. Cambridge University Press.
20. M.A. Koregave (1998) Fundamentals of Invertebrate Palaeontology. Book World Enterprises, Mumbai.
21. Ravindra Kumar (1985) Fundamentals of Historical Geology and Stratigraphy of India. Wiley Eastern Ltd., New Delhi.
22. M. S. Krishnan (1982) Geology of Inida and Burma. CBS Publishers.
23. D. N. Wadia (1998) Geology of India. Tata McGraw Hill, India.
24. G. G. Deshpande (1998) Geology of Maharashtra Geological Society of India, Bangalore.

7. BOTANY

3S- BOTANY

ANGIOSPERM SYSTEMATICS, ANATOMY & EMBRYOLOGY

UNITI : Angiosperm Systematics and Biodiversity.

1.1 Angiosperms: Origin and Evolution **(Pteridospermean and Bennititalean Theory)**

1.2 Botanical Nomenclature: Principles of rules, Taxonomic Ranks, Type concept, Valid publication.

1.3 Herbarium – Concept & significance, Royal Botanical Garden, Kolkata.

1.4 Concept of biodiversity, Ex situ and In situ conservation

1.5 Concept & importance of Biodiversity.

UNIT II: Angiosperm Systematics

2.1 Systems of Classification: Bentham and Hooker's System, Engler and Prantle's system.

2.2 Systematic studies & economic importance of following Families

Dicotyledons (Polypetalae) : Malvaceae, Brassicaceae, Leguminosae, Apiaceae,

UNIT III: Angiosperm Systematics

3.1 Systematic studies & economic importance of following Families

Dicotyledons (Gamopetalae): Asteraceae, Asclepiadaceae, Apocynaceae, Solanaceae, Verbenaceae, Lamiaceae.

3.2 Dicotyledons (Monoclamydeae): Euphorbiaceae.

3.3 Monocotyledons: Liliaceae, Poaceae.

UNIT IV: Anatomy

4.1 Types of Tissues:

Meristematic – Types of meristems

Permanent – Simple and complex.

4.2 Characteristics of growth rings, Sapwood and heartwood.

4.3 Anatomy of root: Primary structure in dicot and monocot root, normal secondary growth in dicot root.

UNIT V: Anatomy

5.1 Anatomy of stem: Primary structure in monocot and dicot stem, normal secondary growth in dicot stem.

5.2 Anomalies in primary structure in *Boerhhavia* stem, secondary structure in *Bignonia* and *Dracaena* stem.

5.3 Leaf Anatomy: Internal structure in *Nerium* and *Maize* leaf.

UNIT VI : Embryology

5.1 Microsporangium, microsporogenesis, development of male gametophyte.

5.2 Megasporangium, types of ovules, megasporogenesis, development of female gametophyte (monosporic, Bisporic & tetrasporic).

5.3 Double fertilization and triple fusion.

5.4 Embryo – Classification of embryo.

5.5 Endosperm types & significance, Suspended animation

LABORATORY EXERCISES

1) Embryology of Angiosperms:
   - i) Observation of wide range of flowers available in the locality and methods of their pollination.
   - ii) Study through permanent slides of T.S. of anthers, microsporogenesis, L.S. of ovule, types of endosperms and embryo of Capsella .
   - iii) Mounting of T.S. of anthers, Pollen grains and pollinia.
2) Anatomy of angiosperms : Preparation of double stained slides of root, stem and leaves of angiosperms mentioned in the syllabus.
3) Taxonomy : Description of ten plants belonging to different families in technical language and identifiction upto family level.
4) Long and short excursion is essential

Note : Field tour reports should be supported by exhaustive field notes and photographic representation of plant species studied

Brassiacaceae- *Brassica,* **Malvaceae-** *Hibiscus, Sida, Malvastrum*, **Fabaceae**- *Crotalaria, Indigifera*, *Tephrosia,* **Caesalpinoidae-** *Caesalpinea, Cassia*, **Mimosoidae**- *Prosopis, Acasia*, **Apiaceae-** *Corindrum,*
Apocynaceae- *Vinca, Thevetia*, **Asclepiadaceae-** *Cryptostegia,Calatropis*, **Solanaceae**- *Datura, Solanum, Withania*, **Euphorbiacea**- *Croton, Jatropha, Euphorbia*, , **Lamiaceae-** *Oscimum, Hyptis*, **Asteraceae**- *Tridax, Lagasca* **Verbanaceae –** *Lantana, Clerodendron*

PRACTICAL EXAMINATION

Time;- 5 Hours **Max. Marks- 50**

Q. 1 Preparation of double stained permanent micropreperation of given angiospermic Material Identification with reasons 10 Marks

Q. 2 Description of given angiospermic plant in technical language, identification up to family, floral formula, floral diagram (two Plants) 20 Marks

Q. 3 Spotting (taxonomy-1, anatomy-2, Embryology-2) 10 Marks

Q. 4 Class record, Excursion report with plant photographic submission 06 Marks

Q. 5 Submission of micropreperation and viva voce 04 Marks

Books Recommended :

1) **A.C.Dutta** : Text Book of Botany.
2) **Andrews A.N**. : Studies in Paleobotany.
3) **Arnold C.A**. : Introduction of Paleobotany.
4) **Bhojwani & Bhatnagar** : Embryology of Angiosperms.
5) **Chandurkar** : Plant Anatomy
6) **Cutter E.G**., 1971 : Plant Anatomy Experiment and Interpretation Part-II, Organs, Edward Arnold, London.
7) **Davis P.H**., and Heywood V.H., 1993 : Principles of Angiosperm Taxonomy : Oliver and Boyd, London.
8) **Eames E.J**. : Morphology of vascular Plants. edition, prentice Hall of India Pvt.Ltd. New Delhi.
9) **Esau K**. : 1977, Anatomy of seed plant, 2nd Edition, John Wiley and Sons, New York.
10) **Gangulee & Kar** : College Botany Vol.II
11) **Gangulee Das and Dutta** : College Botany, Vol.I
12) **Giford E.M. and Foster A.S**., 1988 : Morphology and Evolution of Vascular Plants, W.H. Freeman & Company, New York.
13) **Hartmann H.T. and Kestler D.E**., 1976 : Plant Propagation Principles and practices, 3rd
14) **Heyhood V.H. and Moore D.M**. (Eds) 1984 : Current concepts in plant Taxonomy. Academic Press, London.
15) **Jeffrey C**., 1982 : An introduction to Plant Taxonomy, Cambridge University Press, Cambridge, London.
16) **Maheshwari P**. : Introduction of Embryology of Angiosperms.
17) **Pande B.P**. : A Text Book of Angiosperms.
18) **Radford A.E**., 1986 : Fundamentals of Plant Systematics, Harper and Row, New York.
19) **Rendle A.B.** : Classification of flowering plants, Vol.I & Vol.II.
20) **S.Sundar Rajan** : College Botany, Vol.II & Vol.III.
21) **Shukla & Mishra** : Paleobotany.
22) **Singh and Jain** : Plant Anatomy.
23) **Singh and Jain** : Taxonomy of Angiosperms.

24) **Singh**, 4. 1999, Plant Systematics - Theory and Practices, Oxford and IBH Pvt. Ltd., New Delhi.
25) **Stace C.A**., 1989. : Plant Taxonomy and Biosystematics (2nd Edition) Edward Arnold, London.
26) **Stewart W.N**., 1983 : Paleobotany and Evolution of Plants, Cambridge University Press, **Cambridge. Cutter, E.G**. 1969 : Part-I, Cells and tissues, Edward, Arnold, London.
27) **Trivedi B.S**. & Sharma B.B. : Introductory Taxonomy.
28) **Tyagi & Kshetrapal** : Taxonomy of Angiosperms.
29) **Vasistha P.C**. : Plant Anatomy.
30) **Vasistha P.C**. : Taxonomy of Angiosperms.
31) **Walton** : An Introduction & Study of fossil.
32) Modern Practical Botany, Volume-I, Dr.B.P.Pande, S.Chand Publication, New Delhi.
33) Modern Practical Botany, Volume-II, Dr.B.P.Pande, S.Chand Publication, New Delhi.
34) Modern Practical Botany, Volume-III, Dr.B.P.Pande, S.Chand Publication, New Delhi.

4S- BOTANY
CELL BIOLOGY, GENETICS AND BIOCHEMISTRY

Unit – I : Cell Biology

1.1 Cell concept – Prokaryotic and Eukaryotic cell
1.2 Cell wall –Structure and Functions
1.3 Plasma membrane –Structure (models) and Functions
1.4 Nucleus – Ultra structure (nuclear membrane, nuclear pore complex and nucleolus) and functions
1.5 Chloroplast- Structure and Functions

Unit–II : Cell Biology Structure and functions of-

2.1 Endoplasmic Reticulum
2.2 Golgi complex
2.3 Vacuole
2.4 Ribosome
2.5 Perixysome
2.6 Mitochondria
2.7 Cell cycle: Mitosis and Meiosis

Unit – III : Genetics

3.1 Chromosome- Morphology, Types, Centromere & Telomere
3.2 Chromosomal aberrations –
3.2.1 Structural aberrations: Deletion, Duplication, Inversion and Translocation
3.2.2 Numerical aberrations: Euploidy and aneuploidy

Unit–IV: Genetics

4.1 Mendellism: Mendel's law of Dominance, Segregations and Independent assortment, Incomplete dominance

4.2 Interaction of genes- Complimentary, Supplementary and Epistasis

4.3 Problems based on Mendelism and Interaction of Genes

Unit – V Genetics

5.1 Linkage – Concept, Types and theories

5.2 Crossing over: Concept, Types and theories

5.3 Gene mutations- Spontaneous and Induced

5.4 Extra-nuclear Genome- Mitchondrial DNA and Chloroplast DNA

Unit – VI Biochemistry

6.1 Nomenclature of Enzymes

6.2 Characteristics of Enzymes

6.3 Concept of holoenzymes, coenzymes and cofactors

6.4 Theories for Mechanism of action of Enzymes

6.5 Structure and functions Carbohydrates: Monosaccharides (Glucose), Disaccharides (Galactose) and Polysaccharides (Starch)

PRACTICAL :

I Cell Biology (Any Two)

1. Isolation of mitochondria from plants
2. Isolation of chloroplast
3. Squash preparation for the study of various stages of mitosis
4. Smear preparation for the study of various stages of meiosis.

II Genetics

1. To prove Mendel's Monohybrid ratio.
2. To prove Mendel's Dihybrid ratio.
3. Problems based on Interaction of genes

III Biochemistry

1. To study the enzyme activity of catalase.
2. To demonstrate test for glucose in grapes, & sucrose in cane sugar / beet root.
3. To demonstrate test for protein.
4. To demonstrate the lipid test in oily seeds.
5. To demonstrate the test for starch / cellulose.
6. To demonstrate the activity of enzyme amylase from germinating Wheat grains.

B. Sc. II : Semester – IV

Practical Schedule

Time : 4 hours **Marks : 50**

Q.1 :	Squash/Smear preparation for study of Mitosis/Meiosis stages	10 Marks
Q.2 :	Genetics : To perform given experiment	10 Marks
Q.3 :	Genetics problem	05 Marks
Q.4 :	Biochemistry : To perform given test (Any Two)	10Marks
Q.5 :	Spotting	05 Marks
Q.6 :	Class record and viva-voce	10Marks

Suggested Readings :

1) **Ahluwalia K.B** 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
2) **Buchanan B.B, Gruissem W. and Jones R.L** (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists Maryland, USA.
3) **Dalela & Verma** : Cytology.
4) **Darnell J.** 2000. Molecular Cell Biology (Fourth Edition). W.H. Freeman and Company, New USA.
5) **De-Robertis** EDP : Cell Biology.
6) **Devi P**.2008-Principle and Methods of plant Molecular Biology, Biochemistry and Genetics Agrobios, Jodhpur, India.
7) **Gardner and Simmons Snustad** 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
8) **Gerald Karp** 1999 Cell and Molecular Biology- Concept and Expts. John Wiley and Scne Ine., USA.
9) **Gupta P.K** (1995) Genetics and Cytogenetics. Rastogi Publications, Meerut.
10) **Leninger A.C** (1987). Principles of Biochmistry, CBS Publishers and Distributers (Indian Reprint)
11) **Lodish Etal** 2004 (Fifth Edition). Molecular Cell Biology, W H Freeman and company, New York.
12) **Moore T.C.** 1989. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York, USA.
13) **P.S.Verma & Agrawal V.K.** : T.B. of Cytology.
14) **Pawar C.B** 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai.
15) **Powar C.B** 2005 (Third Edition). Cell Biology, Himalaya Publishing, Mumbai.
16) **Roy S.C and KKDe** 2005 (Second Edition). Cell Biology, New central Book Agency Private Ltd., Kolkata.
17) **Sharma J.R** 1994 Principles and practices of Plant Breeding. Tata McGraw-Hill

18) **Shrivastav H.N.** - Cell Biology and Genetics - New Millenium Edition - Pradip's.
19) **Singh B.D** 2004. Genetics. Kalyani Publication, Ludhiana.
20) **Strickberger** 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.
21) **Veerbala Rastogi** : Introduction to cytology.
22) **Verma P.S and Agarwal V.K** 2006 Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
23) **Verma P.S. and Agarwal V.K.(**1991**)**, Genetics. S Chand Comp. Ltd. Ramnagar, New Delhi.
24) **Verma S.K. and Mohit Verma** 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.
25) **Verma S.K. and Verma Mohit** (2007). A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.
26) Modern Practical Botany, Volume-I, Dr.B.P.Pande, S.Chand Publication, New Delhi.
27) Modern Practical Botany, Volume-II, Dr.B.P.Pande, S.Chand Publication, New Delhi.
28) Modern Practical Botany, Volume-III, Dr.B.P.Pande, S.Chand Publication, New Delhi.

8. ENVIRONMENTAL SCIENCE

3S- ENVIRONMENTAL CHEMISTRY

UNIT I: A. Fundamentals of Environmental Chemistry – (15 Lectures)

Laws of Thermodynamics, Chemical potential , chemical equilibrium , acid base reaction , solubility of gases in water , saturated and unsaturated hydrocarbons.

B. Chemistry of biologically important elements- sources, role and effects

(1) Energy exchange elements – Oxygen, Hydrogen
(2) Activators and Inhibitors – Na, K, P, Ca
(3) Trace elements – Ni, Mg, Mo, Cu, Fe.

UNIT II: Chemistry of Biomolecules – (15 Lectures)

(1) Carbohydrates – Biological importance, classification, structure of Glucose & Sucrose
(2) Oils & Fats(Lipids)- Biological importance, Fatty acids, properties of fatty acids
(3) Proteins - Biological importance, types of proteins, Amino acids, properties of amino acids.

(4) Enzymes – definition, classification, properties, mechanism of action

UNIT III:Toxicology-I (15 Lectures)

(1) Definition, Scope, toxicants – definition, sources.
(2) Factors influencing toxicity (acute, chronic and sub chronic exposures)
(3) Evaluation of toxicity – acute toxicity – LC_{50}, LD_{50} Sub acute toxicity test, chronic toxicity test
(4) Biomagnification, biotransformation and Bioaccumulation.

UNIT IV :Toxicology-II (15 Lectures)

(1) Routs of exposure, mode of actions and physiological effects of –(a) aldrin, (b) B HC (c) DDT, (d) Synthetics detergents
(2) Xenobiotics – definition & mechanism of Detoxification
(3) Bioremedation –definition, types.

UNIT V : Chemistry of Water : (15 Lectures)

(1) Chemical structure of water, Physico-chemical properties of water.
(2) Chemical speciation of heavy metals –
Hg – Distribution and Identification.
Pb- Distribution and Identification.

UNIT VI :Renewable Energy Resources : (15 Lectures)

(1) Solar Energy – Concept , Solar Collectors, Photovoltaics, Solar Water Heater, Solar Cooling, Solar Ponds, Solar Chimney
(2) Hydro power - Concept & Mechanism, Significance
(3) Wind Energy - Concept & Mechanism, Significance
(4) Bioenergy – Biomass, Bioalcohol , Biogas
(5) OTEC – Principles, mechanism and significance.

Practical On paper 3S:-

1. Estimation of trace elements by paper chromatography.
2. Estimation of molarity, normality of given sample.
3. To study the property of enzyme by demonstrating any test.
4. Estimation of carbohydrates .
5. Estimation of proteins.
6. Estimation of amino acids by Ninhydrin test.
7. Demonstration of immobilization of enzyme.
8. Study of Bioaccumulation of pesticides in aquatic animals.
9. Study of Bioaccumulation of detergents in aquatic animals.

10. Demonstration of non-conventional energy sources by working models.
    (i) Solar cells, (ii) Solar cooker, (iii) Wind mills, (iv) Solar Heaters.
11. To study the activity of amaylase.

Note : Visit to non conventional energy plant.

Distribution of Practical Marks. (Max. Marks. – 50)
Time : 6 Hrs.

Q.1	Any one major experiment based on environmental Chemistry	10
Q.2	Any one minor experiment based on environmental Toxicology	09
Q.3	Any one experiment based on environmental Biochemistry	12
Q. 4	Experiment on Renewable Energy	05
Q. 5.	Practical record.	05
Q. 6	Viva – voce	04
Q.7	Visit Report	05
	Total Marks :	50

Books Recommended :

1. Environmental Chemistry by- Ayodhya Singh
2. Environmental Chemistry by- Reddy
3. Environmental Chemistry by- S.S. Dara
4. Environmental Chemistry by- H. Kaur.
5. Chemistry for Enviromental Engg. And Science by – C. N. Swayer , P.L. Maccly , G. F. Parkin.
6. Environmental Chemistry by- Chandrashekhar Reddy.
7. Environmental Science – by S.C. Santra.
8. Environmental Chemistry by B.K. Sharma.
9. Environmental Chemistry by – A. K. Dey.
10. Concept of Environmental Chemistry – G. S. Soudhi ; Narosa publishing , New Delhi.
11. Environmental Chemistry by – R. C. Rsswell ; Edward Armolic Press.
12. Elements of Environmental Chemistry by –H. V. Jadhav.; Himalaya pub. House.

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4S- ENVIRONMENTAL POLLUTION

UNIT I : **Air pollution –** Classification , sources of air pollution, major air pollutants, types of air pollution, effects of air pollutants on plants, , effects of air pollutants on human, effects of air pollutants on materials, status of air pollution in India. (15 Lectures)

UNIT II : **Water pollution –** Definition, sources of water pollution, major pollutants, types of water pollution – fresh water (rivers, streams, ponds, lakes and underground water resources), marine water (coastal and estuarine), effects of water pollution on plants,animals and human beings, eutrophication, water pollution status in India, drinking water quality standards. (15 Lectures)

UNIT III : **Land pollution –** Definition , causes of soil pollution, major soil pollutants, effects of soil pollutants on plants and animals, nutrients in soil (NPK), domestic, municipal, industrial, and agricultural wastes and their relation with soil degradation , soil salination (15 Lectures)

UNIT IV : **Noise pollution –** Definition, sources, effects of noise pollution, psychological and physiological effects of noise pollution, unit of noise, monitoring of noise pollution, noise pollution standards, techniques of measurements of noise pollution, Indian scenario of noise pollution. (15 Lectures)

UNIT V : **Radiation pollution** – Definition, sources, major radioactive isotopes, nuclear fusion & fission reactions, units of radiations, application of radioactive isotopes in various field, effects of radioactive pollution, effects of nuclear weapons, radioactive fallout, health and environmental effects of radioactive fallout. (15 Lectures)

UNIT VI : **Major Environmental Issues :**

(A) Global Warming - causes, consequences and control measures.
Ozone depletion - mechanism, consequences and control measures.

