Prospectus No. 2015122

B.Sc. Part-II (2014-15) (Semester-III & IV)

SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान स्नातक भाग-2
सत्र-3 व 4, परीक्षा

PROSPECTUS
OF
B.Sc. Part-II
Semester-III Examination Winter-2014, and
Semester-IV Examination Summer-2015

2014
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(Prospectus No.2015122)

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EXAMINATION IN ENVIRONMENTAL STUDIES LEADING TO BACHELOR DEGREE, ORDINANCE, 2005

Whereas it is expedient to frame an Ordinance relating to Examination in Environmental Studies leading to Bachelor Degree level, hereinafter appearing, the Management Council is hereby pleased to make the following Ordinance.

1. This Ordinance may be called "Examination in Environmental Studies leading to Bachelor Degree, Ordinance, 2005.".

2. This Ordinance shall come into force from the Academic session 2005-06.

3. In this Ordinance and in other ordinances relating to the examination, unless there is anything repugnant in the subject or context :-
   (i) "Academic session" means a session commencing on such date and ending with such date of the year following as may be appointed by the Management Council.
   (ii) "Admission to an examination" means the issuance of an admission card to a candidate in token of his having complied with all the conditions laid down in the relevant ordinance, by a competent officer of the University.
   (iii) "Applicant" means a person who has submitted an application to the University in the form prescribed for admission to an examination.
   (iv) "Candidate" means a person who has been admitted to an examination by the University.
   (v) "Regular Candidate" means an applicant who has applied for admission to a University examination through an affiliated college, Department or Institute in which he/she has been prosecuting a regular course of study.
   (vi) "Examinee" means a person who present himself/herself for an examination to which he/she has been admitted.
   (vii) "Examination" means an examination prescribed by the University under the relevant Ordinance.
   (viii) "External Candidate" means a candidate who is allowed to take a University examination in accordance with the provision of Original Ordinance No. 151.

4. Save as otherwise specifically provided, the conditions prescribed for admission to the examination under this Ordinance shall apply to all persons who wish to take the examination to the Degrees of the University mentioned in para 5 below.

5. The conditions prescribed for admission to examination under this Ordinance shall apply to following degrees of the University :-
   1) Bachelor of Arts
   2) Bachelor of Performing Arts
   3) Bachelor of Fine Arts
   4) Bachelor of Mass Communication
   5) Bachelor of Social Work
   6) Bachelor of Commerce
   7) Bachelor of Business Administration
   8) Bachelor of Science
   9) Bachelor of Computer Science
   10) Bachelor of Computer Applications
   11) Bachelor of Pharmacy
   12) Bachelor of Science (Home Science)
   13) Bachelor of Technology (Cosmetics)
   14) Bachelor of Engineering
   15) Bachelor of Engineering (Part Time) (Civil)
   16) Bachelor of Textile
   17) Bachelor of Technology (Chemical Technology)
   18) Bachelor of Technology (Chemical Engg.)

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% Amended by ordinance No. 7 of 2006 and 10 of 2007.

% ORDINANCE NO. 42 OF 2005
19) Bachelor of Architecture, and  
20) Bachelor of Laws (Five Year Course)  

6) Environmental Studies shall be a compulsory subject for a previous year examination of the following Bachelor Degrees of the University,  
   1) Bachelor of Arts  
   2) Bachelor of Performing Arts  
   3) Bachelor of Fine Arts  
   4) Bachelor of Mass Communication  
   5) Bachelor of Social Work  
   6) Bachelor of Commerce  
   7) Bachelor of Business Administration  
   8) Bachelor of Science  
   9) Bachelor of Computer Science  
  10) Bachelor of Computer Applications  
     11) Bachelor of Pharmacy  
  12) Bachelor of Science (Home Science)  
     13) Bachelor of Technology (Chemicals)  
     14) Bachelor of Technology (Part Time) (Civil)  

ii) Environmental Studies shall be a compulsory subject for IIIrd & IVth Semester of the following Bachelor Degrees of the University,  
   1) Bachelor of Engineering  
   2) Bachelor of Textile  
   3) Bachelor of Technology (Chemical Technology)  
   4) Bachelor of Technology (Chemical Engineering)  
   5) Bachelor of Architecture, and  

iii) Environmental Studies shall be a compulsory subject for Vth & VIth Semester of the Degree of Bachelor of Laws (Five Year Course)  

iv) Students admitted to Second Year/Third Year/IVth Semester Vth Semester of various degree examination courses in different faculties in the academic session 2005-06 or thereafter shall have  

The main Examination leading to Environmental Studies shall be held in Summer and Supplementary examination in Winter every year, at such places and on such date as may be appointed by the Board of Examinations.  