(B) Case Studies and Episodes
  (a) Bhopal Gas Tragedy
  (b) London Smog
  (c) Fluoride Pollution in India
  (d) Chernobyl Nuclear Disaster.

Experiments based on papers 4S :

1. To estimate settlable particulate matter, RSPM in industrial area.

2. Measurement of noise level by noise level meter.
3. Determination of physical and chemical properties of Solid waste from industries.
4. Determination of chlorides in waste water sample.
5. Qualitative analysis of coal.
6. Analysis of chloride.
7. Analysis of Sulphate
8. Estimation of oil and grease.
9. Determination of Hardness.
10. Determination of D.O.
11. Determination of Phosphate
12. Identification and enumeration of bacteria from air and water.
13. Determination of calorific value of biodegradable waste.
14. Determination of available phosphorous by spectro photometric method.
15. Determination of available phosphorous by spectro photometric method.
16. Determination of Nitrogen from soil by Kjeldhals Method.
17. Estimation of CO_2 and CO from air.

Note : (i) Visit to different industries.
(ii) Study of pollution status in local area.

Distribution of Practical Marks : (Duration 5 Hours)

Q. 1 - Experiment on water pollution	10
Q. 2 – Experiments on air pollution	10
Q. 3 – Experiment on Noise pollution.	05
Q. 4 – Experiment on Soil pollution.	10
Q. 5. – Practical record .	05
Q. 6- Tour Diary	05
Q. 7 – Viva- voce	05
Total Marks -	50

Books Recommended:

1. Ecology and Environment – P.D. Sharma
2. Environmental Chemistry – V.P. Khudesia
3. Environmental Chemistry – B.K. Sharma
4. Environmental Chemistry – Kaur.
5. Industrial Chemistry – B. K. Sharma
6. Environmental Biology & Toxicology – P.D.Sharma
7. Environmental Toxicology – Mido,
8. Biochemistry- Leninger
9. Biochemistry- Satyanarayan
10. Environmental Engineering – S.S.Deswal
11. Water supply & Sanitary Engineering – Rangawala

12. Environmental pollution control Engineering – C.S.Rao, New age international publication
13. Solar Energy – Sukhatme.
14. Indian Industry – A Geographical perspective- K. Siddhartha, S.Mukherjee
15. Renewable Energy – 2nd edition- Godfrey Boyle (Oxford)
16. Shreve's Chemical Process industries- George T. Austin
17. Environmental Chemistry – Chhatwal Anand
18. Plant Physiology – Salisbury & Ross
19. Non Conventional energy Resources – G. D. Rai
20. Experimental Methods For General & Environmental Chemistry – Dr. Anita Rajor
21. Environmental Guidelines and Standards in India – P. K .Goel & K.P. Sharma, Techno Science Publications, Jaipur
22. Environmental Sciences, Daniel Botkin & Edward Keller, John Wiley & sons, New York
23. Environmental Sciences, Eldon D. Enger and Bradley F. Smith, WCB Publishers, Boston
24. Environmental Chemistry – A.K. De, Wiley Eastern ltd. New Delhi
25. Physico Chemical Examination of Water , Sewage, and Industrial Effluent, Pragati prakashan, Meerut

9. SEED TECHNOLOGY (VOCATIONAL)

Semester-III

3S : Seed Technology (Vocational)

There shall be one theory paper of 80 marks and practical examination of 50 marks for each semester. Duration of theory paper shall be 3 hours and practical examination shall be of 4 hours duration.

The syllabus is based on 6 lectures and 6 practical periods per week.

Hybrid Seed Production and Vegetable Seed Production

Unit-I : Introduction :

Definition of heterosis and inbreeding depression and brief history of the development of these concepts.

Genetic, physiologic and Biochemical basis of heterosis. Exploitation of heterosis at commercial scale in Crops : Maize, Peralmillet, Sorghum, Sunflower, Pigeonpea and Cotton.

Fixation of heterosis – an approach.

Apomixes and its exploitation Hybrid Sorghum, Rice.

Unit-II : Devices for Hybrid Seed Production :

Genetic male sterility and hybrid seed production.
Advantages and disadvantages of genetic male sterility.
Role of marker genes linked with genetic male sterility.
Procedure of hybrid seed production and maintenance of seed parent – Pigeonpea, cotton and sunflower.
Cytoplasmic and Genetic male sterity.
Introduction to the system. Synchronisation methods of achievement.
Seed Production of CMS line 'A'.
Seed Production of maintainer line 'B'.
Seed Production of restorer line 'R'.

Unit-III : Hybrid Seed Production in Different Crops :

Floral biology, seed production planning, Land and isolation requirement, wild pollinators, special agronomic practices, maintenance of varietal purity, field inspection, harvesting and threshing in the following crops-

(1) Maize, (2) Pearlmillet, (3) Sorghum, (4) Sun flower, (5) Pigeonpea, (6) Cotton, (7) Hybrid Rice, (8) Hybrid Mustard, (9) Safflower.

Economics of hybrid seed production.
Seed Planning.

Unit-IV : History and Objectives of Vegetable Breeding :

History of vegetable crop improvement.
Objectives of vegetative breeding.
Reproduction, pollination control mechanisms.

A – Asexual reproduction.
- Vegetable propagation
- Apomixis
- Artificial seeds.

B - Sexual Reproduction

Male gamete formation, female gamete formation, fertilization.

C. Pollination Control Mechanisms :

a) Flowering habit : Cucurbits, Asparagus, Spinach.
b) Self incompatibility
Gametophytic : in Lycoperscicum sp and Solanum sp
Sporophytic : Heteromorphic, Homomorphic
c) Male Sterility
Genetic male sterility in tomato, brinjal and muskmelon.

Unit-V : Hybridization Techniques in Vegetables.

Raising of crop, equipment required, emasculation and use of gametocide.
Pollination Methods in Vegetables –
Hand Pollination, rubbing and hooking – use of electric bees.

Breeding Methods in Vegetables –

1. Role of introduction and their utilization collection, maintenance, evaluation, storage.
2. Selection : (a) Pureline selection – Definition, method, achievements.
   (b) Single Plant Selection – Procedure, achievements.
   (c) Clonal Selection – Collection of clones, testing of clones, achievements.
3. Hybridization with reference to vegetable crops crosses between parents, single cross, double cross, back crops, triple cross.

Selection procedure in segregation progenies.
Pedigree selection, Bulk method, pure line family method (PLF), single seed descent method.

Unit-VI : Vegetables Seed Production :

Introduction, importance, present status and future prospectus.
Classification of vegetable crops.
Root crops, Bulbous crops, leafy crops, flowering and fruit crops.
Methods of seed production of the under mentioned crops dealing with the aspect of –
Land requirement, seedling/root production, nursery management, planting cultural practices. Breeding method used, plant protection, seed harvesting vegetable cum seed production, drying, grading, seed extraction method, wet-dry methods.

(a) Tropical Crops :-
Solanaceous : Brinjal, Potato, Chillies, Tomato.
Root Crops :- Radish, Carrot, Colocacea.
Leaf Vegetable –Spinach (Palak), Trigonella (Methi) etc.
Bulb Crops – Onion etc.
(b) Temperate Vegetables : Cauliflower, cabbage.

Practicals :

Hybrid Seed Production :

(1) Studies on inflorescence, floral arrangement floral morphology of some important crop plants cotton, pigeonpea, pearlmillet, and maize.

(2) Artificial emasculation and pollination studies in maize and cotton.
(3) Studies on protogynous and protandous nature of flowers in Pearlmillet and Sunflower.
(4) Studies on synchronisation problems in Pearlmillet, maize and Sunflower.

Vegetable Seed Production :

(1) Raising of nursery and plantin. Nursery requirement and management for different vegetables. Seedling age for transplanting, precautions, irrigation etc.
(2) Floral Biology of Vegetables : Time for opening of flower, time for another maturity, Dehiscence of another hermaphrodite flower.
(3) Study of Pollen grains of Vegetable : Collecton of pollen, germination of pollen grains in water, sugar solution, pollen gelly.
(4) Selfing and Crossing techniques in vegetables, cucurbits, solanaceoeus crops, onion, carrot.
(5) Identification of vegetable seeds. Temperate vegetable, tropical vegetables, temperate-tropical vegetables.
(6) Visit to vegetable breeding farm. Experiments on vegetable seed production. Collection of seeds, separation from pulp, drying etc.

Practical Examination :
Distribution of Marks : Marks : 50

1.	Describe in details the floral biology of the specimen 'A' classify upto family level.	10
2.	Raise a nursery bed for the given vegetable sample and describe.	05
3.	Identify and describe vegetable seeds, specimen and equipments A, B, C, D, E.	10
4.	Study of pollen germination in Sugar Solution.	10
5.	Submission of field report	05
6.	Submission seed specimen and viva-voce.	05
7.	Record book	05

Books Recommended :-

1. Principles of Plant Breeding field crops : R.W.Allard
2. Plant Breeding : B.D. Singh
3. Practices in Plant Breeding : M.M.Bhandari
4. Cytogenetics and Plant Breeding : Chandrasekharan and Parthasarathi
5. Male Sterility in higher Plants : M.L.H.Kaul.
6. Heterosis reappraisal theory and Practice : R.Frankel.

7. Sun flower Science and Technology : Jack F.Carter.
8. Seed Production manual : N.S.C. and Rock feller Publication.
9. Seed Technology : R.L.Agrawal
10. Vegetable Breeding : Bassett M.J. (1986)
11. Vegetable Breeding : Kaloo R.P. (1985)

Seed Technology (Vocational)
Semester IV
4S : Seed Testing and Seed Quality Control

Unit-I : Introduction, history and development of Seed Testing.
National and International Organisations and seed Testing linkages.
Seed testing laboratory layout and furnishing.
Seed testing equipment and their maintenance.
Seed testing laboratory management and functioning.
Seed Sampling and Dividing.
Heterogenity test.
Handling and testing of the sample.
Physical purity analysis.
Determination of other distinguishable varieties.
Moisture testing, germination testing – requirements, seedling evaluation.

Unit-II : Rapid test for seed quality determination.
Seed vigour testing.
Culture purity testing.
Testing of plated seeds.
Uniformity in seed testing results and use of tolerences.
Record keeping and reporting of results.
Storage of guard samples.
Seed testing in relation to seed act and marketing.

Unit-III : Introduction to Seed Quality Control :
Seed Quality, its concept, physical purity, germination, health and genetic purity.
Concept of variety variation – heritable and non-heritable characters.
Seed Quality Control Systems :
Seed legislation, seed certification.
Seed legislation.
Objectives – Indian Seed Act, seed rule and seed order.
Seed Inspector Qualifications, duties and responsibilities.

Unit-IV : Seed Certification :
Concept and history, classes of seed and phases of seed certification.

Phases of seed certification.
Seed Certification Agencies – its organisation.
Seed Certification standards.
Land requirements and isolation distance. Principles of field inspection.

Unit-V : Techniques of field inspection of seed production, plots of varieties and hybrids of cereals, pulses, oil seeds, forage and fibre crops, potato and vegetables.
Inspection at harvesting, threshing, processing.
Sampling for seed quality evaluation.
Issue of certificates and tag, sealing.
Testing of genetic purity of seed in grow out test.
Particularly of cotton.
Revalidation of seed lots.
Interstate seed certification.
New seed policy (1988) provisional seed certification.

Unit-VI : Seed Quality Control Organization India :
Composition and function of Central Seed Committee.
Central sub-committee on crop standards, notification and release.
Central seed certification board, state seed committee.
Management of seed certification programme.
Seed Certification Internationally.
Organisation of Economic Cooperation and Development (OECD)
Seed Certification Schemes.
Future trends in seed certification.
Plant Variety Protection – Plant Breeders Right.

Practicals :-
Seed Testing :

1. Obtaining working sample, making separation, weighing, identification of purity components and reporting results.
2. Testing of germination substrata and determination of moisture holding capacity of sand.
3. Plotting the seeds for germination, seedling evaluation and reporting of the results.
4. Tetrazolium testing of agricultural, vegetable and forestry seeds.
5. Moisture testing by oven drying method.
6. Handling of moisture meter and determination of relative efficacy of moisture meter.

Seed Quality Control :

1. Filling of application form for seed certification.
2. Exercise in field area measurement and field map preparation.
3. Checking of seed source, isolation requirements.
4. Observation in field inspection.
5. Identification of objectionable weed plants and inseparable other crop plants.
6. Study of varietal purity through examination of seeds, seedling and plants, recording of data dn filling result forms.

Practical Examination :
Distribution of Marks : Marks : 50

1.	Filling of seed certification form in detail.	10
2.	Moisture testing by oven dry method / seed germination test.	10
3.	Identify and describe specimen A, B, C, D and E.	10
4.	Determination of physical purity of seeds.	05
5.	Preparation of seed samples by using seed triers.	05
6.	Submission of field visit report and viva-voce.	05
7.	Record book	05

Books Recommended :-

1. Seed Technology : R.L.Agrawal
2. Seed Biology : K.K.Kozlowski
3. Seed Production Manual : National Seed Corporation and Rocke feller publication.
4. Techniques in seed science and technology : P.K.Agrawal and M.Dadlani.
5. A Handbook of Seed Inspectors : Central Seed Committee Ministry of Agriculture.
6. Indian Minimum Seed Certification Standards : N.S.Tunwar, S.V.Singh.
7. Principles of Seed Certification and Testing : N.P.Nema.

BSc.II Semester III
10. ZOOLOGY

There shall be the following paper and practical for B.Sc. Part-II Semester III examination. The syllabus is based on 6 theory periods and six practical periods per week (Total 75-80 theory sessions and 25 practical sessions during the complete semester). There shall be one compulsory theory paper of 3 hours duration, as stated below and a practical examination extending for four hours. Every examinee shall offer the following paper of 100 marks (80 for written examination

and 20 marks for internal assessment) and a practical examination of 50 marks. Candidates are required to pass separately in theory and practical examination.

Semester III

1)	Paper-I: Life and diversity of Chordata and concepts of evolution	Marks Allotted
	Written examination……..	80
	Internalassessment…….	20
2)	Practical:	50
	Total: ……..	150 Marks

Paper -3 S-Zoology

LIFE AND DIVERSITY OF CHORDATA AND CONCEPT OF EVOLUTION

Unit I : **Phylum Chordata;**
Origin of Chordata.
Protochordates:– Type study: Amphioxus: Habits and habitat , External Characters - Digestive system and feeding, Excretory organs, gonads- Affinities of Amphioxus.
Affinities of .Agnatha:
Series Picses:
Type study: *Scoliodon sarrokawah* (Dogfish) – Habits and habitat, External Characters, Digestive system: alimentary canal and digestive glands, Respiratory system: respiratory organ and mechanism of respiration, circulatory System: Structure and working of Heart, major arteries and veins, Lateral line receptors, Migration in fishes-Types, causes and significance.

Unit II : **Class Amphibia:**
Type Study – *Rana tigerina*, Habits and habitat, external, characters. Respiratory organs- Circulatory system; Structure of Heart, major arteries and veins, urinogenital system.. Parental care in amphibia.
Class Reptilia:
Type study- *Calotes versicolor*- Habits and habitat, External characters, circulatory system- Structure of Heart, major arteries and veins. Urinogenital system, snake venom and anti-venom,

Unit III : **Class Aves:**
Type study: Pigeon-*Columba livia* Habits and habitat, External characters, Respiratory system,

urinogenital system. Flight adaptations, Migration in birds.
Class Mammalia:
Primitive mammals: salient features of Prototheria and Metatheria, Morphology of mammalian endocrine glands.
Aquatic mammals.

Unit IV : **Evolution:** Meaning and scope,
Indirect Evidences of evolution: Evidences of organic evolution- morphological and anatomical, physiological and biochemical, embryological.
Direct evidences of evolution: Paleontological evidences: Fossils and fossilization: petrified fossils dead and preserve bodies cast and moulds, trails and foot prints, condition for fossilizations.–, Radioactive carbon dating of fossils - Living fossils.Importance of fossil record. Evidences from connecting links- Peripatus and Archaeopteryx.

Unit. V : **Evolutionary Processes:** Natural selection: Darwinism.Lamarckinsm.
Speciation - definition of species –mode of speciation – Allopatric and Sympatric speciation.
Modern concept of organic evolution-Neo Darwinism. Population Genetic :Hardy –Weinberg equilibrium, Gene pool, Gene frequency, Genetic drift, Convergent, Divergent and Parallel evolution, Coevolution

Unit VI : Adaptive radiations in mammals.
Evolution of Man- brief accounts of Parapithecus, Dryopithecus, Ramapithicus, Australopithecus, Homocreatus Neanderthal man,
Cro-Magnon man and modern man.
Evolution of heart, aortic arches, and urinogenital systems of vertebrates
Animal Adaptation: Desert aquatic and terrestrial.

REFERENCE BOOKS:

1. Integrated Principles of Zoology, 7th Edition, Hickman, C.P. Jr., F.M.Hickman and L.S. Roberts, 1984. Times Mirror/Mosby College Publication. St. Louis. 1065 pp.
2. A life of Vertebrate – K.Z.Young, ELBS Oxford University Press.
3. A Text Book of Chordates – H.S.Bharmah and Kavita Juneja.
4. Modern Text Book of Zoology Vertebrate – R.L.Kotpal, Rastogi Publication Meerut.

5. A Text Book of Chordates – A .Thangamani, S, Prasannakumas, L.M.Narayanan and
6. Arunmugam Saras Publication, Nagercoil.
7. A Text Book of Chordate Zoology – R.C.Dalela – Jaiprakashnath Publication Meerut.
8. Chordate Zoology – E.L.Jordan and P.S.Verma, S.Chand and Company New Delhi.
9. A Text book of Practical Zoology Vertebrate – S.S.Lal, Rastogi. Publication, Meeru
10. Manual of Zoology Vol. II (Chordata), S. Viswanathan (Printers and Publishers) Pvt Ltd., Madras, 891p.
11. Chordate Zoology and Elements of Animal Physiology, Jordan, E.K.and P.S. Verma, 1995. 10th edition, S. Chand & Co Ltd., Ram Nagar, New Delhi, 1151 pp.
12. Zoology of Chordates, Nigam, H.C., 1983. Vishal Publications, Jalandhar - 144 008, 942.
13. The Phylum Chordata, Newman, H.H., 1981. Satish Book Enterprise,Agra - 282 003, 477 pp.
14. Text Book of Zoology, Vol. II (Chordata), Parker and Haswell, 1964.A.Z.T,B.S. Publishers and Distributors, New Delhi - 110 051, 952 pp
15. Chordate Structure and Function, Waterman, Allyn J. et al., 1971. Mac Millan & Co., New York, 587 pp.
16. Simpson, G.C. 1967 - The meaning of Evolution. Revised Edition – New Haven, Tale University Press.
17. Colbert, E.H. 1969 - Evolution of Vertebrates, Wiley, New York.
18. Mayr, Ernst, 1973 - Animal Species and Evolution. The Belknap Press of Harvard University, Cambridge.
19. Dobzansky, T. 1976 - Genetics and the Origin of Species. Oxford and TBH Publishing Co. New Delhi.
20. Savage, J.M. 1976 - Evolution. Amerind Publishing Co. Pvt. Ltd. New Delhi.
21. Elic. Minkoff, 1983 - Evolutionary Biology, Addison Wesley.
22. Life, Origin, Evolution and Adaption (2002) - Sanjib Chattopadhyay. Books and Allied (p) Ltd.
23. P.S.Verma & V.K.Agrawal.(2008) Cell Biology, Genetics, Molecular Biology, Evolution & Ecology –S. Chand Publications.
24. Dhabade. D.S. I. A. Raja. R.A>Gulhane. A.P.Charjan. A.K.Patki., And P.S.Patil.,.A Text Book of Evolution: Sanket Publicatin. Washim
25. Zoology for Degree Students, Prof.Dr.V.K.Agrawal.