Explanation: Examination shall be conducted on the basis of one common question paper for all Bachelor Degree examination courses irrespective of annual or semester pattern.  

Scope of the subject for annual pattern examination and or semester pattern examination shall be as provided under the syllabus.  

Common question paper for all courses covered under this Ordinance along with answer books shall be supplied by the University to the Colleges, Departments and Institutes for conducting the examination of the subject.  

Valuation of the answer books relating to this subject shall be done at College/Department/Institution level only. Remuneration for valuation of answer books shall not be paid by the University. Provided that prescribed evaluation fee for evaluation of each answer Book/s of an external examinee/s appeared from the examination centre shall be paid to each examination centre.  

It shall be obligatory on the part of the College/Department/Institute to submit candidate wise following information to the University on or before the date as may be prescribed by the University: -  

<table>
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<tr>
<th>Sr. No.</th>
<th>Grade/Category</th>
<th>Marks secured</th>
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<tbody>
<tr>
<td>1.</td>
<td>A</td>
<td>- 60 and above</td>
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<td>5.</td>
<td>Fail</td>
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<td>6.</td>
<td>Absent</td>
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12. For the purposes of teaching, learning and examination, the Committee consisting of three teachers shall be appointed by the Principal/Head of the Department/Head of the Institution under his/her Chairmanship/Chairpersonship. While appointing three teachers on the said committee, the Principal shall take care that the teachers to be appointed on the committee, if necessary, shall be from different faculty.

13. i) Duration of theory examination of this subject shall be three hour.
   ii) For all Bachelor Degree examinations, common question paper of 100 marks shall be provided by the University.
   iii) Distribution of these 100 marks shall be as follows :-
       a) Part-A, Short Answer Pattern - 25 Marks
       b) Part-B, Essay type with inbuilt choice - 50 Marks
       c) Part-C, Essay on Field Work - 25 Marks

14. Medium of instruction shall be English or Marathi or Hindi. Question paper shall be supplied in English and Marathi and Hindi. A candidate shall have option to write answers in English or Marathi or Hindi.

15. Examination for the subject Environmental Studies shall be compulsory for external candidates appearing as a fresh candidate at Winter and/or Summer examination.

16. For teaching of the subject, there shall be atleast two hour per week. For teaching the subject to the regular candidates, a full time approved teacher of the University and or a person having Postgraduate Degree in any faculty with second class shall be considered eligible.

17. For teaching of the subject, additional fee to be charged to regular candidate shall be as prescribed by the University.

18. Every College/University Teaching Department shall Charge additional fee of Rs. 100/- to every student of the subject Environmental Studies. Out of this Rs.100/-, the College/University Teaching Department shall have to pay Rs.25/- to the University as an examination fee of each candidate for the subject Environmental Studies.

19. The Grade secured by an examinee in the examination of this subject shall not be considered for providing the facility of A.T.K.T. in next higher class.

20. The provisions of Ordinance No. 18/2001 shall not be applicable for securing a grade or higher grade in the examination of this subject.

21. Result of the Final Year of the respective Degree shall not be declared of an examinee unless he/she secures any one of the grade in the examination of subject.
Provided an examinee admitted to Five Year LL.B. course desiring not to continue his/her education beyond Sixth Semester of the said course shall have to secure any one of the grade in the examination of the subject otherwise his/her result of Sixth Semester for awarding B.A. degree shall not be declared.

22. Certificates shall be issued, to the successful examinees in the subject Environmental Studies, after the examination.
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.
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.
9) N. Piskunov : Differential and Integral Calculus, Peace publishers,
Moscow.
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.

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,
variation 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,
4) D. A. Murray : Introductory course on Differential Equations.
Orient Longman (India), 1967.
6) A. R. Forsyth : A Treatise on Differential Equations, Macmillan
and Co. Ltd., London.
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
New Delhi.
14) Raisinghaniya M.D. : Ordinary and Partial Differential Equations,
S.Chand and Co., New Delhi.