Practical:-

Two practical per week of 3 periods duration. Examination shall be of 5 Hrs duration and of 50 marks.

A) Taxonomy of Chordata:

1. **General characters and classification of Phylum Chordata:**
2. **General characters and Classification up to orders of the following chordates or as per the availability in the laboratory from the major orders, (Specimens or Models):**

Protochordata: Herdmania, Doliolum Salpa, Amphioxus.
Agnatha: Petromyzon, Myxine.
Pisces: Scoliodon, Torpedo, Acipenser, Exocoetus. Hippocampus
Amphibia: Ichthyophis, Salamander, Bufo, Hyla.
Reptilia: Varanus, Phrynosoma, Chameleon, Cobra, krait, Russell's viper, Typhlops, Hydrophis
Aves: Duck, Woodpecker, Kingfisher, Parrot.
Mammalia: Mongoose, Squirrel. Manis. Bat., monkey,

B) Dissections:

1. Dissection - afferent and efferent branchial vessels, cranial nerves, internal ear of scoliodon.
2. Dissection - Digestive system, Arterial system, venous system, reproductive system of rat.
3. Permanent micro-preparations .a. Fish scales. b. Ampullae of Lorenzini. c. Eyeball muscles.
4. Observations of air bladder in air breathing fishes.

C) Osteology. Rabbit, Varanus (excluding loose bones of skull).

D. Evolution:

1. Study of fossils, including living fossils.
2. Study of Evidences of evolution.
   i) Analogous and Homologous organs.
   ii) Connecting links (Peripatus, Archaeopteryx, Limulus)
   iii) Embryological evidences
3. Application of Hardyweinberg`s law
4. Study of Mesozoic Reptiles (By Models/Charts).
5. Mimicry, coloration in animals.
6. Beak and Leg modifications with reference to: Parrot, Woodpecker, Kingfisher, Heron, Duck, Sparrow/Pigeon Hawk/Kite, Owl.

E. Histological Slides :- Amphloxus, Frog, Rat

Slides :

Amphioxus : T.S, Oral hood, Pharynx, Tail
Frog :- T.S. lung, Stomoch, Kidney, T.S. Intestine,
Rat :- T.S. Liver, Pancrease, Ovary, Testies, Pituitary, Thyroid, Adrenal

DISTRIBUTION OF MARKS FOR PRACTICAL EXAMINATION.

1.	Dissection: -	10
2.	Permanent stained micro preparation.	05
3.	Spotting. (Specimens, Slides, bones, fossil)	10
4.	Practical on evolution -	10
5.	Class record	05
6.	Viva - Voce	05
7.	Submission of study tour report.	05
	Total Marks:	50

BSc.II Semester IV
ZOOLOGY

There shall be the following paper and practical for B.Sc. Part-II Semester IV examination. The syllabus is based on 6 theory periods and six practical periods per week (Total 75-80 theory sessions and 25 practical sessions) during the complete semester. There shall be one compulsory theory paper of 3 hours duration the semester, as stated below and a practical examination extending for four hours. Every examinee shall offer the following paper of 100 marks (80 for written examination and 20 marks for internal assessment) and a practical examination of 50 marks. Candidates are required to pass separately in theory and practical examination.

Semester IV

1)	Paper-I: Advanced Genetics and Animal Ecology.	Marks Allotted
	Written examination……..	80
	Internal assessment …….	20
2)	Practical:	50
	Total: ……..	150 Marks

ZOOLOGY Paper 4 S
ADVANCED GENETICS AND ANIMAL ECOLOGY

UNIT I : **Concept of genes.**
Mendel`s laws of hereditary – Monohybrid – Laws of dominance, law of segregation. Dihybrid cross – Law of

independent assortment. Interactions of genes: , Supplementary factor, complementary factor, duplicates factor, inhibitory factors, and lethal factors – dominant and recessive.

UNIT II : **Linkage** - Types of linkage, linkage group, arrangement of linked genes, and significance of linkage.
Crossing over – Mitotic and meiotic crossing over, Mechanism of crossing over, theories of crossing over – Darlington's theory, breakage and exchange theory, and copy choice theory. Types of crossing over – Single, double and multiple crossing overs. Factors affecting crossing over, Significance of crossing over.
Multiple alleles. Multiple alleles in relation to eye color in Drosophila.Blood group in man, Erythroblastosis foetalis

UNIT III : **Sex determination:** Autosomes and sex chromosomes, Sex determination in animals, Chromosomal Theory. Genic Balance Theory. Environmentally and hormonally controlled sex determination, Gynandromorphs.
Genetic disorders; Sickle cell anemia, , Huntington's chorea. Diabetes mellitus. Non-disjunction: Turner's syndrome, Klinefelter's syndrome, Down's syndrome.Edwrd`s Syndrome,Biochemical genetics:;Cystic fibrosis, Phenylketonuria, Albinism, Alkaptonuria, Goiters, cretinism. Sex linked genetic disorders and their inheritance in man; Hemophilia and color blindness.

UNIT IV : **Genetic Screening and parental diagnosis: -** Parental, Carrier, Predictive, CVS (Chorionic Villous Sampling), Amniocentesis, Gene probe and DNA analysis. Genes in Human Heredity: - Inheritance of eye color. Skin color. Recessive genes and consanguineous marriages Genetic counseling: - Risk of marriages in affected family. Birth control measures (male and female).
Kinds of twins**: -** Identical, Fraternal, Siamese twins. .Significance of twins study

UNIT V : **Ecology:** concept and scope:
Abiotic factors:
Water: Properties, water problem in terrestrial and aquatic habitat. **Temperature:** Temperature range, Temperature tolerance, Effects of temperature on animals. Homeotherms, poikilotherms. Dormancy, hibernation, aestivation & diapauses. **Light**: Spectral

distribution, Biological effects of light on aquatic and terrestrial animals: Reproduction, Metamorphosis, pigmentation, vision, photo kinesis, phototropism, photoperiodism, migration.

Biotic factors:

Intra specific and interspecific associations, Predation, parasitism, Antagonism. , commensalisms, mutualism, competition, (Gauze's Principle).

UNIT VI : **Ecosystem:** *Relationship between habitat and ecological niche* - Autotrophic and heterotrophic producer, consumer - trophic level - energy flow in an ecosystem - food chain - food web - pyramids - Ecotypes. Homeostasis of ecosystem.

Terrestrial ecosystem: Classification and Biomes, Aquatic ecosystem: Fresh water ecosystem-Lentic and lotic ecosystem,

Marine ecosystem: Characteristics, salinity, temperature - pressure, zonation and stratification Estuarine ecology: Characteristics types, fauna and their adaptations.

REFERENCE BOOKS:

1. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology – P.S.Verma & V.K.Agrawal.
2. Principles of Genetics – S.K.Jain
3. Genetics – P.K.Gupta
4. Applied Genetics – C.Pmmanuol.
5. Genetics: M.W.Strickberger, New York.
6. Principles of Genetics: Sinnot, Dunn and Dobzansky.
7. Principles of Genetics: Edidon Gardner.
8. Genetics. Verma, P.S. and V.K. Agarwal.. S.Chand & co. New Delhi
9. Gene VI .Lewin, B. 1998. Wiley Eastern Ltd., New Delhi.
10. Human Genetics. Rothwell, N.V.1979. Prentice Hall of India, New Delhi

Practical:-

Two practical per week of 3 periods duration. Examination shall be of 5 Hrs. duration and of 50 marks.

A) Genetic experiments:

1. Recording of Mendelian traits in man.
2. Detection of monohybrid and dihybrid cross with the help of plastic beads.
3. Culturing *Drosophila* using standard methods .Drosophila – male and female identification, Mutant forms (from pictures)

4. Demonstration of bar bodies.
5. Preparation of human Karyotypes from Xerox pictures.
6. Photo slides for, Turner's syndrome, Klinefelter's syndrome, Down's syndrome
7. Detection of syndrome from chromosome spread picture.
8. Study of following human genetic traits and application of Hardy-

   Weinberg Principle to them – Baldness, length of index and ring Finger, attached and free earlobes, rolling of tongue, PTC taste. Other notable traits.

B) Ecology

1. Use of pH meter for estimation of pH in soil samples, b. Use of pH meter for estimation of pH in water samples
2. Estimation of Dissolved oxygen, salinity, pH, free CO2, carbonates and bicarbonates, calcium in water samples.
3. Adaptations of aquatic and terrestrial animals based on a study of museum specimens. Such as rocky, sandy, muddy shore animals, flying and burrowing animals.
4. Study of natural ecosystem and field report of the visit.
5. Field collection methods;
6. Identification of common animals - Soil invertebrate diversity, diversity of birds and mammals in parks / botanical gardens, threats to local biodiversity.
7. Construction of a food web diagram based on a field visit.
8. Mounting of plankton.
9. Qualitative analysis of fresh water plankton

C) General:-

1. Visit to a National park or sanctuary, and submission of report.

DISTRIBUTION OF MARKS FOR PRACTICAL EXAMINATION.

1.	Ecological: Estimations -/Analysis	10
2.	Spotting. (2Spot from Sec.A & 3 Spot from Section B of 2 Marks each)	10
3.	Micro preparation.	05
4.	Genetic experiment -	10
5.	Class record	05
6.	Viva - Voce	05
7.	Submission of study tour report.	05
	Total Marks :	50

BSc. Part II. Semester III.
11. INDUSTRIAL FISH AND FISHERIES (VOCATIONAL)

There shall be a following paper and practical for B.Sc.Part-II Semester III examination. The syllabus is based on 6 theory periods and six practical periods per week (Total 75-80 theory periods and 25 practical during the complete semester). There shall be one compulsory paper of 3 hours duration, in theory as stated below and practical examination extending for six hours. Every examinee shall offer the following paper of 100 marks, (Out of which 80 marks will be for written examination and 20 marks for internal assessments) and practical examination of 50 marks. Candidates are required to pass separately in theory and practical examination.

			Marks
1)	Paper-I: FISH BIOLOGY		
	Theory (Written)	…….	80
	Internal assessments	..…...	20
2)	Practical:	……..	50
		Total:	150Marks

Paper 3 S- INDUSTRIAL FISH AND FISHERIES
FISH BIOLOGY
(SEED PRODUCTION AND FISH PATHOLOGY.)

Unit-I : Principles of fish breeding, Different stages of seed- Eggs, Spawn, fry and fingerlings Riverine collection. Transportation of fish seed and brood fish. Life cycle of penaeid and non-penacid prawn.

Unit-II : Pituitary gland and its role in fish breeding. Methods of fish and prawn breeding; induced breeding, bundh breeding, ovulating agents used (fish pitutary glands, HCG, pheromones and new generation drugs). Factors influencing fish breeding.

Unit-III : Hatching techniques. Different types of hatcheries; hatching hapa, vertical jar hatchery, chinese hatchery, D-variety hatcheries, prawn hatcheries and their management.

Unit-IV : Different types of farms and ponds. Topography, design, layout and construction of a fish seed farm. Nursery,rearing ponds, their preparation an management; harvesting of fry and fingerlings.

Unit-V : Principles of disease dignosis and fish health management. Pathogens, symptoms and treatment of infectious diseases; bacterial, fungal, viral, protozoan,

helminthic, crustacean. Abolishing, pathogens and controlling its spreading.

Unit-VI : Non-infectious and nutritional diseases and their treatment. Fish immunization and vaccines. Important disease problems of prawns, cultured shellfishes and their control. Environment in relation to diseases.

Practicals.

1. Methods of isolation and culture of bacteria and fungi.
2. Identification methods for common bacterial and fungal pathogens of fish.
3. Examination and identification of common fish parasites.
4. Fish disease diagnosis.
5. Study of normal histology of gills, skin, kidney, spleen and liver and related histopathology.
6. Assessment of water quality.
7. Experimental treatments, case studies and field visits.
8. Characteristics of gravid fishes and selection for induced breeding.
9. Anatomy (Dissection)and Histology of fish endocrine glands.
10. Collection and preservation of pituitary glands;
11. Preparation of extract; hypophysation.
12. Study of different hatchery system.
13. Water quality monitoring in hatcheries.
14. Fish seed and brood fish transportation.

Practical Examination

Practical Examination will be of six hours duration and for total 50 marks.

Distribution of marks for the practical examination.

Q.1	Identification of spots I to X	15 Marks
Q.2	Water analysis experiment.	10Marks
Q.3	Dissection of pituitary gland OR Preparation and administration of pituitary extract	10 Marks
Q.4	Identification of fish pathogens.	05 Marks
Q.5	Record and field diary	05 Marks
Q.6	Viva voce	05 Marks
	Total :	50 Marks

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2. Giant Prawn farming, New, M.B.(Ed.) Elsevier Scientific Publishing Co.,Amsterdam.
3. Fresheater prawn farming : A mannual for the culture of M.Rosenbergii new, M.B.and S.Sngholka, 1982, FAO, Fish.Tech.Pap225, FAO,Rome.
4. The Biology and culture of Tilapias, Pullin, R.S.V. and R.H. Lowe-Mcconel (Eds.), 1982. ICLARM Conference Proceedings, 7, ICELARM, Manila, Philippines.
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6. The theory and practice of induced breeding in fish. Harvey, B.J. and W.S. Hoar, 1979, IDRC-TS 21e. IDRC, Ottawa, Canada.
7. Bivalve Culture in Asia and the Pacific. Davy, F.B. and M.Graham (Eds.) 1982, IDRC-200e. IDRC-Asia Regional Office, Singapure.
8. Fish and Fisheries of India, Jhingram V.G.,1982. Hindustan Publishing Corporation, New Delhi.
9. Coastal aquaculture in the Indo-Pacific region, 1972. Pillay, T.V.R.(Ed.). Fishing News.
10. Handbook of Tropical aquaculture. Bard, J.1976. Centre Technique Forestier Tropical. Nogent-Sur-Marne,France.
11. Farming Marine fishes and shrimps; a multidisciplinary treatsise. Korringa, P. 1976. Elsevier Scientific Publishing company, Amsterdam.
12. Prawn farming today: Opportunities, techniques and development. Wickins, J.F.1986. Outlook on Agriculture, 15(2):52-60.
13. Fish Pathology. Robers, R.J.(Edd.) 1978. Bailliere Tindall, London.
14. Parasites and diseases of fish cultured in the tropics. Kabata,Z. 1985. Taylor and Frances, London.
15. Integrated agriculture farming systems. Pullin, R.S.V.and Z.H.Shehades (Eds.), 1980. ICLARM Coonference Proceedings, 4, ICLAR. Manila, Philippines.
16. A hatchery manual for the common Chinese and Indian major carps. Jhingran, V.G. an R.S.G.Pullin, 1985, ICLARM. Studies and Reviews 11.ICLARM, Manila, Philippines.
17. Principal diseases of marine fish and shellfish. II Edition, 1990, Vol.1. Diseases of marine fish, Vol.2. Diseases of marine shellfish. Sindermann, C.J.Academic Press, London.
18. Wyonarovich, E. and L.Horvath, 1980. The artificial propagation of warm water fin fish - A manual for extension. FAO Fisheries Technical paper- 201.
19. Advances in aquaculture, 1979. Food and Agriculture Organization. Fishing News.
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21. Handbook of Mariculture: Crustacean aquaculture, 1986. McVey James, P.(Ed.), CRC, Florida.

22. Selection, Hybridization and genetic engineering in aquaculture, 1987. Tiews, K.(Ed.), Heenemann, Berlin.
23. Aquaculture in Asia, 1990. AFSIB, Mangalore.
24. Fish culture, 1962. Hickling, C.F.Faber & Faber.
25. Practical approach to Fresh Water Culture,1985, Malu R.A.,Bharati Publication, Akola.
26. Aquaculture; Farming and husbandry of freshwater an d marine organism, 1972. Bardach, J.E.Wiley.
27. Cage aquaculture, 1987. Beveridge, M.C.M. Fishing News.
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29. Aquaculture, 1979. Reay, P.J.Edward.
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39. Aquaculture of Fresh water Prawns/Macrobrachium species, Goodwin, H.J. and I.A.Hanson. United States Department of Commerce, NTIS.
40. Handbook of shrimp farming, 1991, MPEDA, Cochin.
41. Problems in prawn culture, 1978. Shigeno, K.Amerind Publications.
42. Pond culture of the Malaysian Prawn, Macrobranchaya Rosenbergii. Theodore, I.J.S. and Others, USDC, NTIS.

BSc. Part II. Semester IV

INDUSTRIAL FISH AND FISHERIES (VOCATIONAL)

There shall be a following paper and practical for B.Sc.Part-II Semester Four examination. The syllabus is based on 6 theory periods and six practical periods per week (Total 75-80 theory periods and 25 practical during the complete Semester). There shall be one compulsory paper of 3 hours duration, in theory as stated below and practical examination extending for six hours. Every examinee shall offer the following paper of 100 marks, (Out of which 80 marks will be for written examination and 20 marks for internal assessments) and

practical examination of 50 marks. Candidates are required to pass separately in theory and practical examination.

		Marks
Paper-I:	**AQUACULTURE**	
1)	Theory(Written)	……80
	Internal assessments	...….20
2)	Practical:	50
	Total :	150 Marks

PAPER-4 S INDUSTRIAL FISH AND FISHERIES (VOCATIONAL) (AQUACULTURE)

Unit I : Definition, history, scope and importance of aquaculture, Status of aquaculture in different countries, Extensive, semi-intensive and intensive culture.
Different systems of aquaculture-monoculture, polyculture, integrated farming, pond culture, cage culture, pen culture, raft culture, raceway culture, culture in recirculatory water system, warm water and cold water aquaculture, sewage-fed fish culture.

Unit-II : Concept and principle of aquafarm management, Preparation of stocking pond; Prestocking management, predators and their control. Aquatic weeds, algal blooms and their control. Liming and fertilization.

Unit-III : Selection of species for culture, seed procurement and stocking. Post-stocking management, supplementary feeds and feeding. Nutritional requirement and formulation of artificial diets. Storage of feeds. Feeding techniques. Natural food an its importance in aquaculture.

Unit-IV : Characteristics of brackish water. Brackish water resources of India. Existing culture practices in bheris, pokkali paddy fields and kharlands. Breeding and culture of brackish water fins fishes milkfish, gray mullets, pearls- spot ,cock-up, etc.

Unit-V : Mari culture-culture of edible oysters, mussels, clams, cockles, sea urchins, sea cucumber, etc. Pearl oyster culture. Culture of sea weeds. Important species of cultivable penaeid and non-penaeid.

Unit-VI : prawns. Tiger prawn culture, fresh water prawn culture. Polyculture of prawns with finfish. Air-breathing fish culture.

PRACTICALS

Collection and analysis of soil and water, samples for physicochemical characteristics;
Study of food cycle in a pond,
Collection and identification of fish food organisms.
Visits to farms to study different systems of aquaculture.
Maintenance of brood fish.
Preparation of Nursery, rearing and stocking ponds,
Identification of aquatic insects, weeds and predators and their control.
Water quality analysis,
Feed preparation and feeding. Identifications of seed of cultivable fish species.
Seed stocking.
Examination of plankton from culture ponds.
Fish growth, survival an production analysis.
Identification of important species of brackish water finishes and shellfishes and their seed.
Collection and rearing of brackish water shrimps and fishes.
Identification of cultivable species of prawns oysters, mussels, clams, sea weeds, etc.
Visits to prawn hatcheries and marine culture centers.

Practical Examination

Practical Examination will be of six hours duration and for total 50 marks.

Distribution of marks for the practical examination.

Q.1	Identification of spots I to X	- 15Marks
Q.2	Soil analysis experiment.	- 10 Marks
Q.3	Identification. of plankton from culture ponds	- 10 Marks
Q.4	Submission of collection, food preparation, permanent slides	- 05 Marks
Q.5	Record and field diary	- 05 Marks
Q.6	Viva voce	- 05 Marks
	Total :	50 Marks

EQUIPMENTS AND FACILITIES

1.	Earthen ponds (0.05-0.1ha)	- 2
2.	Cement cisterns (25 m2)	- 4
3.	Portable Chinese hatchery	- 1
4.	Breeding haps	- 4
5.	Hatching haps	- 6
6.	Drag net	- 1
7.	Hand nets	- 3

8.	Compound microscopes	-	4
9.	Ocular micrometers	-	4
10.	Centrifuge	–	2
11.	Homogenizers	-	6
12.	Syringes	-	12
13.	Needles	-	24
14.	Catheter	-	3
15.	Droppers	-	12
16.	Beakers (assorted)	-	12
17.	Enamel trays	-	6
18.	Plastic drays	-	6
19.	Refrigerator	-	1
20.	Hot air oven	-	1
21.	Hand mince	-	1
22.	Water analysis kit	-	1
23.	pH meter	-	1
24.	O_2 analyzer	-	1
25.	Spectrophotometer	-	1
26.	Colorimeter	-	1
27.	Plankton nets	-	3
28.	Plastic pools	-	6
29.	Sieves for soil texture analyses	-	1 set
30.	Sedgwick Rafter Cells	-	2
31.	Glass troughs	-	12
32.	Pressure cooker	-	1
33.	Millipore filters	-	6
34.	Autoclave	-	1
35.	Phase contrast microscope	-	1
36.	Microtome	-	1

Facility for tissues block making, staining and mounting, glassware for

Analysis of carboon dioxide, alkality and ammonia, petri dishes, test tubes, etc.

REFERENCES

1. Principles and prectices of pond aquaculture. A state of the art review. Lennan, J.F.,R.O., Smitherman and G.Tehobanglous (Eds.), 1983, Oregon State University, U.S.A.
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41. Pond culture of the Malaysian Prawn, Macrobranchaya Rosenbergii.
Theodore, I.J.S. and Others, USDC, NTIS.

12. BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION (VOCATIONAL)

There shall be a following paper and practical for B.Sc. Part-II Semester III examination. The syllabus is based on 6 theory periods

and six practical periods per week (Total 75-80 theory periods and 25 practical during the complete semester). There shall be one compulsory paper of 3 hours duration, in theory as stated below and practical examination extending for 6 hours. Every examinee shall offer the following paper of 100 marks, (Out of which 80 marks will be for written examination and 20 marks for internal assessments) and practical examination of 50 marks. Candidates are required to pass separately in theory and practical examination.

			Marks
1)	Paper-I: **LABORATORY TECHNIQUES**		
	Theory (Written)	…..	80
	Internal-assessments	…..	20
2)	Practical:	…..	50

		Total :	150 Marks

Paper 3 S. BTSP.
LABORATORY TECHNIQUES

UNIT-I : Distilled Water - Types of distilled water and their uses, distillation stills, construction and functioning of metal stills, solar stills and glass stills (including triple distilled water stiles) proper collection and storage. Amount and types of impurities. What are ion-exchanges and how they work; regeneration of ion exchangers, uses of ion-free water.

Unit-II : Cleaning agents (composition) for various types of dirty glassware: pipette cleaners (construction and proper use); removal of hard water marks from glassware; storing of glassware. What is standard joint equipment; proper usage and cleaning; Utility of standard joint equipment.

Unit-III : Methods of sterilization of glassware and storage of sterilized glassware. Steriware disposable plastic petridishes and injection syringes and their uses. Glass blowing-equipment for glass blowing-safety in handling; cutting and glass blowing.

Unit-IV : Solutions- Definition of solute, solvent, molar, molal, normal, weight percent, ppm/ppb; calculation of molecular weight, interconversion between percent molar and normal; methods of dilution and sources of error. pH-What is pH? Methods of determining pH;pH paper; pH indicators and their range and uses in the Biology laboratary. Buffer Solutions-theory of buffering; some standard buffers Acetate, Phosphate,

TRIS, TRIS glycine calculation of pH of buffer-solutions.

Unit-V : Balances:- Chemical, Physical, analytical, beam, single pan, double pan, top pan, torsion, electrical, spring, parts and working, degree of accuracy and sources of errors. Tempreature sensing control devices: thermometer, hermocouples, thermostat-construction, calibration and use of incubators, oven, water bath and shakers.

Unit-VI : Common organic solvents - characteristics, uses, purification and relcamation, safety in handling of organic solvents, Colorimeter, spectrophotometer, flame photometer, theory, construction use and maintenance.

PRACTICAL COURSE

1. Preparation of various grades of distilled water.
2. Cleaning of glass wares, microscope slides etc.
3. Use and maintenance of standard joint equipment
4. Sterilization of glassware
5. Glass blowing, cutting glass plates, tubes and rods, bending tubes, drawing Capillary, sealing vials.
6. Use and care of balances.
7. Preparations of solutions, buffers as per theory.
8. Use and care of pH meter.
9. Acid base titration.
10. Preparation and maintenance of aquarium, terrarium.
11. Maintenance of living organisms, plants & animals.
12. Maintenances of museum and herbarium.
13. Water analysis DO, CO2, BOD, COD, pH, Salinity, Chlorides, nitrates, phosphates, fluorine, silicates, Alkalinity, hardness.
14. Analysis of heavy metals in soil and water -Hg, Cd, Pb.
15. Estimation of plant and animal population in aquatic and terrestrial Ecosystem.
16. Use and maintenance of colorimeter, spectrophotometer and flame photometer

DISTRIBUTION OF MARKS FOR PRACTICAL EXAMINATION

Q 1.	Estimation of heavy metals in Soil/water	12
Q 2.	Water analysis, any one DO, CO2, alkalinity, Hardness, pH, salinity, Chlorides, Phosphates, nitrates.	10
Q 3.	Identification of Phytoplankton/Zooplanktons OR Acid-base titration OR Glass blowing, cutting glass plates	10
Q 4.	Minor experiment on Colorimeter/photometer	08
Q 5.	Practical record	05

Q 6.	Viva-Voce	05
	Total :	**50**

BOOKS RECOMMENDED

1. Limnology: Welch, McGraw Hill Book Co. N.Y. 2. Principles of Biochemistry : Lehninger A.L., Warth Publisher N.Y.
2. Methods for Physical and Chemical analysis of Fresh waters: Golterman, Clymo and Ohnstand, IBP hand book No. 8 Blackwell Scientific Publications.
3. Fresh water animals of India (An ecological approach) : G.T.Tonapi, Oxford & IBH Publishing Co. New Delhi.
4. Text Book of Physiology and General Biology: Dr. R.R.Dhande and G.N.Vankhede, Bajaj Publications, Amravati.
5. Work book on Limnology: A.D.Adoni, Publication MAB Committee, Department of Environment, Govt. of India.
6. Fundamentals of Aquatic Ecosystem : Barnes, A.K. & K.H.Mann., Balckwell scientific Publications, Oxford.
7. Quantitative inorganic analysis: A.I.Vogel, ELBS publisher.
8. Essentials of plant techniques: Dwivedi J.N., Scientific Publishers, Jodhpur.
9. Introduction to plant tissue culture : Dey Dalyankumar, Central Book Agency, Calcutta.
10. Plant Cell and tissue culture : Narayan Swami S. Tata McGraw Hill.
11. An introduction to plant tissue culture: Razdan M.K., Oxford & IBH, New Delhi.
12. Plant Biotechnology: Trevan M.D., TMH, Delhi.
13. Biotechnology: Trehan Keshao, Wiley Est. Ltd.
14. Fundamentals of Biotechnology: Purohit S.S., Agro Biotechnical Publisher, Bikaner.
15. Elements of Biotechnology: P.K.Gupta, Rastogi Publications.

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BSc. Part II. Semester IV
BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION
(VOCATIONAL)

There shall be a following paper and practical for B.Sc. Part-II Semester-IV examination. The syllabus is based on 6 theory periods and six practical periods per week (Total 75-80 theory periods and 25 practical during the complete Semester).

There shall be one compulsory paper of 3 hours duration, in theory as stated below and practical examination extending for 6 hours. Every examinee shall offer the following paper of 100 marks, (Out of which 80 marks will be for written examination and 20 marks for internal assessments) and practical examination of 50 marks. Candidates are required to pass separately in theory and practical examination.

1)	Paper-I: **BIOLOGICAL ELECTRONIC AND TISSUE CULTURE TECHNIQUE**	Marks
	Theory (Written)	….. 80
	Internal assessments	….. 20
2)	Practical:	….. 50
	Total :	150 Marks

PAPER-4 S BTSP
BIOLOGICAL ELECTRONIC AND TISSUE CULTURE TECHNIQUES

UNIT-I : Organization of teaching laboratory-chemicals & reagents / glassware / specimens / living organisms /equipment / purchase and maintenance of living organisms including-aquarium, terrarium, animal house, garden.

Unit-II : Abiotic pollutants of water and their indicators and assay techniques. Distribution of plants and animals-Methods of survey, determination of frequency dominance etc. Air pollution determination of abiotic and biotic components.

Unit-III : Simple circuits - how to read a circuit diagram; parallel and series connections; fuses, plugs, wires for common electrical equipments; voltage stabilizers; safety in handling electrical equipments.

Unit-IV : Chromatographic techniques: theory, methods and application of paper chromatography; TLC, ion-exchange, gel-filtrations and other types, fraction collector; gradient elution techniques. Electrophoresis-theory, methods and applications-paper and gel electrophoresis.

Unit-V : Tissue culture techniques and their application-Cellular components-identification, separation for in vivo & in vitro Studies-applications.

Unit-VI : Immunological techniques-antigen antibody, reactions; monoclonal antibodies; blood grouping.

Isolation and characterization of molecules of the cell: sugars, proteins, amino acids, lipids, RNA, DNA.

PRACTICAL COURSE

1. Study of effect of pollutants on aquatic fauna.
2. Study of air pollution.
3. Simple circuits, soldering, changing plugs, wires, fuses, voltage stabilizers, rheostats.
4. Repair and maintenance of oven, incubator, electrical water bath, shakers.
5. Purification of organic solvents.
6. Paper chromatography (one & two dimensional)
7. Thin layer chromatography.
8. Electrophoresis, gel and paper techniques and maintenance of equipments.
9. Column chromatography including ion-exchange and gel filtration.
10. Plant and animal tissue culture techniques.
11. Separation of cellular components, use of senicator and high speed centrifuge.
12. Enzyme action and factors affecting enzyme action
13. Still reaction of isolated chloroplast.
14. Immunological techniques.
15. Isolation of proteins and DNA (as per theory)
16. Quantitative determination of glucose, proteins, amino acids, DNA, chlorophyll.
17. Tissue culture techniques.

DISTRIBUTION OF MARKS FOR PRACTICAL EXAMINATION

Q 1.	Estimation of glucose/proteins/DNA/chlorophylls. By Chromatography - Thin layer or paper	….	15
Q 2.	Soldering of wires ….		07
Q 3.	Enzyme action or Identification of blood groups…… ….		10
Q 4.	Minor experiment on Electrophoresis or Tissue Culture……..		08
Q 5.	Practical record …… …		05
Q 6.	Viva-Voce…….……...		05
			Total…. 50

BOOKS RECOMMENDED

1. Fundamentals of Aquatic Ecosystem : Barnes, A.K. & K.H.Mann., Balckwell Scientific Publications, Oxford.
2. Quantitative Inorganic Analysis : A.I.Vogel, ELBS publisher.
3. Essentials of Plant Techniques: Dwivedi J.N., Scientific Publishers, Jodhpur.
4. Introduction to Plant Tissue Culture : Dey Dalyankumar, Central Book Agency, Calcutta.
5. Plant Cell and Tissue Culture : Narayan Swami S. Tata McGraw Hill.
6. An Introduction to Plant Tissue Culture: Razdan M.K., Oxford & IBH, New Delhi.
7. Plant Biotechnology: Trevan M.D., TMH, Delhi.
8. Biotechnology: Trehan Keshao, Wiley Est. Ltd.
9. Fundamentals of Biotechnology: Purohit S.S., Agro Biotechnical Publisher, Bikaner.
10. Elements of Biotechnology: P.K.Gupta, Rastogi Publications.

13. STATISTICS

The examination in Statistics of third and fourth Semester will comprise of one theory paper each, internal assessment and practical examination. Theory paper will be of 3 Hrs duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of 4 Hrs duration and carry 50 marks.

The distribution of marks for practical will be as follows :

1.	Practical record	08 marls
2.	Practical Viva Voce	12 marks
3.	Practical problems	30 marks

The following syllabi is prescribed on the basis of 6 lecturers per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question in every Unit with internal choice for each of 12 marks and one compulsory question covering all the syllabus of Semester III & IV(8 marks)

The College imparting instructions in Statistics should provide 12 digit desk model electronic calculators to the every student for practical work.

3S – STATISTICS

Unit – I : Indian Applied Statistical System

1.1 Present official statistical system in India

1.2 Methods of collection of official statistics, its reliability and limitations

1.3 De-Jure and De-Facto methods of census, it's merits and demerits

1.4 Principal publications on Statistics such as - Population, Agriculture, Industry, Trade, Labour & Employment, Prices, Transportation and Communication, Banking & Finance

Unit – II : Demographic Methods

2.1 Definition of vital statistics and vital events

2.2 Sources of demographic data: - Registration method with its shortcomings, census, adhoc survey, hospital records and demographic profiles of Indian census

2.3 Measurement of Mortality: -

2.3.1 Crude death rate (CDR) with merits & demerits

2.3.2 (SDR) specific death rate, Age – SDR with merits and demerits

2.3.3 Infant mortality rate with limitations

2.4 Standardized death rate: Direct & Indirect methods

Unit–III : Fertility and Life Table

3.1 Life table: Assumption, Description & main features

3.2 Relations between various elements of life table

3.3 Construction of life table, uses of life table

3.4 Definition of stable & stationary population

3.5 Measurement of Fertility: -

3. 5.1 Crude birth rate (CBR) with merits & demerits

3. 5.2 General and total fertility rate (GFR & TFR)

3.5..3 Specific fertility rate, Age – Specific fertility rate with merits & demerits

3.6 Measurement of Population Growth: -

3.6.1 Crude rate of natural increase & vital index

3.7 Gross and net reproduction rate (GRR & NRR) with its merits and demerits

Unit IV : Estimation and Testing of Hypothesis

4.1 Point and Interval estimation & estimate of a parameter

4.2 Properties of estimator: - Unbiased ness, Consistency, efficiency and sufficiency.

4.3 Concept of bias & standard errors of an estimate, standard errors of sample mean and proportion.

4.4 Concept of Hypothesis: - Null and Alternative hypothesis
4.5 Types of Errors: - Type – I and Type – II , critical region
4.6 Level of significance, p – values, power of test.

Unit –V : Sampling from a Distribution
5.1 Definition of a random sample
52 Drawing random samples from standard distribution as Binomial, Poisson, Normal distribution.
5.3 Concept of statistics and its sampling distribution
5.4 Independence of sample mean and variance in random sampling from normal distribution (without derivation)
5.5 Sampling distribution of sum of Binomial, Poisson and mean of Normal Distribution

Unit – VI : Sampling Distributions
6.1 Chi-square distribution & derivation of p.d.f.
6.2 MGF of chi-square distribution & cumulant generating function
6.3 Limiting from of chi-square distribution for large degrees of freedom
6.4 Additive property of χ^2 variates
6.5 Conditions for the validity of χ^2 test
6.6 Applications of χ^2distribution: - Assumptions of χ^2
6.6.1 Chi-square test for population variance.
6.6.2 Chi-square test for Goodness of fit
6.6.3 Chi-square test for Independence of Attributes
6.7 2X 2 contingency table and Yate's correction

B.Sc. II (3S)

List of Books : 3S

1) Goon A.M. Gupta M.K. Dasgupta B. (1991): Fundamentals of Statistics, Vol. 1 World Press, Calcutta
2) Gupta S.C. and Kapoor V.K. : Fundalentals of Mathematical Statistics, Sultan Chand.
3) J.D. Gibbons : Non-parametric Statistical Inference.
4) Croxton F.E. and Cowden D.J. (1969) : Applied General Statistics, Prentice Hall of India.
5) Goon A.M., Gupta M.K. Dasgupta B.(1986): Fundamentals of Statistics, Vol.II, World Press Calcutta.
6) Guide to current Indian Official Statistics : Central Statistical Organisation. Govt of India, New Delhi.

7) Saluja M.P.: Indian Official Statistical Systems, Statistical Publishing Society, Calcutta
8) Shrivastava O.S. (1983) : A Textbook of Demography, Vikas Publishing.
9) Gupta S.C. and Kapoor V.K. : Fundaamentals of Applied Statistics, Sultan Chand.
10) Gupta and Mukhopadhyay P.P. : Applied Statistics, Central Book Agency.

List of Practicals :3S

1) Drawing random samples from Binomia & Poisson, distributions.
2) Drawing a random sample from a Normal distribution.
3) Test of significance based on Chi-Square test, - Text for population variance.
4) Testing of significance of sample correlation coefficient and uses of Z transformations.
5) Testing of equality of means and variances in sampling from a bi-variate Normal distribution.
6) Chi-square test for goodness of fit.
7) Chi-square test for Independence of zattributes in contingency tables
8) Computation crude death rates.
9) Computation of age specific death rates.
10) Computation of Standardised death rate by direct and indirect method.
11) Construction of life table
12) Computation of various measures of fertility.
13) Computation of G.R.R. and N.R.R.

4S – STATISTICS

Unit – I : Sampling Distributions [t and F)
1.1 Student's t-distribution: definition, derivation its p.d.f.
1.2 Importance of student's t-distribution and confidence limits for μ
1.3 Limiting form of t-distribution
1.4 Applications of t-distribution: Assumptions for t test.
1.4.1 test for single mean
1.4.2 t-test for difference of means
1.4.3 Paired t-test for difference of means
1.5 Snedecor's F-statistics: definition, derivation of p.d.f.
1.6 Applications of F-distribution: Assumption
1.6.1 F-test for equality of population variance

1.7 Relation between t and F distribution and F & χ^2

Unit –II Large Sample Tests

2.1 Statement of central limit theorem and its uses
2.2 Fishers z-transformation and its uses
2.3 Large sample test for single mean and single proportion
2.4 Large sample test for difference of two means and two proportions
2.5 Sampling from Bivariate normal distribution: concept & definition
2.5.1 Test for significance of sample correlation coefficients
2.5.2 Test for equality of means and equality of variances.