**4S-Mathematics – Paper-VII**

(Laplace Transforms and Fourier Series)

**Unit I** : Laplace transform. Linearity of Laplace transform. Existence
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 piecewise 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-

**Reference Books :**

1) T. M. Karade : Lectures on Differential Equations, Sonu-Nilu
Publication, Nagpur.
2) Erwin Kreyszig : Advanced Engineering Mathematics, John Wiley
3) A. R. Forsyth : A Treatise on Differential Equations, Macmillan
and Co. Ltd., London.
5) B. Courant and D. Hilbert : Methods of Mathematical Physics,
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 and 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:

2. PHYSICS
3S PHY

Unit I: Mathematical background and Electrostatics (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)

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)

Unit VI: Atmosphere and Geophysics (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

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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**

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<th>Sr. No.</th>
<th>Name of the student</th>
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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**

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</table>

Signature of the teacher incharge

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 a subtractor
17. Study of OP AMP as a differentiator
18. Study of OP AMP as an integrator
19. To determine characteristics of Phototransistor
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 ā A. Mottershead (PHI)
3. Integrated Electronics ā J.Millman ; C.Halkias (TMH)
4. Electronics Devices & circuits ā Sanjeev Gupta (Dhanpat Rai Pub.)
7. Electromagnetic theory and holography ā satya parakash
8. A text book of geology ā G.B. mahapatra
9. Engineering and general geology ā parbin singh.
11. Relativity ā Goyal and Gupta
13. Elements of Special theory of relativity ā S.P.Singh and M.K.Bagde

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)

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 ā Solar energy, Wind energy, ocean energy- Waves & tides, geothermal energy, Hybrid Systems, Hydrogen energy systems, Fuel cells.

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:

<table>
<thead>
<tr>
<th>Date</th>
<th>Sr. No.</th>
<th>Name of the student</th>
<th>Expt 1</th>
<th>Expt 2</th>
<th>Expt 3</th>
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</table>

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 performed:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of the student</th>
<th>Expt 1</th>
<th>Expt 2</th>
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Signature of the teacher incharge

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. Polarpots of solarpanel
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.

REFERENCE BOOKS:
1. Laser and non-linear optics ï B B Laud.
2. Optoelectronics and fiber optics communication ï C.K Sarkar, D.C. Sarkar.
3. An introduction to fiber optics ï R. Allen Shotwell
4. Optics ï Ajoy Ghatak.
5. Optical fiber Communication ï John M. Senior
6. Principles of optics ï B.K. Mathur
7. Optics and laser ï V.K. Sewane
8. Optics and atomic physics ï D.P. Khandelwal.

3. Chemistry
3S Chemistry
(Effective from session 2014-15)

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 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).

B.Sc. Part- II (Semester- III)
3S Chemistry

Total Lectures: 84
Marks: 80
Note: Figures to the right hand side indicate number of lectures.

Unit I

A) Covalent Bonding:
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 He₂, H₂, N₂ and O₂. Stability sequence of species of O₂ i.e. O₂⁺, O₂⁻, O₂²⁺, O₂²⁻ and O₂³⁻. Paramagnetic nature of O₂. MO structure of heteronuclear diatomic molecules viz. NO, HF and CO (Coulson 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- BeCl₂, BF₃, CH₃, NH₃, PCl₃, SF₆, IF₇, SnCl₂, NH₄, H₂O, SF₅Cl, BrF₅, XeF₆, SOF₃, COF₂, PCl₅). 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 numerals 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 KMnO₄, K₂Cr₂O₇ as oxidants in acidic medium in redox titrations. Use of I₂ 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:

Unit III 14L
A] Aldehydes and Ketones:
Preparation of acetaldehyde from ethanol, ethylidene chloride and acetylene. Preparation of benzaldehyde from benzene (Gattermann-Koch reaction) and toluene. Preparation of acetone from isopropyl alcohol, isopropylidene chloride and propyne. Preparation of acetylacetone from benzene and ethyl benzene. Structure of carbonyl group, acidity of á-hydrogen in carbonyl compounds. Reactions of aldehydes & ketones: Cannizaro, Reformatsky, Perkin with mechanism, Mannich reaction, Benzoim and Aldol condensations. Clemmensen, Wolf-Kishner, MPV and LiAlH₄ reductions. [8]