Unit – III Non-Parametric Tests

3.1 Definition: Non-Parametric Tests & its assumptions, order statistics
3.2 Sign test for Univariate and Bivariate distribution
3.3. Wilcoxon – Mann – Whitney test
3.4 Run test and Median Test
3.5 Spearman's Rank Correlation test
3.6 Kolmogorov – Smirnov one sample & two sample tests

Unit – IV : Economic Statistics (Index Number)

4.1 Definition of Index number and problems in construction of index numbers
4.2 Simple aggregate and weighted average methods
4.3 Price and Quality index number: Laspeyre's, Paasche's Walsh, Marshal – Edworth, Dorbish – Bowley's and Fisher's
4.4 Value Index, Uses of index numbers
4.5 Price Relatives, Quantity Relatives and values relatives
4.6 Time and Factor reversal tests
4.7 Consumer Price Index (cost of living index): its concept, methods of construction; Limitations and its uses

Unit – V : Time Series Analysis

5.1 Concept of time series, its components and uses
5.2 Illustration of Trend, Seasonal and cyclic variations, random components (Fluctuations)
5.3 Additive and Multiplication models of time series
5.4 Measurement of Trend
5.4.1 Graphical and semi – average method
5.4.2 Least square and moving average method

5.5 Measurement of Seasonal variations
5.5.1 Meaning of deseasonalisation
5.5.2 Simple average and link relatie method
5.5.3 Ratio – to – trend and Ratio – to – Moving average method

Unit – VI : Demand Analysis

6.1 Concept of demand and supply, Neccessities and luxuries
6.2 Law of demand and supply, Equilibrium price
6.3 Price elasticity of demand
6.4 Price elasticity of supply
6.5 Income elasticity
6.6 Cross elasticities of demand
6.7 Types of data required for estimating elasticities.
6.8 Pareto's law of income distribution.

List of Books : 4S

1) Goon A.M. Gupta M.K. Dasgupta B. (1991): Fundamentals of Statistics,Vol. 1 World Press, Calcutta
2) Gupta S.C. and Kapoor V.K. : Fundalentals of Mathematical Statistics, Sultan Chand.
3) J.D. Gibbons : Non-parametric Statistical Inference.
4) Croxton F.E. and Cowden D.J. (1969) : Applied General Statistics, Prentice Hall of India.
5) Goon A.M., Gupta M.K. Dasgupta B.(1986): Fundamentals of Statistics, Vol.II, World Press Calcutta.
6) Guide to current Indian Official Statistics : Central Statistical Organisation. Govt of India, New Delhi.
7) Saluja M.P.: Indian Official Statistical Systems, Statistical Publishing Society, Calcutta
8) Shrivastava O.S. (1983) : A Textbook of Demography, Vikas Publishing.
9) Gupta S.C. and Kapoor V.K. : Fundaamentals of Applied Statistics, Sultan Chand.
10) Gupta and Mukhopadhyay P.P. : Applied Statistics, Central Book Agency.

List of Practicals :4S

1) Test of significance based on t-test
2) Test of significance based on F-test
3) Large sample test for single mean and difference of means
4) Large sample test for single proportion and difference of proportions
5) Non-Parametric Test : Sign test for Univariate and Bivariate distributions.
6) Non-Parametric Test : Wilcoxon-Mann-Whiteney test.

7) Non-Parametric Test : Run test and Median test
8) Non-Parametric Test : Kolmogorov- Smirnov Test
9) Computation of index number by simple aggregate and Weighted average method.
10) Construction of price and quantity indes numbers by Laspeyre's Passche's and Fisher's Method
11) Applications of time reversal test and factor reversal test
12) Construction of cost of living index numbers
13) Measurement of linear trend by—
    i) Graphical Method
    ii) Method of Semi averages.
    iii) Method of least squares
    iv) Method of moving averages
14) Measurement of seasonal variations by-
    i) Method of simple averages
    ii) Ratio to trend method
    iii) Ratio to moving average method
    iv) Method of link relative
15) Estimation of price elasticity of demand, income elasticity of demand and cross elasticity of demand.

List of Equipments and instruments required for a batch of students at under graduate statistics laboratory for B.Sc. I, II & Final

1)	Twelve digits desk model electronics calculator	–	25
2)	Biometrica tables Vol.I and Vol.II	–	05 each
3)	Sevel figure logarithmic tables	–	10
4)	Statistical Tables (Compiled	–	10
5)	Random number tables	–	10
6)	A mathematical typewriter	–	01
7)	A duplicating machine	–	01
8)	Personal Computer	–	05
9)	Printer	–	01
10)	Statistical posters and charts	–	01

11) Software packages, Like Stastat, Stat Lab., SPSS/OR other useful packages may be provided in laboratory for practical purpose

14. COMPUTER SCIENCE/COMPUTER APPLICATION/ INFORMATION TECHNOLOGY

The examination in Computer Science/Computer Application /Information Technology will comprise one theory paper and practical examination for each semester. The theory paper will be of 3 hour duration and carry 80 marks. The Practical examination will be of 4 Hrs. duration and carry 50 marks.

The distribution of marks in practical examination will be as follows :

1.	Programm writing/execution (on group A & B)		30 Marks
2.	Practical Record		10 Marks
3.	Viva-Voce		10 Marks
		Total :	50 Marks

3S - COMPUTER SCIENCE/COMPUTER APPLICATION / INFORMATION TECHNOLOGY

Object-Oriented Programming with C^{++} and Web Technology.

Unit-I : Concept of OOP, Comparision with POP, features of OOP, advantages and applications of OOP, Introduction to C^{++}, structure of C++ program, tokens, keywords, identifiers, basic data types & user defined data types, Constants, variables, declaration of variables, dynamic initialization of variables, types of symbolic constants.

Unit-II : Operators : Scope resolution operator, member dereferencing operator, implicit & explicit conversions. Control structures : if, switch, do..while, while, for statements Functions: Function prototype, Function calling and returning, their types, inline functions, default arguments, constant arguments, function overloading.

Unit-III : Classes and objects : Data abstraction and, Encapsulation, Data Hiding, class specification, defining objects, accessing class member, defining member functions, Nesting of member function, friend functions, passing objects as arguments, Returning objects from functions.
Constructors : Defining constructor, parameterized constructor, multiple constructors in a class, constructor with default argument, copy constructor, destructor.

Unit-IV : Basic elements of communication system, Network concept, advantages, goals, network topologies : Star, ring, completely connected N/W, Hybrid N/W, multipoint n/w, LAN, WAN, OSI model.

Unit-V : HTML : Introduction, Need of HTML application of HTML, Basic structure of HTML, HTML tags and attributes : Adding tags, include attributes < HTML >, < HEAD >, < TITLE >, < BODY >, < P >, < Br >, < HR >, Heading tags, table tags,< LINK>, < IMG >, < ROWSPAN >, < COLSPAN >, < MARQUEE >,<

BLOCKQUOTE >, < A >, < I >, < B >, list tag, Attributes : allign, background colour, text color.

Unit-VI : Style sheet : advantages of style sheet & applications of style sheet, CSS : Introduction, CSS stylesheet properties : Units, classes and ID attributes. Properties : Text, font, colour, background, border, display, height, line, margin, width, CSS with HTML.

Book recommended :

1) Object Oriented Programming with C^{++} : E Balgurusamy TMH.
2) Mastering C^{++} : K.R. Venugopalan
3) Programming with C^{++} : Robert Lafore
4) Programming with C^{++} : R.S. Nisar Ali
5) Computer Fundamental and Networking : P.K. Sinha
6) Local Area Network : Keiser, TMH, Publication
7) Computer Networks : Andrew S. Tanenbaum, PHI.
8) HTML in 21 days : Tech media publication
9) HTML4 for dummies Mastering by Ed Tittel, IDG Publications.
10) HTML4 Unleashed, Professional Reference Edition by Rick Darnell
11) C++ for beginners : by B.M. Harwani, SPD Publications

Practicals : Minimum 16 practicals based on

A. Unit - I, II, III (Minimum 8 practicals)
B. Unit - IV, V, VI (Minimum 8 practicals)

4S : COMPUTER SCIENCE / COMPUTER APPLICATION / INFORMATION TECHNOLOGY

Advanced C^{++} and Web Designing

Unit I : Arrays and Pointers : one-dimentional, two-dimentional arrays, Defining Pointers, arrays of objects, Pointer to objects, this pointer operator overloading : Defining operator overloading, overloading arrays, Binary, and assignment operators, rules for overloading operators.

Unit-II : Inheritance : Introduction, derived classes, Single inheritance, multiple inheritance, Hierarchical and Hybrid inheritance.

Templates : Function, class, members and Function templets.

Unit-III : Virtual Functions and Polymorphism :- Introduction, Pointers to derived class, dynamic binding, defination

of Virtual Function, pure Virtual Functions, Rules For Virtual Functions.

Working with Files : Introduction, Hierarchy of File Stream Classes, opening and closing of Files, File modes, File pointers and their manipulations, File Input/Output with Fstream class.

Unit-IV : Introduction to XML : History of Markup languages, features of XML, Simple XML document, logical structure of XML elements, Components of XML documents : The document prolog and document instance. CSS with XML.

Unit-V : Document type Defination (DTD): Introduction, need of DTD, declaring elements, element content models, declaring attributes, attribute types : internal and external DTD, entities and their types.

Unit-VI : XML Schemas : Introduction, features, Comparison with DTD, Schema elements, element type element attributes, XML schema data types, converting DTD to schema, Namespaces : Introduction, declaration, default & prefit namespaces, scope of namespaces collusion & Applications.

Books Recommended :-

1. Object Oriented Programming with C^{++} : E Balguruswamy-THM
2. Mastering C^{++} : K.R. Venugopalan
3. Programming with C^{++} : R.S. Nisar Ali
4. Mastering XML, Ann Navaro, Chuck White, Linda Burman, BPB Publication.
5. Applied XML Solutions, BPB Publications.
6. Inside XML, BPB Publication
7. Essential XML. Box
8. XML and Related Technology, Kahate
9. XML How to Program Deitel.

Practicals :-

Group A : Minimum 08 practicals based on Unit I to III.
Group B : Minimum 08 practicals based on Unit IV to VI

15. COMPUTER APPLICATION (VOCATIONAL)

The examination in Computer Application (Vocational) will comprise one theory paper and practical examination for each semester. The theory paper will be of 3 hour duration and carry 80 marks. The Practical examination will be of 4 Hrs. duration and carry 50 marks.

The distribution of marks in practical examination will be as follows :

1.	Practical based on Computer Lab I	15 Marks
2.	Practical based on Computer Lab II	15 Marks
3.	Viva-Voce (based on lab I & II)	10 Marks
4.	Record/Practical Journal	10 Marks
	Total :	50 Marks

3S: COMPUTER APPLICATION (VOCATIONAL)

Visual Basic and RDBMS

Unit- I : Introduction to VBm, Integrated Development, Environment, Tool bar, Menu Bar, Project explorer, tool box, Property window, form designers, form layout, Immediate windows, Project Objects, Event Properties and Methods.

Unit- II : Selecting and using controls, command buttons, text box, labels, option buttons, list box, check box, combo box, image object, picture box, line object data control.

Unit- III : Working with variables, storage of variables, operators, order of operators, conditional and logical operators, Control Structurs : IF--then, ENOZF, IF-- ELSE, nested if..Else, SELECT case, goto, I I F ( ), do loop, for loop, Nested for loop.

Unit- IV : Fundamentals of DBMS, RDBMS, Architecture of database System, Data base approaches, Entity, Relationship, Domain & attributes, keys, Mapping Constraints, Functional Dependancies, Normlization : Normal Form, 1NF, 2NF, 3NF, BCNF.

Unit- V : SQL: Components of SQL, Data types, DDL Commands : create, Alter, Drop, for tables and Views, DML Commands : Select, Insert, Update, Delete, DCL Command : Commit, Rollback. ORDER By, GROUP By and Having clause.

Unit- VI : Functions : Numeric Functions, Character Functions, Conversion Functions, Group Functions.
Joins : Equi-join, Non-equijoin, Selfjoin, Outerjoin, Unions.
Data Integrity : Types of Integrity Constrains, Displaying integrity Constraints:

Books

i) Guide to VB - Peternorton-Techmedia

ii) Mastering VB - Evangelous Petroutsos
iii) Visual Programming 6.0 -Microsoft press programming guide.
iv) Introduction to DBMS : Majumdar & Bhattacharya
v) Database Concepts and : Ivon Bayross
System for students.
vi) Programming with SQL : Ivon Bayross
vii) Understanding Oracle : James Perry, J.Q. Lateer.

Practicals : Minumum 08 practicals on Unit I to Unit III and Minimum 08 practicals on Unit IV to VI.

4S : COMPUTER APPLICATIONS (Vocational)

Advance VB and RDBMS

Unit-I : VB Programms : Programme structure, procedure & Functions, priavate and public procedure, virables Code, Passing data by reference and value, passing control as argument, design time and runtime properties.

Unit-II : Interacting with Data; Database and Visual basic, data Control, advance data Control usage, advanced database control using VB application Wizard.

Unit-III : Printing output in VB : Printing information using print collection, controlling output, scalling output, formatting with fonts, simple VB programs, connection with database.

Unit-IV : PL SQL PL SQL block, architecture, data types, type declarations, Control Structure.
Cursor : Types of Cursors, Creating, Opening and fetching cursors, cursor attributes, closing cursors.
Transaction : SET TRANSACTION Command, Savepoint and Rollback segments.

Unit-V : Secutiry concepts, Types of Security, User ID, Security Object, Previleges : types of previleges : GRANT, REVOKE previleges, column passing privelege, Database triggers, procedures.

Unit-VI : Dynamic SQL : Limitations of Static SQL, Basic concept of Dynamic SQL, Dynamic statement execution, Dynamic Queries.
SQL *Forms; creating forms, entering data, running forms, editing forms, creating and running reports.

Books Recommended :

i) Introduction to DBMS : Mujumdar & Bhattacharya.
ii) Database Concepts and: Ivan Bayros
Systems for students
iii) Programming with SQL: Ivon Bayros

iv) Understanding oracle : James Perry, J.Q. Lateer.
v) Visual Programming 6.0 : Microsoft press Programming guide.
vi) Guide to VB : Peternorton (Techmedia)
vii) Mastering VB : Evangelous Petroutsos - BPB.

Practicals : Minimum 08 practicals on Unit I to Unit III and Minimum 08 practicals on Unit IV to Unit VI.

16. ELECTRONICS

The examination in Electronics of third semester shall comprise of one theory paper of 80 marks of three hour duration and internal assessment of 20 marks.

The practical examination will be of 4 hours duration and Carry 50 Marks.

At the time of practical examination every student has to perform one experiment.

Distribution of marks is as under:

1:	Experiment (Construction, testing and performance)	------30 Marks
2:	Practical record	------10 Marks
3:	Viva voce	------10 Marks

	Total	**------50 Marks**

Semester-III
3S – Electronics
(Amplifier and Combinational Logic)

NIT I : Feedback Amplifier and Oscillator

Concept of feedback, feedback theory, positive and negative feedback, advantage of negative feedback, physical idea of feedback,(Block diagram only),concept of oscillator, basic elements of oscillator, Barkhausen Criteria of oscillation, concept of tank circuit. RC oscillator-Phase shift and Wein bridge oscillator, LC oscillator- Colpitts and Hartley oscillator, , Sawtooth oscillator.

UNIT II : Operational amplifier and applications.

Difference amplifier(concept, construction and working), block diagram of operational amplifier, pin diagram, characteristics of ideal op amp, concept of virtual ground, parameter of op amp: input impedance, output impedance, open loop gain, close loop gain,

CMRR, slew rate, input offset voltage and current, input bias current.

Applications: Op amp as inverting and non inverting amplifier, adder, Subtractor, Differentiator and Integrator.

UNIT III: Advanced application of Op- Amp:

Solution to simultaneous equation, differential equation for harmonic, damped harmonic oscillator, regenerative comparator, logarithmic amplifier, Astable, Monostable and Bistable multivibrator and its time period (construction and working).

UNIT IV : A/D and D/A converter

Need of A/D and D/A converter, Characteristics and Applications.

D/A converter: R-2R ladder type, Weighted resister, sample and hold circuit, specification.

A/D converter: Single and Dual slope, counter type, successive approximation type, specification,.Numerical based on A/D and D/A Converter.

UNIT V : Combinational logic circuit

Encoder: Binary to BCD, Decimal to BCD, IC 74147, Decoder: 2 to 4 line, BCD to decimal, BCD to 7 segment, IC 7447, Multiplexer: 4X1, 8X1, De multiplexer: 1X4, 1X8, (Definition, construction, operation and application of above)

Unit VI : Memories:

Concept of memory, primary and secondary memory, classification of memories, volatile and non volatile memories, memory Hierarchy, semiconductor memory: RAM, ROM, PROM, EPROM, EEPROM, floppy disk, hard disk, formatting of magnetic disk. Optical memories: CD, DVD, CCD,Cache memory, Real and virtual memory,

Practical :- At least 10 Experiments based on above Syllabus.

Books Recommended:

1) Basic electronics by B.L.Thereja (S.Chand and Company)
2) Digital and analog technique by Navneet, Kale and Gokhale (Kitab mahal prakashan)
3) Element of electronics by Bagde and Singh (S.Chand and Company)
4) Principle of electronics by V.K.Mehta
5) Principle of electronics by M.L.Gupta
6) Electronics devices and circuits by Mottershed

7) Introduction to digital electronics by Mohinder Singh
8) Fundamental of electronics by Anokh Singh
9) Basic electronics by Grob
10) Digital principle and application by Malvino and Leanch

Semester-IV
ELECTRONICS

The examination in electronics of Fourth semester shall comprise of one theory paper of 80 marks of three hour duration and internal assessment of 20 marks.

The practical examination will be held at the end of Fourth semester of 50 marks of 4 hours duration.

At the time of practical examination every student has to perform one experiment.

Distribution of marks is as under:

1: Experiment (Construction, testing and performance)	------	30 Marks
2: Practical record	------	10 Marks
3: Viva voce	------	10 Marks

Total :		**50 Marks**

4S – Electronics
(8085 Microprocessor and Communication System)

UNIT I : Architecture and timings of 8085

Evolution of microprocessor, microcomputer,(Block diagram with function of each block),architecture of Intel 8085 microprocessor, function of each block of 8085**,** Functional pin diagram **and** function of all pins of 8085, instruction format. Instruction cycle, fetch and execute operation, machine cycle and state, timing diagram.

UNIT II : Instruction and programming of 8085

Addressing mode, classification of instruction set of 8085 with examples, concept of stack and stack pointer, PUSH and POP instruction, Concept of subroutine: CALL and RET instruction, Delay subroutine (using one register and register pair).

Programming : Algorithm, Flowchart, Assembly and machine language, assembly language program for addition, subtraction, multiplication, division, finding maximum and minimum numbers.

UNIT III : Interfacing

Basic interfacing concept, memory mapped I/O and I/O mapped I/O sFuncchemes, data transfer scheduling.

8255PPI: block diagram, function of each block, Functional pin diagram, , function of each pin, operating modes of 8255, control word format in I/O and BSR mode, illustrative example.

Unit IV : Modulation and Demodulation :

Need for modulation, AM theory, Power relation, Numerical on AM, AM Systems :DSB-SC System, SSB-SC System, Theory of FM, frequency spectrum Numerical on FM ,Comparison of AM and FM, Phase Modulation, Demodulation of AM and FM: diode detector, slope detector.

UNIT V : Generation of AM and FM, Transmitter and Receiver

Generation of AM (Collector modulator), Generation of FM: Direct FM ,Diode reactance modulator, The Reactance Tube Modulator and Indirect FM, AM and FM Transmitter and Receivers :Block diagram and working, TRF receiver, Superhetrodyne receiver, AGC, Concept of External noise, Atmospheric noise, Internal and Thermal noise.

UNIT VI : Pulse Modulation and Digital Communication

Pulse Modulation, Sampling Theorem, PAM, PWM, PPM and PCM (Bandwidth of PCM, Quantizing Noise), Applications of PCM, Multiplexing Principles,: TDM and FDM, Comparison of FDM and TDM, Numerical.

Digital Communication: Data transmission: Bandwidth, Serial and parallel transmission, Direction of data transmission (Simplex, Half duplex, full duplex), Mode of data transmission (Synchronous and Asynchronous).

Practical :- At least 10 Experiments based on above Syllabus.

Books recommended:

1) A Text Book of Communication Engineering by A.Kumar
2) Electronics Communication by Roddy and Coolean
3) Telecommunication principle circuit and system S.Rambhadran
4) Basic Electronics B.L.Thereja
5) Modern Digital and Analog Communication System by B.P.Rathi
6) Communication Electronics by N.D.Deshpande
7) Microprocessor and Microcomputer By B.Ram
8) Microprocessor Architecture, Programming and Application by Ramesh Gaonkar
9) Introduction to Microprocessor by A.P. Mathur

10) Modern Digital Electronics by R.P.Jain
11) Microprocessor Architecture and Application by Dougulas Hall.
12) Communication Electronics Principle and Applications by Frenznel

17. BIOCHEMISTRY
Semester-III
Biochemistry

The examination in Biochemistry will comprise of two theory papers, one in each semester and one practical in each semester. Each theory paper will be of 3 hours duration and shall carry 80 marks each. The internal assessment will carry 20 marks. The practical examination will be of 6 to 8 hrs duration in one day & shall carry 50 mks.

The following syllabus is prescribed on the basis of six lectures per paper per week and six practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 mks & 1 compulsory question covering all the syllabus of semester I (8 mks).

3S-Biochemistry
(Intermediary Metabolism)

UNIT-I : a) Glycogen synthesis in liver and muscles, Glycolysis and its regulation, Glycogenolysis, TCA and its regulation.
b) HMP pathway, Gluconeogenesis, Glyoxalate bypass.
c) Mitochondrial ETC, Oxidative phosphorylation.

UNIT- II : a) Introduction to lipid metabolism, hydrolysis of triacylglycerols, transport of fatty acid into mitochondria.
b) B- Oxidation of saturated fatty acids, ATP yields from fatty acid oxidation, biosynthesis of saturated and unsaturated fatty acid.
c) Metabolism of Ketone bodies, biosynthesis of triglycerides.

UNIT- III: a) Biosynthesis of Phospholipids, glycolipids, sphingolipids.
b) Cholesterol; regulation of cholesterol metabolism.

UNIT- IV: a) General reactions of amino acid metabolism such as transamination, oxidation deamination and decarboxylation.
b) Urea cycle and its regulation.

a) Degradation and biosynthesis of amino acids- Glycine, serine, Cysteine, Methionine, Phenylalanine and Tyrosine.

UNIT- V: a) Sources of atoms in purines and pyrimidine molecules.
Biosynthesis and degradation of purines and pyrimidines.
b) Regulation of purines and pyrimidine biosynthesis.

UNIT- VI: a) Biosynthesis and degradation of porphyrins.
b) Production of bile pigments.

PRACTICALS: 3S Biochemistry

1) Estimation of blood glucose by GOD/POD Method.
2) Isolations of glycogen from liver and estimation by GOD/POD method.
3) Determination of achromic point of salivary amylase.
4) Demonstration of effect of temperature on enzyme catalysed reaction.
5) Demonstration of urease activity on urea.
6) Demonstration of immobilization of enzyme.
7) Estimations of vitamin c by dye method.

Distribution of Marks : Semester III Biochemistry Practicals

1.	Long experiment(One)	:	15 marks
2.	Short experiment	:	10 marks
3.	Short experiment	:	10 marks
4.	Viva voce	:	8 marks
5.	Class work and Practical Record	:	7 marks

	Total :		50 marks

Semester-IV
Biochemistry

The examination in Biochemistry will comprise of two theory papers, one in each semester and one practical in each semester. Each theory paper will be of 3 hours duration and shall carry 80 marks each. The internal assessment will carry 20 marks. The practical examination will be of 6 to 8 hrs duration in one day & shall carry 50 mks.

The following syllabus is prescribed on the basis of six lectures per paper per week and six practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 mks & 1 compulsory question covering all the syllabus of semester I (8 mks).

4S-Biochemistry
(Enzymology)

UNIT-I : a) General characteristics, nomenclature, IUB classification of enzymes.
b) Defination with examples of holoenzymes, apoenzymes, coenzymes, cofactors, activators, inhibitors, activesite, metaloenzyme, marker enzyme, monomeric and oligomeric enzymes.
c) Unit of enzyme activity, isoenzyme, multienzyme complexes, enzyme specificity.

UNIT-II: a) Isolation, purification and crystallation of enzymes, test for homogeneity.
b) Enzyme assay, factors affecting enzyme activity- Substrate concentration, enzyme conc., pH, temp.
c) Derivation of Michalies Menton equation for unisubstrate reaction, Km and its significance, Line Weaver Burk plot and its limitation.
d) Bisubstrate reactions- sequential and ping- pong mechanism with examples.

UNIT- III: a) Kinetics of zero and first order reaction.
b) Significance of energy of activation and free energy.
c) Reversible and irreversible inhibition, competitive, non- competitive and uncompetitive inhibition.
d) Determination of Km and Vmax in presence and absence of inhibitors.

UNIT- IV: a) Allosteric enzymes, role of cofactors in enzyme catalysis- NAD/NADP, FAD/FMN, Coenzyme- Q, Biotin, Cobamide, Lipoamide, TPP, THF, Pyridoxal phosphate.
c) Role of metal ions in enzyme catalysis with special emphasis on coenzyme function.

UNIT- V: a) Acid- base catalysis, covalent catalysis.
b) Proximity and orientation effect, strain and distortion thesis.
c) Mechanism of action- Lock and Key hypothesis, Induced fit model.

UNIT- VI: a) Application of immobilized enzymes in industry.
b) Production of glucose from starch, glucose- fructose syrup from sucrose.
c) Use of lactose in dairy industry. Use of proteases in food, detergents and leather industry
d) Medical applications of enzymes such as use of glucose oxidase in enzyme electrodes.

Practical : 4S Biochemistry

1. Estimation of DNA by Diphenylamine reagent.
2. Estimation of RNA by Orcinol reagent.
3. Estimation of amino acids by Ninhydrin method.
4. Estimation of protein by Folin-Lowry method.
5. Estimation of Cholesterol in given sample by Libermann-Burchard reagent.
6. Separation of chlorophylls by column chromatography
7. Estimation of inorganic phosphorus by Fiske- Subbarao method.

Distribution of Marks : Semester IV Biochemistry Practicals

1. long experiment(One)	:	15 marks
2. Short experiment	:	10 marks
3. Short experiment	:	10 marks
4. Viva voce	:	08 marks
5. Class work and Practical Record	:	07 marks

18. MICROBIOLOGY

Semester-III

MICROBIOLOGY

The examination shall comprise of two theory papers, one in each semester and one practical in each semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry 50 marks.

The following syllabus is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of semester-III (8 Marks).

3 S-Microbiology

Molecular Biology and Genetic Engineering

Unit I : Gene multiplication and expression

a) Concept of gene – Definition of Gene, Muton, recon, cistron, gene within gene, split gene.
b) Replication of DNA- Modes of replication, (Conservative, Semiconservative and Dispersive). Experiment of Meselson and Stahl to prove semiconservative mode of replication. Mechanism of replication with enzymes involved, models of replication: Knife and fork, rolling circle.
c) DNA repair mechanisms- light and dark.
d) Genetic code- Characteristic features of genetic code.

e) Out line of Protein synthesis- Transcription and Translation.

Unit II : Gene : Regulation and Mutation

a) Gene regulation Mechanisms - *lac* operon , *trp* operon.

b) Mutation- Definition & types of mutations - Base pair substitution, frame-shift, point, missense, nonsense & silent mutations, Random Vs. Directed mutation,
Rate of mutation, Effect of Mutation on Phenotype,

c) Genetic suppressions:- Intragenic (Intracodon suppression, reading frame Suppression) and extragenic suppression (Non sense and Missense Suppression).

d) Molecular basis of spontaneous and induced mutations - Spontaneous mutation (Tautomerism), Induced Mutation (Chemical Mutagens) e.g. Base analogues, Nitrous Oxide, Hydroxylamine, Acridine dyes, Physical mutagens e.g. X-rays, Gamma rays, U.V. light.

Unit III : Genetic recombination:

Mechanism of recombination **:**

Breakage and reunion, breakage and copying, complete copy choice.

Transfer of genetic material in prokaryotes**:**

a) Transformation: Experiment of Griffith. Avery, MacLeod and McCarty experiment to prove Genetic Transformation. Mechanism of Transformation.

b) Transduction: Experiment of Zinder and Lederberg. General mechanism of Transduction. Types of Transduction: Generalized and Restricted, Complete and Abortive, Low Frequency and High Frequency Transduction. Comparison between Transformation and Transduction.

c) Conjugation: Experiment of Lederberg and Tatum, Experiment of Davis, Nature and function of F-Plasmid. Hfr formation. Various Mating types. Mechanism of conjugation: i)F^+ x F^- ii) Hfr X F^-. F' Plasmid and Sexduction.

Unit IV : Tools of Genetic Engineering:

a) Introduction to basic technique of genetic engineering.

b) Enzymes for splicing: Restriction endonucleases.

c) Range of DNA manipulating enzymes: Nucleases, Ligases, Polymerases, DNA modifying enzymes, Topoisomerases.

d) Vectors: Ideal characters and types: Plasmid, Cosmid and Bacteriophage.

Unit V : Techniques of genetic engineering:

a) Isolation of Genomic and Plasmid DNA from bacteria, Analysis of DNA fragment size by agarose gel electrophoresis.

b) Introducing λ□□DNA into host cell, competent cells, transduction of cells and identification of transformed cell (e.g. Antibiotic resistance gene in Plasmid) Selection of clones: Direct (colony hybridization) and Indirect method (southern blotting).

c) Definition, method and applications of gene mapping, DNA sequencing (by microarray) and PCR.

d) Introduction to expression of cloned genes. Construction of gene library. Cells for cloning.

Unit VI : Applications of Genetic Engineering:

a) Health care biotechnology: - Recombinant Insulin, Recombinant Hepatitis vaccine, Gene therapy, DNA probes in diagnosis.

b) Agricultural biotechnology: - Transgenic plants.

c) Environmental biotechnology: - Genetically engineered microbes for pollution control.

d) Industrial biotechnology: - Strain improvement for industrial product.

Practicals

1. Isolation of genomic DNA from bacteria.
2. Demonstration of agarose gel electrophoresis.
3. Genetic recombination in bacteria.
   a) Transformation b) Conjugation
4. Estimation of DNA and RNA.
5. Isolation of fermentative mutant using physical mutagen (U.V. radiation).
6. Detection of streptomycin (antibiotic resistant mutant) by replica plating technique.
7. Transformation of plasmid DNA using $CaCl_2$.

Distribution of marks

III Semester Microbiology practicals

1. Major experiment - 15 Marks

2. Minor experiment	-	10 Marks
3. Viva-Voce	-	10 Marks
4. Spotting	-	10 Marks
5. Laboratory journal	-	05 Marks
TOTAL		50 Marks

Books Recommended For SEM- III:-

1. Recombinant DNA:-James. D. Watson, John. Tooze, David.Kutz
2 Introduction to Genetic Engineering: - Nicholas
3. An Introduction to Genetic Analysis: - David Suzuki, Anthony. Griffths
4. Biochemistry: - Lehninger
5 General Microbiology. Vol 1& II. : - Powar & Daginawala
6 Molecular Biology of the Cell: - J. D. Watson, D. Bray
7 The DNA Story: - J. D. Watson
8 Genetics of Prokaryotes: - Srivastava et.al
9 Genes: - Pramod Kumar
10. Genetic Engineering and its Applications -Joshi P.
11 Gene Transfer and Expreesion a Laboratory Manual: - Michael Kriegler
12 Concept in biotechnology: - D. Balasubramanium
13 Essential Genetics: - Daniel. Hartl.

PRACTICALS :

1. Microbes in Action : Saley, Wandermark, Tarporewala, Bombay.
2. Medical Microbiology Vol.II : R.Cruickshank.
3. A mannual of Microbiological : A.J.Salle.
   Methods.
4. Microbiological Methods : Collins
5. Difco mannual

Semester-IV
MICROBIOLOGY

The examination shall comprise of two theory papers, one in each semester and one practical in each semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry 50 marks.

The following syllabus is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of semester-IV (8 Marks).

4 S-Microbiology
Medical Microbiology

Unit I : Epidemiology

a) Definition, classification and scope of epidemiology.
b) Infection- Types of infection and modes of transmission.
c) Normal flora of human body.
d) Infection process, pathogenicity and virulence, Microbial virulence factors: toxins, enzymes
e) Control of communicable diseases.

Unit II : Immunology

a) Organs and cells of immune system
b) General Nonspecific factors- Physiological barriers, Natural cellular factors, Natural humoral factors.
c) Immunity- Definition and classification
d) Innate immunity- Species, Racial, Individual, Herd immunity.
e) Acquired immunity- Active and passive immunity,
f) Immune response and hypersensitivity

Unit III : Serology

a) Antigens- Definition, types and factors determining antigenicity, Bacterial antigens.
b) Antibodies- Definition, Structure, classification, Properties and differences, monoclonal antibodies.
c) Antigen Antibody reactions- Agglutination, Precipitation, Complement fixation test, ELISA and RIA.

Unit IV : Pathogenic Bacteria

Study of following bacteria with respect to their morphology, cultural and biochemical properties,

antigenic structure, pathogenesis, laboratory diagnosis and prophylaxis:

a) Staphylococcus aureus.
b) Clostridium tetani.
c) Salmonella typhi.
d) Mycobacterium tuberculosis.
e) Treponema pallidum.
f) Vibrio cholerae.

Unit V : Other Pathogenic organisms

a) Viruses- AIDS , Hepatitis, Polio, Rabies.
b) Rickettsias- *R. prowazekii*
c) Protozoa- *E. histolytica*
d) Fungi-*C. albicans*

Unit VI- Antimicrobial chemotherapy

a) Ideal characters of chemotherapeutic agents
b) Major antimicrobial agents and its clinical uses:
   i) Antibacterial agents: Rifampicin, Chloramphenicol, Streptomycin and Ciprofloxacin
   ii) Antiviral agents: Azidothymidine, Amantadine.
   iii) Antifungal agents: Griseofulvin, Amphotericin B, Imidazoles.
c) Basic mechanism of antibiotic action
d) Antimicrobial susceptibility testing: Introduction to CLSI (NCCLS), MIC.
   Disc diffusion, agar dilution, broth dilution (macro and micro).

Practicals

1. Studies of microbial enzymes and biochemical tests:
   a) Urease b) Coagulase c) Oxidase d) IMViC e) Sugar fermentation
2. Isolation and Identification of following bacteria:
   a) *Staphylococcus aureus* b) *E. coli* c) *Salmonella typhi*
3. Serological Tests:
   a) Widal b) Pregnancy test c) VDRL
4. Antibiotic sensitivity by Disc diffusion method.
5. Clinical investigations:
   a) Blood grouping and Cross matching
   b) TLC, DLC
   c) Hemoglobin estimation
   d) Test for carbohydrates and Proteins in Urine
   e) Blood glucose and cholesterol
6. Cultural examination of Urine, Blood, Sputum, Stool, Pus, CSF.
7. Isolation of pathogenic fungi
8. Study Tour.

Distribution of marks

IV Semester Microbiology practicals

1. Major experiment - 15 Marks
2. Minor experiment - 10 Marks
3. Viva-Voce - 10 Marks
4. Spotting - 10 Marks
5. Laboratory journal - 05 Marks

TOTAL : 50 Marks

Books Recommended For SEM- IV :-

1. Medical Bacteriology : Dey N.C. & Day T.K.
2. Medical Microbiology Vol. I & II : Cruickshank K.R.
3. Text Book of Microbiology : Ananthanarayan R. & C.E. Panikar
4. Medical Parasitology : Dey N.C. & Dey T.K.
5. Dorland's Pocket Medical Dictionary
6. Microbiology : Zinsser W.
7. Preventive & Social Medicine : Park & Park
8. General Microbiology & Immunity : S.G.Wilson. Vol. I & II
9. Medical Microbiology : R. Anantnarayan
10. Fundamental Priciples of : A.J.Salle. Bacteriology
11. Microbes & Diseases of Man : W.C.Deb. (Helminthology)
12. Microbiology : B.D.Davis, R.Dulbecoco, H.N.Eisen, H.S.Ginsburg.
13. Parasitology : K.D.Chatterjee
14. Text Book of Medical Microbiology: H.L.Chopra.

PRACTICALS :

1. Microbes in Action : Saley, Wandermark, Tarporewala, Bombay.
2. Medical Microbiology Vol.II : R.Cruickshank.
3. A manual of Microbiological Methods. : A.J.Salle.
4. Microbiological Methods : Collins
5. Difco mannual

19. FOOD SCIENCE
Semester III
3S : Food Microbiology

UNIT-I : Introduction to microbiology, Brief History, Food Microbiology, Microorganisms and its relation with food, various type of microorganisms; Bacteria Algae; fungi, viruses Protozoa etc.

Taxonomy; Definition taxonomic ranks, Classification ,major characteristics used for classification eukaryotes and prokaryotes three domain system Microbial cell, Structure important organs of cell.

UNIT-II : Growth of microorganisms; Age of cell, synchronized and balanced growth generation time exponential growth and rate constant, Microbial growth curve, method of measurement of growth, cell mass and its determinant intrinsic factors affecting growth, mode of nutrition in microorganisms, nutritional requirement of microorganisms.

UNIT-III : Bacteria; introduction general characteristics, Size , Shape, Colony Characteristics, Classification of bacteria Gram positive Gram negative bacteria, Group of Bacteria important in food, such as acid forming bacteria Proteolytic bacteria Lipolytic bacteria Saccharolytic bacteria, Pectinolytic bacteria, Thermophillic, Thermoduric bacteria, Psychrotropic, Halophillic, Rope forming, etc. Genera of bacteria important in food and their application such as *Acetobactor, Aeromonas, Alkaligenes, Bacillus, Clostridium, Ervinia, Escherishia, Lactobacillus, micrococcus.*

UNIT-IV : Yeast, Moulds, Size, shape, Structure, important organs sexual and asexual spores. Genera of yeast and Moulds important in food Aglance at classification of yeast and mould .Genera of moulds important in food such as mucor Rhizopus Aspergillus, Penicillium Tri chothecium etc. and their application A short introduction to Algae viruses Actenomycetes, Protozoa.

UNIT-V : Cultivation of microorganisms; pure culture, isolation of pure culture, Media; type of media, composition and preparation of media, maintenance and preservation of culture, sterilization processes, staining and observation, type of staining simple differential staining gram staining spore staining. Enumeration of microorganisms various method of enumeration.

UNIT – VI : Microbiology of some important basic foods;normal microflora in milk,milk products,eggs,meat and other animal products,fruit and fruit products,vegetable and vegetable products,cereals,etc.

Microbial contamination, causes of contamination, prevention of contamination, prevention, common food borne pathogenic microorganisms.

Fermentation; definition, types; Batch, Continuous ,Aerobic and Anaerobic fermentation. Methods of microbial examination of food.

Practicals

1. Simple laboratory techniques.
2. The working and handling of microscope
3. Preparation and sterilization of nutrient media
4. The techniques of aseptic transfer of microbes
5. Isolation of bacteria by streak plate technique and other
6. Identification of microorganisms by simple staining
7. Identification of microorganisms by gram staining
8. Staining of yeast.
9. Staining of Mould.
10. Enumeration of microorganisms with serial dilution techniques
11. Enumeration of microorganisms with MPN method.
12. Microbial analysis of water.
13. Useful and harmful microorganisms in food stuff
14. Preparation of staining solution.