B] Carboxylic acids:

Unit IV 14L
A] Optical isomerism:
Element of symmetry, chirality, asymmetric carbon atom, enantiomers, diastereoisomers, relative and absolute configurations, DL and RS nomenclature, racemisation and resolution (by chemical method). [4]

B] Geometrical isomerism:
Cis-trans & E-Z nomenclature, Methods of structure determination. [3]

C] Conformational isomerism:
Unit V
A) Thermodynamics and Equilibrium:
   (i) Gibb’s and Helmholtz’s free energy function. Physical significance of Gibb’s free energy, Change in free energy as a criteria of spontaneity and equilibrium. Variation of free energy G with P & T. Gibb’s-Helmholtz’s equation in terms of G and its application. (ii) Partial molal function, chemical potential, derivations of Gibb’s-Duhem equation. Chemical potential of an ideal gas in gaseous mixture. Derivation of vant Hoff’s isotherm and its application to equilibrium state. Derivation of vant Hoff’s equation and its applications. (iii) Numericals.

B) Phase Equilibrium:
   (i) Immiscible liquids, Nerst distribution law and its application to association and dissociation of solute in one of the solvent. Process of extraction, derivation of formula for the amount of solute left unextracted after nth extraction. (ii) Phase transition - Clausius-Clyperon equation (only qualitative statement). (iii) Partially miscible liquids - Phase diagram of phenol-water, triethyl amine - water and nicotine-water systems. (iv) Numericals.

Unit VI
A) Liquid state:

B) Electrochemistry:
7) To determine partition coefficient of iodine between \( \text{CCl}_4 / \text{Kerosene} \) and water.
8) To determine solubility of benzoic acid at different temperature and heat of solution.

**Distribution of Marks for Practical Examination**

<table>
<thead>
<tr>
<th>Time: 6 hours (One Day Examination)</th>
<th>Marks: 50</th>
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<tbody>
<tr>
<td>Exercise-I</td>
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<tr>
<td>Exercise-II</td>
<td>.......... 18</td>
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<td>Viva-Voce</td>
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<td>Total</td>
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B.Sc. Part-II, Semester-IV

4S Chemistry

**Total Lectures: 84**

**Marks: 80**

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

**Unit I**

A] Chemistry of elements of transition series: 14L


B] Extraction of elements: 3L

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).

**Unit II**

A] Inner transition elements: 11L


B] General Principles of Metallurgy: 3L

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.

**Unit III**

A] Polynuclear hydrocarbons: 4L


B] Reactive methylene compounds: 6L

Malonic Ester: Synthesis from acetic acid, Synthetic applications—Synthesis of acetic acid, succinic acid, glutaric acid, crotonic acid and malonyl urea. Acetoacetic ester: Synthesis from ethyl acetate, Synthetic applications—Synthesis of acetic acid, propionic acid, isobutyric acid, succinic acid, glutaric acid, crotonic acid, acetyl acetone and 4-methyl uracil.

C] Carbohydrates: 4L

Constitution of glucose, cyclic structure, Pyranose and Furanose structure, Epimerization, conversion of glucose to fructose and vice-versa. Introduction to fructose, ribose, 2-deoxyribose, maltose, sucrose. (their structures only—determination not needed).
Unit IV
14L

**A| Aromatic nitro compounds:**
- Nitrobenzene: Synthesis from benzene, Reduction of nitrobenzene in acidic, neutral and alkaline medium.  

**B| Amino Compounds:**
- Basicity and effect of substituents. Methods of preparation of aniline from nitrobenzene, Reactions: with acetyl and benzoyl chlorides, Br_2(aq) and Br_2(CS_2), Carbylamine reaction, alkylation, Hoffmann\(\hat{a}\) exhaustive methylation and its mechanism.

**C| Diazonium Salts:**
- Preparation benzene diazonium chloride, Synthetic applications- Preparation of benzene, phenol, halobenzene, nitrobenzene, benzonitrile, coupling with phenol and aniline.

**D| Amino acids and Proteins:**
- Classification, Strecker and Gabrial phthalimide synthesis, Zwitterion structure, Isoelectric point, peptide synthesis, Structure determination of polypeptides by end group analysis.