Books Recommended

1. Microbiology Vol.I &II by C.B. Powar and H.F.Daginawala.
2. Microbiology by M.A. Pelezar, R.D. Reid & C.S. Chan, Tata Macgraw Hill Publication Co limited, New Delhi.
3. Food Microbiology by W.C. Fraizer, Tata Macgraw Hill Publication.
4. Introduction to Microbiology by A.S. Rao
5. Food Microbiology by Adam Moss
6. Dairy Microbiology by Prohit
7. Food Microbiology by Prohit
8. Food Microbiology by Bohra Pradeep.

The distribution of marks in practical shall be as follows:

A)	Two short experiment	-	20marks (10 Each)
B)	One long experiments	-	15 marks
C)	Viva voce	-	10 marks
D)	Practical records	-	05 marks
	Total	-	50 marks

Semester-IV

4S : Food Preservation and Quality Control

Unit I : Quality factors in food; Appearance factors, Textural factors, flavor factors, other quality factors, food spoilage; Definition, causes of food spoilage, factors affecting food microbiology, major types of food microbiology, (microbiological, biochemical, physical and chemical), common spoilage in basic food stuffs**.**

Unit II : Food preservation, principal of food preservation, importance and for food preservation, methods of food preservation, food preservation by low temperature, refrigeration, freezing, freeze drying, difference between refrigeration and freezing, changes during freezing and application.

Unit III : Food preservation by high temperature, sterilization, pasteurization (HIST, LTLT, etc.), canning. Blanching, drying; advantages, changes during drying, methods of drying; sun drying, hot air drying, drum drying, spray drying, etc.

Unit IV : Preservation by irradiation; effect of irradiation, microwave heating, advantages and disadvantages. Preservation by concentration; by heating and reserve osmosis.

Preservation by chemicals:

Class I, classs II preservatives, examples in food preservation and application example salting, pickelling, smoking, acidification, addition of sugar etc.

Unit V : Food adulteration; various techniques of detection. Food laws; examples PFA, ECA (essential commodity act) FPO, MMPO (milk and milk product order), agmark, BIS, CPA (consumer protection act), food safety act, HACCP.

Unit VI : Packaging; functions of packaging, types of packaging materials; metal, glass, flexible films, single films, edible, biodegradable films, paper, board, latest trends in packaging. Classification of packages, food labeling; definitions, principle, categories, mandatory requirements in labeling; labeling laws.

Hygiene and sanitation:

Imp. and definitions, cleaning, cleaning agents, types of sanitizers, personal hygiene, pest control.

Practicals:

1. Estimation of calcium.
2. Estimation of iron.
3. Estimation of vitamin C.
4. Estimation of fats in milk.
5. To determine adulterants by physical methods.
6. To determine the food adulterants chemically in fats and oil.
7. To determine the food adulterants chemically in sugars.

8. To determine the food adulterants chemically in species.
9. To determine the food adulterants chemically in tea and coffee.
10. To determine the food adulterants chemically in milk and milk products.
11. Effect of germination on vitamin C in legumes and cereals.
12. Effect of germination on reducing sugars in legumes and cereals.

Books Recommended:

1. Microbiology Vol. I &II - C.B.Powar And H.F.Daginawala.
2. Food Microbiology - W.C.Frazier, Tata Mcgraw Hill Publication.
3. Preservation of Fruits and Vegetables - Girdharilal & Sidappa, ICAR, New Delhi, 1967.
4. Manual of Analysis of Fruits & Vegetable Products - Ranaganna S., Tata Mcgraw Hill Publishing Co. New Delhi.
5. Foods: Facts & Principles - N.Shakuntala Manay And M.Shadaksharwamy, Published - Wiley Eastern Ltd.
6. Food Science and Nutrition- Sunetra Roday Publiser, Oxfoard University Press.
7. Food Science- Sumati, R Mudmbi, 2nd Edition, New Age International Publisher.
8. Food Science- B.Shrilaxmi, 3rd Edition New Age International Publisher.
9. Laboratory Techniques in Food Analysis- D. Pearson, Pub. Butterworth's.
10. Curricula on Food Safety- Directorate General Of Health Services Ministry of Health & Family Welfare Govt. of India Nirman Bhawan New Delhi.
11. Food Storage and Food Preservation- Vijiya Khader.
12. Nutrition and Dietetics-Shubhangi Joshi. 2nd Edition.
13. Food Science -Norman Potter 5thedition.

The distribution of marks in practical shall be as follows:

A)	Two short experiment	-	20 marks (10 Each)
B)	One long experiments	-	15 marks
C)	Viva voce	-	10 marks
D)	Practical records	-	05 marks
	Total	-	50 marks

20. INDUSTRIAL MICROBIOLOGY

Semester-III

Industrial Microbiology

The examination shall comprise of two theory papers, one in each semester and one practical in each semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry 50 marks.

The following syllabus is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of semester-III (8 Marks).

3 S – Industrial Microbiology
(Industrial Fermentation, Metabolism and Bioinstrumentation)

Unit-I : Fermentation, Metabolism and Enzymology

A] a) General concept of fermentation and respiration.
b) Metabolism – definition and general strategy.
c) Metabolic pathways – (EMP, TCA, Oxidative phosphorylation and ETC)

B] Enzyme–Definition, nature, terminologies used in enzymology,classification and nomenclature of enzyme.
Enzyme active site, mechanism of enzyme action (lock and key model and induced fit model.)

Unit-II : Industrial production of ;

A] Biomass production (bacterial, fungal and yeast)
B] Biofertilizer production (bacterial, algal, mycorrhizal)
C] Microbial insecticide (bacterial, viral and fungal)

Unit-III : Industrial production of ;

A] Enzyme Amylase (bacterial and fungal)
B] Vitamins (Riboflavin)
C] Alcohol Ethanol (Molasses and waste sulphite liquor)
D] Organic acids (acetic acid, lactic acid, citric acid)
E] Amino acid (glutamic acid)
F] Beverages (Wine and Beer)

Unit-IV : Downstream processing of above fermentation products;

a) Pretreatment (cell disruption and flocculation)

b) Solid liquid separation (filtration, sedimentation, centrifugation)

c) Concentration (membranes, salt and solvent precipitation, evaporation, liquid-liquid extraction and distillation)

d) Purification (Precipitation, chromatography, adsorption and elution)

e) Formulation (drying, extrusion, granulation and tabletting) to be added.

Unit-V : Antibiotic and Vaccine Production;

a) Antibiotics (Penicillin and Streptomycin)

b) Vaccine (BCG, Salk, recombinant Hepatitis vaccine)

c) Toxoid (Diphtheria, tetanus)

d) Control, testing and standardization of vaccine.

Unit-VI : Introduction to:

a) Spectroscopy, (Beer Lambert's Law) components, working and Applications of colorimeter and UV-Visible spectrophotometers.

b) Chromatography (paper and Thin layar)

c) Electrophoresis (Paper and Gel)

d) Role of radio- active isotopes in Microbiology.

Practicals

1. Microbiological examination of raw milk by plate count test, for coliform (MPN) and Yeast and molds
2. Microbiological examination of vegetables and fruits by plate count test for coliform (MPN) and test for yeast and molds
3. Production and estimation of Alcohol (ethanol)
4. Methods for detection of food adulteration
5. Methylene blue reduction test and Phosphatase test.
6. Demonstration of Mashroom cultivation
7. Test of sterility of food products (Milk and food)
8. Estimation of Riboflavin
9. Isolation of antibiotics producing microorganisms from soil
10. Demonstration of enzyme production by microorganisms (Amylase and casinase)
11. Isolation and study of food spoilage microorganisms from sweets and bakery products
12. Organization of one study tour (short / long)

Distribution of Marks : Semester III Industrial Microbiology Practicals

1. Major experiment (any one)_____ 10
2. Minor experiment (Any two)_____ 10

3. Viva-voce_____ 10
4. Spotting_____ 10
5. Laboratory Journal_____ 05
6. Study tour report_____ 05

Total 50

List of the recommended books;

1. Lehninger's principles of Biochemistry, by Nelson, Cox (M. M. Macmillan, New York)
2. Fundamentals of Biochemistry by Donald Voct, Judit's Voet, Charlotte Oratt (john Wiley and Sons New York)
3. Text book of Biochemistry by, O. P. Agrawal,
4. Text Book of Biochemistry By, West and Todd
5. Text Book of Biochemistry by, J. L. Jain
6. Text Book of Biochemistry by, U. Samarayan

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Semester-IV
Industrial Microbiology

The examination shall comprise of two theory papers, one in each semester and one practical in each semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry 50 marks.

The following syllabus is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question on every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of semester-IV (8 Marks).

4 S – Industrial Microbiology
(Food, Dairy Microbiology and Biostatistics)

Unit I : Food Microbiology:

1. Sources of contamination of fresh food.
2. Microbial spoilage of food
3. Preservation of food materials
   a. Low and High temperature
   b. Dehydration
   c. High osmatic pressure
   d. Chemical preservatives
   e. Radiations
   f. Canning

4. Food poisoning:
   a. Food infection
   b. Food intoxication

Unit II: Milk Microbiology:

A) Definitions
B) Sources of Microorganisms in milk
C) Types of microorganisms from milk
D) Pasteurization of milk- LHT, HIT, UHT
E) Phosphatase test and its applications
F) Quality and grades of milk

Unit III: Fermented milk products:

A) a. Introduction
   b. Selection of food for manufacturing of fermented food products
B) Fermented food products:
   a. Sauerkrat
   b. Pickles
   c. Idli
   d. Bread
   e. Oriented food products

Unit IV: Fermented milk products:

A) Introduction
B) Selection of raw milk for manufacturing of fermented milk products
C) Production of Yoghurt, Dahi, Cheese
D) Cultured butter milk: Lassi, Chhach
E) Acidophilus milk products
F) Production of Kefir, Kaumiss and Leben
G) Neutritional and therapeutic values of fermented milk products
H) Defects and spoilagwes of fermented milk products
I) Tests and standereds for fermented milk products
J) Pethogens in fermented milk products

Unit V: Meat and Fishery Products:

A) Spoilage of fresh and Processed meat
B) Fermented sausage and country cured hems
C) Fish sausages
D) Microbiological quality of various sea food products
E) Preservation of meat/ Fish and Poultry products

Unit VI: Biostatistics

1. Importance and applications:
   a. Tabulation and classification of data
   b. Frequency distribution
   c. Graphical presentation of data

2. Measures of Central tendency
   a. Mean
   b. Median
   c. Mode
3. Co-relation and their linear regression:
   a. Coefficient of correlation
   b. Linear least square
   c. Fil method of regression
4. Hypothesis testing- (Chi Squire test, X^2 test, t- test)
5. Different methods of daa presentation with special reference to bioststical samples

Practicals

1. Microbiological examination of canned foods, ice cream, egg by plate count, test for coliform (MPN) yeasts and molds
2. Production and estimation of citric acid
3. Production of fermented food products, curd, idli and cheddar cheese
4. Effect of ultra violet radiation on microorganisms present in food (fermented milk, and food products)
5. Estimation of fats present in the milk
6. Hansa test for detection of adulteration of cow milk with buffalo milk
7. Isolation of polychrophillic microflora from food
8. Demonstration of microbes present in curd and lassi
9. Test of sterility of food products (Pickles, and Bakery products)
10. Immobilization of yeast cells and demonstration of invertase activity
11. Isolation of microflora from fishery products
12. Organization of one study tour (Short/Long) and submitting tour report.

Distribution of Marks : Semester III Industrial Microbiology Practicals

Major experiment (any one)_____10
Minor experiment (Any two)_____10
Viva-voce_____10
Spotting_____ 10
Laboratory Journal_____05
Study tour report_____ 05
Total_____50

List of the recommended books;

1. Fermentation technology, by Whittakar

2. Industrial Microbiology , by Casida (Wiley Eastern Ltd. Publication)
3. Industrial Microbiology by, A. H. Patel (MacMillan Publication)
4. Fundamentals of Dairy Microbiology by, J. B. Prajapati (Ekta publication)
5. Modern Food Microbiology by, James M. Joy (B. S. Publication)
6. Industrial microbiology by, B. M. Miller and W. Litsky)
7. Outline of Dairy Sacterio, Ogy by, S.U. Kumar
8. Industrial Microbiology by, Prescoot and Dunn
9. Food Microbiology by Frezier
10. Industrial Microbiology by, Rose

21. BIOTECHNOLOGY (REGULAR / VOCATIONAL)

Semester-III

Biotechnology

The examination shall comprise of two theory papers, one in each semester and one practical in each Semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry 50 marks.

The following syllabus are prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question in every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-III (8 marks).

3 S BIOTECHNOLOGY

Essential Mathematics, Biostatistics, Bioinformatics and Biophysical methods

Unit I : **Essential Maths:**

Sets: Definition, Subset. Union, intersection, Venn Diagrams, Complement of a Set, Universal Set. Use of Logarithms for simple problems (Without log tables). Binomial theorem (Without proof) – Simple Examples.

Limits of a function: Concept of limit, Limit of function at a point, Simple algebraic limits.

Derivative/ Differentiation: Derivative of simple algebraic functions. Derivatives of standard Trigometric & Logarithmic functions (without proof). Addition rules, Subtraction rules, Product rule (Treatments only).

Integration: Integration as antidifferentiation, Problems involving simple polynomial functions.

Unit II : **Introduction to statistics:**

Sampling:- Types of Sampling- Purposive sampling, Random sampling , Simple sampling & Stratified sampling.

Probability:- Random Experiment, Sample space, Event, Probability of an Event, Axioms of probability.

Unit III : **Measures of central Tendencies:**

Mean, Calculation of Mean of ungrouped & grouped data. Mode & Median of ungrouped data. Measures of deviation, Mean deviation & Standard deviation (For Ungrouped Data), Test of significance, ANOVA.

Unit IV : **General Biophysical methods:**

Acids and Bases, Ionization of strong acids and bases, pH and pOH, Buffers, pH changes in buffers, Buffer capacity, Blood buffers, Henderson – Hasselbalch Equation.

Radioactivity - Nucleus. Properties. Nuclear forces. Nuclear models (liquid drop and shell model). Radioactive nucleus. Nuclear radiations and their properties - alpha, beta and gamma. Half life-physical and biological. Role of Radioactivity in Biology.

Unit V : **Thermodynamics as applied to biological systems**

Laws of thermodynamics**,** Enthalpy. Entropy. Free energy. Gibb's free energy (G). Helmholtz free energy (A). Chemical potential. Half cell potential. Redox potential. General idea about structure and bioenergetics of mitochondria and chloroplast.

Unit VI : **Bioinformatics- Introduction**

Historical overview and definition, goal, scope, bioinformatics applications, limitations, major databases in bioinformatics, Information retrieval from databases, tools for web search, Primary, secondary, composite databases and structural databases..

Practicals:

1. Validation of Beer Lambert Law
2. Determination of absorption maxima of protein.
3. Determination of absorption maxima of DNA.
4. Determination of action spectra of chlorophyll.
5. Determination of least count for ocular micrometer.
6. Determination of size of microscopic cells/ organisms using ocular micrometer.

7. Analyze the height of the plants inoculated with growth promoting microbes to determine mean height, standard deviation and standard error.
8. Practical based on Chi-square and t- test.
9. Demonstration of Hill's reaction.
10. Retrieval of information from NCBI
11. Retrieval of information from EBI
12. Retrieval of structure file from PDB
13. Preparation of buffers using pH meter
14. Preparation of buffer using Henderson – Hasselbalch equation.

Distribution of Marks for IIIrd Semester Biotechnology practical examination

1.	Major experiment	-	12 Marks
2.	Minor experiment	-	08 Marks
3.	Viva-Voce	-	10 Marks
4.	Spotting	-	10 Marks
5.	Practical record	-	05 Marks
6.	Study tour / Visit	-	05 Marks
			TOTAL 50 Marks

REFERENCE BOOKS:

1. Fundamentals of Mathematical Statistics-S.C. Gupta and V.K.Kapoor. S. Chand & Co.
2. Discrete Mathematics - B.S. Verma, Vishwa Prakashan.
3. Statistics for Biologists- Campbell R.C. Cambridge University Press, Cambridge.
4. Practical Statistics for Experimental Biologists- Ward Law A.C.
5. Statistical Methods in Biology- Baily N.T.J, English University Press.
6. An Introduction to Biostatistics- P.S.S. Sunderrao & J. Richards, Prentice Hall Pvt. Ltd. India.
7. Biophysics - Cotrell (Eastern Economy Edition)
8. Clinical Biophysics –Principles and Techniques- P. Narayanan (Bhalani Pub.Mumbai)
9. Biophysics – Pattabhi and Gautham (Narosa Publishing House)
10. Instrumentation measurements and analysis – Nakara, Choudhari (Tata McGraw Hill)
11. Handbook of analytical instruments – R.S. Khandpur (Tata Mc Graw Hill)

12. Biophysical Chemistry- Upadhyay, Upadhyay and Nath – (Himalaya Pub. House, Delhi).
13. Methods in Biostatistics- B K Mahajan. Jaypee Brothers, New Delhi.
14. Basic Biostatistics and its application- A K Datta. New Central Book Agency (P) Ltd, Kolkata.
15 Elements of Biostatistics – S Prasad. Rastogi Publications, Meerut.
16. Biophysics- G R Chatwal. Himalaya Publishing House.
17. Biophysics – Mohan P Arora. Himalaya Publishing House.
18. Bioinformatics A Beginner's Guide WILEY INDIA PVT LTD
19. Bioinformatics Basics: Applications in Biological Science and Medicine, Second Edition. Robert R. Ruffolo. TAYLOR & FRANCIS GROUP
20. Biochemical Calculations. I H Segel. John Wiley & Sons

Semester-IV
Biotechnology

The examination shall comprise of two theory papers, one in each semester and one practical in each Semester. Each theory paper will be of 3 hours duration and carry 80 marks. The internal assessment will carry 20 marks. The practical examination will be of at least 4 hours duration in one day and shall carry 50 marks.

The following syllabi are prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper has been divided into 6 units. There shall be one question in every unit with internal choice for each of 12 marks & one compulsory question covering all the syllabus of Semester-IV (8 marks).

4 S BIOTECHNOLOGY
GENETIC ENGINEERING AND MICROBIAL BIOTECHNOLOGY

Unit-I : **Molecular basis of life**:
Structure of DNA.
Replication of DNA in prokaryotes and eukaryotes.
DNA damage and repair mechanisms.
Homologous (Holiday model) and non-homologous (site-specific) recombination (transposons).
Genetic code.

Unit-II : **Protein synthesis:**
Transcription and Translation process in prokaryotes and eukaryotes.
RNA processing in eukaryotes.
Post- translational modification of proteins.

Regulation of gene expression in prokaryotes (lac operon) and eukaryotes.

Unit-III : Gene cloning:

Isolation of genomic and plasmid DNA.
DNA manipulating enzymes.
Cloning vectors:- Plasmids, bacteriophages, cosmids and phagemids.
Southern blotting and colony hybridization.
PCR.
Gene library.

Unit-IV : Microbial Biotechnology I- Medicine:

Interferon.
Insulin.
Recombinant vaccines.
Dextran.
Amino acids.
Pharmaceutically important recombinant products – (Growth harmone, erythropoietin)

Unit-V : Microbial Biotechnology II- Industry:

Batch and continuous fermentation.
Types of bioreactors(CSTR, Fluidized bed reactor, UASB).
Alcohol fermentation.
Penicillin fermentation.
Gluconic acid fermentation.
Citric acid fermentation.
Amylase fermentation.