Unit V
14L

- Colligative Properties of Dilute Solutions: 14L
  1. Definition and examples of colligative properties.
  2. Elevation of boiling point, thermodynamic derivation of the relationship between elevation of boiling point and molar mass of a non-volatile solute. Cotrell\(\hat{a}\) method for determination of elevation of boiling point. (iii) Depression of freezing point, thermodynamic derivation of the relationship between depression of freezing point and molar mass of a non-volatile solute. Rast\(\hat{a}\) method for determination of depression of freezing point. (iv) Abnormal behavior of solution. Van\(\hat{a}\) Hoff\(\hat{a}\) factor \(\Delta A\) Determination of degree of association and dissociation from Van\(\hat{a}\) Hoff\(\hat{a}\) factor. (v) Numericals.

Unit VI- Crystalline state
14L

- Symmetry in crystal, plane of symmetry, axis of symmetry and point of symmetry. Law of constancy of interfacial angles. Elements of symmetry in cubic crystals. Laws of symmetry. Law of rational indices, Weiss and Miller indices of a lattice planes, calculation of interplaner distance \(d(h,k,l)\) from Miller indices in a cubic system. Seven crystal systems and fourteen Bravais lattices, Bravais lattices of cubic system, Simple cubic system (S.C.C.), body centered cubic system (B.C.C.) and face centered cubic system (F.C.C.). Calculation of number of constituent units in S.C.C., B.C.C. and F.C.C. Ratio of interplaner distances for 100, 110 and 111 lattice plane in S.C.C., B.C.C. and F.C.C. (No geometrical derivation). Derivation of Bragg\(\hat{a}\) equation for X-ray diffraction, Bragg\(\hat{a}\) X-ray spectrometer method for the determination of crystal structure of NaCl and KCl. Anomalous behaviour of KCl towards X-ray. Numericals.

**Semester- IV 4S Chemistry Practicals**

<table>
<thead>
<tr>
<th>Exercise I: Inorganic estimations</th>
<th>14 Laboratory sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Chromatographic separation of binary mixture containing Cu(II), Co(II) and Ni(II) ions by paper chromatography and determination of (R_f) values.</td>
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<tr>
<td>2) Estimation of Zn(II) by complexometric titration.</td>
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<tr>
<td>3) To determine the strength of unknown calcium salt solution by complexometric titration.</td>
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<tr>
<td>4) Estimation of hardness of water by complexometric titration.</td>
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<tr>
<td>5) Colorimetric or spectrophotometric estimation of Cu(II) in commercial copper sulphate sample as ammonia complex.</td>
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<tr>
<td>6) To determination of concentration of unknown KMnO_4 solution from standard solutions of KMnO_4 by colorimetrically or spectrophotometrically.</td>
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</tbody>
</table>

**Exercise II: Organic Chemistry Practicals 12 Laboratory Sessions**

1. Isolation of casein from milk.
2. Isolation of nicotine from tobacco leaves.
3. Isolation of caffeine from tea leaves.
4. Isolation of lycopene from tomato juice.
5. Estimation of glucose.
7. Determination of equivalent weight of an organic acid.
Distribution of Marks for Practical Examination

Time: 6 hours (One Day Examination)

<table>
<thead>
<tr>
<th>Exercise-I</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise-II</td>
<td>18</td>
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<tr>
<td>Viva-Voce</td>
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<tr>
<td>Record</td>
<td>07</td>
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<td>50</td>
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</tbody>
</table>

Total: 50

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

3. Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan- S. Chand & Co.
6. Concise Inorganic Chemistry by J.D. Lee, ELBS.
10. Chemistry Facts, Patterns & Principles by Kneen, Rogers and Simpson, ELBS.
12. Inorganic complex compounds by Murmann, Chapman & Hall.
24. Stereochemistry and mechanism through solved problems by P.S. Kalsi.
31. Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dholgara, Orient Longman.
32. Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.
40. Physical Chemistry: Levine.
41. Practical Physical Chemistry: Palit and De.
42. Practical Physical Chemistry: Yadav.
43. Practical Physical Chemistry: Khosla.
45. Practical Chemistry: Dr. S.B. Lohiya, Bajaj publication, Amravati.
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° C 20 nos./batch
6. Thermometer 0-110° 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 p- nitrochlorobenzenes. iii) Acetanilide to p-nitroacetanilide. Continuous and batch nitration.