Unit-VI : Microbial Biotechnology III- Environment:

Energy from Biomass (Biogas and Biodiesel)
Microbial Pesticides and Biofertilizers.
Microbial Bioremediation.
Bioleaching.
Biodegradation of xenobiotic compounds.
Water Treatment – Aerobic and Anaerobic

Practicals.

1) Agarose gel electrophoresis of nucleic acid.
2) Isolation of Genomic DNA.
3) To check purity of DNA
4) Plasmid isolation – Mini preparation.
5) DNA ligation
6) Competant cell preparation
7) Transformation.
8) Restriction enzyme and restriction digestion of plasmid DNA.
9) Laboratory scale production and estimation of ethyl alcohol.

10) Laboratory scale production and estimation of amylase.
11) Laboratory scale production and estimation of citric acid.
12) Isolation of *Azotobacter*.
13) Isolation of Phosphate solubilizing bacteria.
14) Determination of Chemical oxygen demand (COD).
15) Determination of Biological oxygen demand (BOD) .

Distribution of marks for IV Semester Biotechnology practical examination

1.	Major experiment	-	12 Marks
2.	Minor experiment	-	08 Marks
3.	Viva-Voce	-	10 Marks
4.	Spotting	-	10 Marks
5.	Practical record	-	05 Marks
6.	Study tour / Visit	-	05 Marks

	TOTAL		50 Marks

Books Recommended For SEM- IV:-

1. Recombinant DNA:-James. D. Watson, John. Tooze, David.Kutz
2 Introduction to Genetic Engineering: - Nicholas
3. General Microbiology. Vol 1& II. : - Powar & Daginawala
6 Molecular Biology of the Cell: - J. D. Watson, D. Bray
7 The DNA Story: - J. D. Watson
8 Genes: - Pramod Kumar
10. Genetic Engineering and its Applications -Joshi P.
11 Gene Transfer and Expreesion a Laboratory Manual: - Michael Kriegler
12 Concept in Biotechnology: - D. Balasubramanium
13 Molecular Cloning.- A Laboratory Manual, J. Sambrook, E.F Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York
14. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York, 1988
15. Molecular Biology LabFax, TA. Brown (Ed.), Bios Scientific Publishers Ltd., Oxford, 1991
16. Molecular Cell Biology (5^{th} Edition) J. Darnell, H. Lodish and D. Baltimore, Scientific American Books, Inc., USA,
17. Gene VI (Xth Edition) Benjamin Lewin, Oxford University Press, U.K.
18. Molecular Biology and Biotechnology. A comprehensive desk reference, R.A. Meyers (Ed.) VCH Publishers, Inc., New York, 1995
19. Genomes, TS. Brown

20. Environmental Biotechnology. S. V. S. Rana, Rastogi Publications Meerut.
21. Industrial Microbiology by A. H. Patel
22. Industrial Microbiology by Casida.
23. Biotechnology by U. Satyanarayana.

22. BIOINFORMATICS

3S Bioinformatics
(Fundamentals of Bioinformatics)

Unit I : Water as a biological solvent, Structure of water and polarity, Concept of osmolarity, ionization of water, weak acids and bases, Terminologies like, pH, Buffer solution, Morality, Normality, Normality, equivalent weight and their function in cell.

Unit II : Carbohydrates, Definition and classification of carbohydrates, structure, occurrence, and biological importance of Monosaccharide, disaccharides, oligosaccharides, polysaccharides, and Mucopolysaccharides. Proteoglycanns and glycoprotein.

Unit III : Lipids and fatty acids, Classification, nomenclature , structures and properties of saturated and unsaturated fatty acid, Simple and Compound lipids, Triglycerides, glycerophospholipids, Glycolipids, Isoprenoids, and Steroids, Biological functions of lipids.

Unit IV : Proteins, Introduction, Structure, Basic Building Blocks of Proteins, Protein structure, Primary, Secondary, tertiary and Quaternary structures. Denaturation and renaturation of proteins, Biological function of proteins.

Unit V : Enzymes, General characters and properties of enzymes, Nomenculature of enzymes, Holoenzymes, apoenzymes, active sites of enzymes, isoenzymes, Mechanism of enzymes action, factors affecting rate of enzyme catalized reaction, Enzyme kinetics. Km value.

Unit VI : Metabolism, Definition, Bioenergetics, ATP, structure and biological role, EMP pathway, TCA cycle, Beta hydrolysis, Lipid Biosynthesis, Protein synthesis.

Practicals : 3S Bioinformatics

Section I: Qualitative test and Biochemical Preparations

1. Qualitative analysis of Carbohydrates
2. Qualitative tests for proteins, lipids and aminoacis
3. Preparation of buffers of different pH.

4. Measurenet of pH of given sample by universal indicator solutions, ph strip and Ph meter.

Section II: Quantitative analysis

1. Paper chromatography of amino acids.
2. Paper chromatography of Sugars .
3. TLC
4. Estimation of glucose by Benedict's method
5. Estimation of glycine
6. Saponification value of oils.
7. Estimation of proteins by Biurate method.

Distribution of Marks for Practicl Examination:

Time: 6 Hours Marks 50

1. Section I (Practical experiment)_____15
2. Section II (Practical Experimnt)_____ 15
3. Viva Voce_____10
4. Practical Record_____ 10

4S Bioinformatics
(Fundamentals of Molecular Biology and immune System)

Unit I : Structure of DNA, forms of DNA-A,B,C,D and Z DNA. Secondary structure of RNA, Replication in prokaryotes and Eukaryotes. Structural organization of Eukaryotic and Prokaryotic genomes. Organelle genome organization and Transposable genetic elements.

Unit II : Fundamentals of Structural, Comparative and Functional Genomics and its applications. Genome sequencing methods. Introduction to Genome analysis. Structural organization of Eukaryotic and Prokaryotic genes. Regulation of gene expression in Eukaryotes and Prokaryotes.

Unit III : Process of Translation in Eukaryotes and Prokaryotes: Translational factors, Initiation, Elongation and Termination. Regulation of translation in Eukaryotes and Prokaryotes. Structure of Eukaryotic and Prokaryotic Ribosomes.

Unit IV : Organs and cells of immune System and their function. Various types of Antibodies, their structure and function. Antigen Antibody Reaction. Antigen, Hapten.

Unit V : Humoral and Cell mediated immunity, MHC and immunity to infectious dieses, Vaccins, Lymphocytes trafficking, T-lymphocytes, B-lymphocytes, Macrophages, Dendritic cells, natural killers,

Lymphokines, Activated killer cells, Eosinophiles, Nuetrophiles and mast Cells.

Unit VI : Molecular Basis of immunity: Theories of Antigen-Antibody reactions. T Lymphatic and B Lymphatic responses. Different Classes of immunoglobulins and their differentiation. Interferons and Interleukins and its applications.

Practicals : 4S Bioinformatics

Section I: Molecular Biology

1. Isolation of plant DNA by CETAB Method.
2. Isolation of organism DNA by Modified CETAB method.
3. Isolation of Chloroplast.
4. Isolation of Mitochondria.
5. Amplification of DNA by RAPD method.
6. Introduction to Instrumentations: Laminar Air Flow, PCR, Gel Documentation System, Hi-speed centrifuges, Bench top Centrifuges, UV-Spectrophotometer.
7. Separation of Proteins by using SDS-PAGE.
8. Preparation of different percent of Agarose Gel.
9. Isolation of RNA.
10. Quantification of RNA and DNA by UV-Spectrophotometer.

Section II: Quantitative analysis

1. ELISA- test
2. Test for *Salmonella* strain by using Widal Kit.
3. VDRL- test.
4. Identification of Blood Groups.
5. Identification of RH factor.
6. To perform Antibiotic sensitivity test by Multiple disc method.

Distribution of Marks for Practicl Examination:

Time: 6 Hours Marks 50
SectionI (Practical experiment)_____15
Section II (Practical Experiment)_____15
Viva Voce_____ 10
Practical Record_____ _____10

23. APPICULTURE
3S APICULTURE
Paper III (Entomology & Bee Pathology)

Unit – I :
a) Bees, Insects – harmful & beneficial, man has hunter & beekeeper, bees relation to human culture.

b) Insects & Classification- Classification of hymenoptera, position of bee in hymenoptera solitary & social bees, progressing evolution of social organization among related bees.

Unit – II :
a) Genera of bees, honeybees, geographical distribution, nesting behavior, castes & division of labor, general organization of Trigona.
b) Apis species, Identification of A. florae, A. dorsata , A. cerena, & A. mellifera. Sub spicies, varieties & races. Comparative morphology of Apis species, & individual castes in Apis species.
c) Head & Abdomen, wax glands, sting apparatus, scent gland.

Unit – III :
a) Comparative anatomy, digestive system, circulatory system, respiratory system, nervous system, excretory system, reproductive system and sense organs.
b) Mating fertilization, metamorphosis in different castes, physiology of bees , digestion circulation, excretion, respiration & reproduction.

Unit – IV :
a) Signification of Temperatures, humidity & ventilation of hive.
b) Bee behaviors, Orientation, communication, bee dances, conditioned reflexes Behavioral relation to individual castes egg laying , nursing, foraging , guarding seating, robbing & frightening .

Unit- V : Bee pathology
a) General classification of bee diseases, diagnostic symptoms. Toxic effects and lethal effects of poisonous pollen, nectar, insecticides & chemicals
b) Pathogenic infection – Viral, bacterial, fungal, protozoan & various diseases by endoparasites. & ectoparasites.

Unit – VI : Bee pathology
a) Predator, enemies of bees- wasps, robber fly, and dragon fly, mites. spider, pseudo scorpion, bee louse, wasp moth, frogs, lizard, birds and monkey.
b) General methods of diagnostic preventing, curative measures. Breeding methods for evaluating bee strains, apiary sanitation, control on introduction & migration of stock quarantine measures.

BSc. II. Semester-III Lists of Practical.

1. Identification of species of Apis and Trigona with caste differentiation.
2. Species of honey bees including Trigona
3. Comparative external morphology of different parts of body,
   a. parts of head, (Worker, drone, queen)
   b. Mounting of antenna, mandibles, compound eye, ocelli, labrum, proboscis
   c. Structure of Thorax, division of thorax, wing structure, legs structure. Petiole, Structure of Abdomen.
   d. Mounting of typical tergum, typical sternum, wax glands, wax mirrors, scent gland, male and female genitalia, mounting of sting.
4. Internal anatomy;
   a. Hypo pharynx with glands, salivary glands.
   b. Digestive system adult detailed structure oesophagus, honey stomach typical movement by of honey stomach, ventriculus, and proctodaeum.
   c. Circulatory system : Haemocoel and heart,
   d. respiratory system, mounting tracheas, types of spriracles air sacs
   e. reproductive system, male complete system. Structure of sperms mounting of sperm. Female complete system, queen ovaries, ova
   f. Nervous system; entire system in adult, sense organs on antennae, .
5. Methods of microscope diagnosis, structure of first spriate.
6. Nosema symptoms, microscopic diagnosis structure of spores
7. Microscope examinations of EFB bacteria
8. Fungal disease Chalk brood stone brood
9. Viral disease of larva and adults sac brood
10. Bee pest and predators: birds, snakes, lizards frogs, spiders predator wasps ants robber flies, mantids, different type external pests-*Verora jacobsoni, Tropiaelaps clareae, Acarapis wooki*, and Neocypholaelaps.
11. Wasps nest identification of species control; wasps. Wasps. Wax moth life history P.D.B.*Bacillus thuragieenis*.

Field Visit :- (One visit atleast within the state and One visit atleast outside the state.)

i) Visit to Apiary
ii) Visit to leading institutions.

Practical-III :

The distribution of marks for practical examination shall be as follows :-

1.	Spotting.(1-10)	15
2.	Major Dissection (Different organ systems)	12
3.	Minor Dissection (Air sacs, heart, sense organs, sting, wax and scent gland)	08
4.	Permanent stained mounting.	05
5.	Viva-voce.	05
6.	Practical Record	05
	TOTAL :	50

4 S APICULTURE
(BEE CHEMISTRY)

Unit –I : Fundamentals of honey.

Introduction to bee chemistry major chemical constituents of bees & bee products. Raw material - nectar, composition of nectar, conversation of nectar into honey, unripened (Immature) & ripened (Mature) honey.

Unit – II : Properties and types of honey

a) Physico-chemical & Biochemical characteristics of honey, composition and variations in it due to different factors.
b) Different types of honey - extra floral honey, apiary honey, unifloral, multifloral honey & extra floral honey ,honey dew, squeezed honey.

UNIT- III: Properties and quality standards of honey.

a) Natural properties of honey, hygroscopic & thixotropy, granulation, fermentation, antibacterial activity.
b) Quality standards of honey, Specifications of honey as per Agmark / BIS / PFA. Factors affecting to the quality of honey, comparison with world standards.

UNIT –IV: Processing of honey and bee wax.

a) Handling and processing of honey. Diversification of honey products - domestic & industrial applications.
b) Bees wax, secretion of wax, composition of wax, wax from A. florae, Apis cerana, A. dorsata & A. mellifera. Excretion of bees wax, processing & bleaching of bees wax, quality of bee wax, BIS specifications, bee wax in industrial applications.

UNIT- V : Bee pollen and bee venom.

a) Bee collected pollen, composition of bee pollen, industrial use of bee pollen, collection of pollen by pollen trap.
b) Bee venom, principle of secretion of venom, composition of bee venom, collection of venom from bee colonies, preparation of bee venom, application of bee venom in medical field.

Unit – VI : Royal jelly and propolis.

a) Royal jelly - origin of royal jelly, composition of royal jelly, royal jelly in industrial products, collections of royal jelly, preservation of royal jelly.
b) Propolis - properties & uses of propolis.

BSc, II. Semester-IV. List of Practical.IV

1. Collection of nectar.
2. Nectar concentration by sugar refractrometer
3. Concentration from sealed and unsealed comb of different species.
4. Use of honey testing kit.
5. Analysis of honey as specification of Agmark/BIS and practical with honey testing kit.
6. To distinguish apiary and squeezed honey, capital density, pollen counts.
7. Analysis of bee wax,
   a. Melting point. b. saponification value, c. acid value
   d. Easter value, e. Iodine value, f. Easter/Ash % total volatiles % Aroma, colour.
8. Demonstration of honey processing unit.
9. Demonstration of bee wax extraction Unit.
10. To determine Composition of bee pollens.
11. Collection of pollen by pollen traps.
12. To determine Composition of Royal Jelly
13. Collection and preservation of Royal Jelly.

Field Visit :- (One visit atleast within the state and One visit atleast outside the state.)

i) Visit to Apiary
ii) Visit to leading institutions.

Practical-III :

The distribution of marks for practical examination shall be as follows :-

1.	Spotting.(1-05)	10
2.	Physico-chemical analysis of honey.	10
3.	Analysis of bee Wax.	15
4.	Comments on honey bee products. (Any one)	05

5.	Viva-voce	05
6.	Practical Record	05
	TOTAL	50

List of Reference Books for the subject Apiculture (Semester III & IV) :-

1. First Lession in Beekeeping : Dadant C.D. Malilton, Illinois.
2. Honey A Comprehensive survey pub-Heinemann(London) & International Bee Research Association England.
3. Value added products for Beekeeping Food & Agriculture - Organisation United Nation Bulletin No.124.
4. Studies in Chemistry of Indian Honeys & Bee Waxes. Thesis for M.Sc. degree submitted to Botany Uni. - Phadke R.E.
5. Investigation of Indian Honey bee Product -
6. Beekeeping in Integrated Mountain Development - Economics & Scientific perspective Publication.
7. Beekeeping- Teach yourself Books,By-Vernon F.(1984)
8. The Chemistry and Technology of Waxes, Reinhold publication Corpn. N.Y.
9. A.B.C.& X.Y.Z of Bee Culture 39 edition - A.Y.Root & Co. America.
10. The hive & the Honey Bee- 1975, 4th edition Dadant Publication, America.
11. Bees their vision, chemical senses & language-1950, Cornel University Press- By Fon firsh, & Karl.
12. Honey bee Biology 1982- By Free Johnson & Central Association of Bee Keepers England.
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24. ENVIRONMENTAL STUDIES

Total Marks : 100

PART-A
SHORT ANSWER PATTERN 25 Marks

1. The Multidisciplinary nature of environmental studies

. Definition, scope and importance.
. Need for public awareness. (2 lecture hours)

2. Social Issues and the Environment

. From Unsustainable to Sustainable development
. Urban problems related to energy

. Water conservation, rain water harvesting, watershed management
. Resettlement and rehabilitation of people; its problems and concerns.
Case studies.
. Envionmental ethics : Issues and possible solutions.
. Climate change, global warming, acid rain, ozone layer depletion, nuclear
accidents and holocaust. Case studies.
. Wasteland reclamation.
. Consumerism and waste products.
. Environment Protection Act.
. Air (Prevention and Control of Pollution) Act.
. Water (Prevention and Control of Pollution) Act.
. Wildlife Protection Act.
. Forest Conservation Act.
. Issues involved in enforcement of environmental lesislation.
. Public awareness. (7 lecture hours)

3. Human Population and the Environment

. Population growth, variation among nations.
. Population explosion - Family Welfare Programme.
. Environment and human health.
. Human Rights.
. Value Education.
. HIV / AIDS.
. Women and Child Welfare.
. Role of Information Technology in Environment and human health.
. Case Studies. (6 lecture hours)

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PART-B
ESSAY TYPE WITH INBUILT CHOICE 50 Marks

4. Natural resources :

. **Renewable and non-renewable resources :**

. Natural resources and associated problems.

- Forest resources : Use and over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture,

fertilizer - pesticide problems, water logging, salinity, case studies.

- Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, Case studies.
- Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

. Role of an individual in conservation of natural resources.

. Equitable use of resources for sustainable lifestyles.

(8 lecture hours)

5. Ecosystems

. Concept of an ecosystem.

. Structure and function of an ecosystem.

. Producers, consumers and decomposers.

. Energy flow in the ecosystem.

. Ecological succession.

. Food chains, food webs and ecological pyramids.

. Introduction, types, characteristic features, structure and function of the following ecosystem :-

- Forest ecosystem
- Grassland ecosystem
- Desert ecosystem
- Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lecture hours)

6. Biodiversity and its conservation

. Introduction - Definition : genetic, species and ecosystem diversity.

. Biogeographical classification of India.

. Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.

. Biodiversity at global, National and local levels.

. India as a mega-diversity nation.

. Hot-spots of biodiversity.

. Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.

. Endangered and endemic species of India.

. Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity. (8 lecture hours)

7. Environmental Pollution

. Definition

. Causes, effects and control measures of :-

- Air pollution
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution

- Thermal pollution
- Nuclear hazards

. Solid Waste Management : Causes, effects and control measures of

. Role of an individual in prevention of pollution.

. Pollution case studies.

. Diaster management : floods, earthquake, cyclone and landslides.

(8 lecture hours)

PART-C

ESSAY ON FIELD WORK

25 Marks

8. Field work

. Visit to a local area to document environmental assets - river / forest / grass land / hill / mountain

. Visit to a local polluted site - Urban / Rural / Industrial / Agricultural

. Study of common plants, insects, birds.

. Study of simple ecosystems - pond, river, hill slopes, etc.

(5 lecture hours)

(**Notes :**

i) Contents of the syllabys mentioned under paras 1 to 8 shall be for teaching for the examination based on Annual Pattern.

ii) Contents of the syllabys mentioned under paras 1 to 4 shall be for teaching to the Semester commencing first, and

iii) Contents of the syllabys mentioned under paras 5 to 8 shall be for teaching to the Semester commencing later.

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(M) Magazine

(R) Reference

(TB) Textbook

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