Unit II [14]

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

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

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

   a. Passivity – Introduction, chemical and mechanical passivity, oxide film
   b. Theory of passivity.

B) Methods adopted for preventing corrosion (metal coating processes)
   b. Types, radioactive waste, biomedical waste and non radioactive waste containing toxic and heavy metals. Methods of their disposal.

UNIT VI: Industrial solid waste and Treatment processes

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

B) Hazards waste –

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 Aniline by 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 + Na₂CO₃) 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**

<table>
<thead>
<tr>
<th>Time: 6 – 8 hours (One Day Examination)</th>
<th>Marks: 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Unit I (Exercise No. 1)</td>
<td>15</td>
</tr>
<tr>
<td>2. Unit II (Exercise No. 2)</td>
<td>15</td>
</tr>
<tr>
<td>3. Viva-Voce</td>
<td>10</td>
</tr>
<tr>
<td>4. Record</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
</tr>
</tbody>
</table>

**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.

4S Industrial Chemistry (Regular/Vocational)

Material Science and Industrial Pollution

<table>
<thead>
<tr>
<th>Total Lectures: 84</th>
<th>Marks: 80</th>
</tr>
</thead>
</table>

**Unit I**


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


**Unit II**


**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.

**Unit IV**

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.


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.

**Unit V**

Water and Waste Water Treatment

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

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.


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
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
13) NEERI Manual.
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

• 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

• 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

• 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)

UNIT IV: Catalytic cracking processes

• 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

• Recovery of butadiene from naphtha steam cracking effluent stream
• Dehydrogenation of butane (Houdray process)
• Dehydration 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

• 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 Examination) Marks: 50
Exercise No. I: (Practical Expt.) é é é é 15 Marks
Exercise No. II: (Practical Expt.) é é é é 15 Marks
Viva-Voce é é é é 10 marks
Record é é é é 10 Marks

Total: 50

Semester – IV

4S Petrochemical Science

UNIT I: Ethylene Derivatives-I
- 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 from ethylene and other sources

UNIT II: Ethylene Derivatives –II
- 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
- 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

- Role of PdCl₂ and CuCl₂ in VAM synthesis
- Application and uses of VAM
- Acetaldehyde manufacture through oxidation of ethyl alcohol (Wacker process)
- Market for acetaldehyde
- Ethanol manufacture by direction of ethylene (Shell process)
- Market for ethanol
• Acrylamide manufacture with respect to chemistry catalyst and optimum conditions and market

UNIT IV: Butadiene derivatives

• Synthesis of isoprene by various routes
• Good-Year Scientific design process, dehydrogenation of tert-amylenes (Shell process)/dehydrogenation of C₅ stream, acetone-acetylene route
• Manufacture of adipic acid, sulpholane, chloroprene from butadiene
• Chemistry process flow and market for above products

UNIT V: Benzene derivatives

• 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

• Chemistry, operating conditions, flow scheme, description and market for the xylene derivatives
• Terephthalic acid: para-xylene oxidation route, Toray industries process, Lummus process
• Di-methyl Terephthalate 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 Examination) Marks: 50
Exercise No. I: (Practical Expt.) é é é é é 15 Marks
Exercise No. II: (Practical Expt.) é é é é é 15 Marks
Viva-Voce é é é é é 10 marks
Record é é é é é 10 Marks
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Total: 50
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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
5. Fuels and Combustions, Sameer Sarkar, Orient-Longman Ltd. Hyderabad
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

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

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Burette</td>
<td>20 Nos.</td>
</tr>
<tr>
<td>2</td>
<td>Pipette 10ml, 25ml</td>
<td>20 Nos. each</td>
</tr>
<tr>
<td>3</td>
<td>Mohr pipette 2ml, 5ml</td>
<td>10 Nos. each</td>
</tr>
<tr>
<td>4</td>
<td>Conical flask with stopper</td>
<td>50 Nos.</td>
</tr>
<tr>
<td>5</td>
<td>Standard volumetric flask</td>
<td>20 Nos.</td>
</tr>
<tr>
<td>6</td>
<td>Density Bottle</td>
<td>20 Nos.</td>
</tr>
<tr>
<td>7</td>
<td>Balance (Electronic/Digital)</td>
<td>02 Nos.</td>
</tr>
<tr>
<td>8</td>
<td>Aniline Point Apparatus</td>
<td>01 No.</td>
</tr>
<tr>
<td>9</td>
<td>U-tube viscometer of different capillary size</td>
<td>02 Nos.</td>
</tr>
<tr>
<td>10</td>
<td>Thermometer (0 to 110°C I P Grade)</td>
<td>10 Nos.</td>
</tr>
<tr>
<td>11</td>
<td>Thermometer (0 to 360°C I P Grade)</td>
<td>10 Nos.</td>
</tr>
<tr>
<td>12</td>
<td>Test tube (20 and 50 ml with rubber cork)</td>
<td>50 Nos.</td>
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<tr>
<td>13</td>
<td>Smoke Point Apparatus (I P Grade)</td>
<td>01 No.</td>
</tr>
<tr>
<td>14</td>
<td>Abel Flash Point apparatus (I P Grade)</td>
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<tr>
<td>15</td>
<td>Pensky Marten’s Flash Point apparatus</td>
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<tr>
<td>16</td>
<td>Cleveland Open Cup Flash point Apparatus</td>
<td>01 No.</td>
</tr>
<tr>
<td>17</td>
<td>Porcelain dish</td>
<td>10 Nos.</td>
</tr>
<tr>
<td>18</td>
<td>Constant Temperature bath</td>
<td>02 Nos.</td>
</tr>
<tr>
<td>19</td>
<td>Hot Plate</td>
<td>01 No.</td>
</tr>
<tr>
<td>20</td>
<td>Air condenser</td>
<td>20 Nos.</td>
</tr>
<tr>
<td>21</td>
<td>Glass tubing 6mm, 10mm</td>
<td>20ft. Each</td>
</tr>
<tr>
<td>22</td>
<td>Glass rod 4mm, 8mm</td>
<td>20 ft. Each</td>
</tr>
<tr>
<td>23</td>
<td>Stop watches</td>
<td>04 Nos.</td>
</tr>
<tr>
<td>24</td>
<td>LPG Cylinder with regulator</td>
<td>01 No.</td>
</tr>
<tr>
<td>25</td>
<td>Refractometer</td>
<td>01 No.</td>
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<tr>
<td>26</td>
<td>Refrigerator</td>
<td>01 No.</td>
</tr>
<tr>
<td>27</td>
<td>Water Distillation Plant</td>
<td>01 No.</td>
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<tr>
<td>28</td>
<td>Beaker 250 ml</td>
<td>20 Nos.</td>
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<tr>
<td>29</td>
<td>Beaker 50, 100, 500, 1000 ml</td>
<td>07 Nos.</td>
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<tr>
<td>30</td>
<td>Hot Air Oven</td>
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<tr>
<td>31</td>
<td>Heating Furnace</td>
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<td>32</td>
<td>Karl Fisher Auto Titrator</td>
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<td>33</td>
<td>Dean and Stark Apparatus</td>
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<td>34</td>
<td>Flame Photometer</td>
<td>01 No.</td>
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<td>35</td>
<td>Colorimeter</td>
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<tr>
<td>36</td>
<td>Bomb Calorimeter</td>
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<tr>
<td>37</td>
<td>Spectrophotometer</td>
<td>01 No.</td>
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<tr>
<td>38</td>
<td>Oxygen Cylinder with pressure regulating valve</td>
<td>01 No.</td>
</tr>
<tr>
<td>39</td>
<td>Vacuum Pump</td>
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<tr>
<td>40</td>
<td>Air source</td>
<td>01 No.</td>
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<tr>
<td>41</td>
<td>Air Flow meter</td>
<td>01 No.</td>
</tr>
<tr>
<td>42</td>
<td>Desiccators</td>
<td>06 Nos.</td>
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<tr>
<td>43</td>
<td>Water Suction</td>
<td>04 Nos.</td>
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<tr>
<td>44</td>
<td>Filtration Flask with Buckner Funnel</td>
<td>20 Nos.</td>
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<tr>
<td>45</td>
<td>Heating Mental</td>
<td>06 Nos.</td>
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<tr>
<td>46</td>
<td>ASTM Distillation apparatus</td>
<td>01 No.</td>
</tr>
<tr>
<td>47</td>
<td>Viscometer and Constant temperature bath</td>
<td>01 Set of viscometer</td>
</tr>
<tr>
<td>48</td>
<td>Apparatus for oil determination in given sample as per I P norm</td>
<td>01 No.</td>
</tr>
<tr>
<td>49</td>
<td>Reid Vapor Pressure Apparatus with const. temp. Bath</td>
<td>01 No.</td>
</tr>
<tr>
<td>50</td>
<td>Ductility measuring meter</td>
<td>01 No.</td>
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<tr>
<td>51</td>
<td>Penetrometer</td>
<td>01 No.</td>
</tr>
<tr>
<td>52</td>
<td>Copper Corrosion Test Apparatus</td>
<td>01 No.</td>
</tr>
<tr>
<td>53</td>
<td>Crankcase Oil Dilution Apparatus</td>
<td>01 No.</td>
</tr>
<tr>
<td>54</td>
<td>Redwood Viscometer No. I &amp; II</td>
<td>01 No. each</td>
</tr>
</tbody>
</table>

6. GEOLOGY

B.Sc. II

3S-Geology

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 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.


UNIT V : Classification, geographic distribution, lithological characteristics, fossil contents and economic importance of Gondwana Supergroup and Deccan Traps. Intertrappean and Infra-trappean.
UNIT VI: Jurassic of Kutch, Triassic of Spiti. Cretaceous 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:
UNIT I: 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 Boerhavia 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 identification 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

Brassiacaeae- Brassica, Malvacaeae- Hibiscus, Sida, Malvastrum,
Fabaceae- Crotalaria, Indigifera, Tephrosia, Caesalpinoidae- Caesalpinea, Cassia, Mimosoidae- Prosopis, Acasia, Apiaceae- Corindrum,
Apocynaceae- Vinca, Thevetia, Asclepiadaceae- Cryptostegia, Calatrops, Solanaceae- Datura, Solanum, Withania,
Euphorbiaceae- Croton, Jatropha, Euphoria, , Lamiaceae- Oscium, Hyptis, Asteraceae- Tridax, Lagasca Verbanaceae – Lantana, Clerodendron
PRACTICAL EXAMINATION

Max. Marks- 50

Q. 1 Preparation of double stained permanent micropreparation 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 micropreparation and viva voce 04 Marks

Books Recommended:

1) A.C. Dutta: Text Book of Botany.
4) Bhujwani & Bhatnagar: Embryology of Angiosperms.
5) Chandurkar: Plant Anatomy
10) Gangulee & Kar: College Botany Vol.II

21) Shukla & Mishra: Paleobotany.
22) Singh and Jain: Plant Anatomy.
23) Singh and Jain: Taxonomy of Angiosperms.
28) Tyagi & Kshetrapal: Taxonomy of Angiosperms.
33) Modern Practical Botany, Volume-II, Dr.B.P. Pande, S.Chand Publication, New Delhi.

4S- BOTANY

CELL BIOLOGY, GENETICS AND BIOCHEMISTRY

Unit – I: Cell Biology

1.1 Cell concept I Prokaryotic and Eukaryotic cell
1.2 Cell wall I Structure and Functions
1.3 Plasma membrane I Structure (models) and Functions
1.4 Nucleus I 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- Mitochondrial 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) 10 Marks
Q.5 : Spotting 05 Marks
Q.6 : Class record and viva-voce 10 Marks

Suggested Readings:
3) Dalela & Verma : Cytology.
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) Routes of exposure, mode of actions and physiological effects of (a) aldrin, (b) BHC (c) DDT, (d) Synthetics detergents
(2) Xenobiotics definition & mechanism of Detoxification
(3) Bioremedaion 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, Pb - Distribution and Identification.

UNIT VI : Renewable Energy Resources : (15 Lectures)
(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.
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.
11. To study the activity of amaylase.

Note: Visit to non conventional energy plant.

Distribution of Practical Marks. (Max. Marks. – 50)

| 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
10. Concept of Environmental Chemistry by G. S. Soudhi ; Narosa publishing , New Delhi.
11. Environmental Chemistry by R. C. Rsswell ; Edward Armolic Press.
UNIT II : Water pollution – Definition, sources of water pollution, major pollutants, types of water pollution in 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 settleable particulate matter, RSPM in industrial area.
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.
10. Determination of D.O.
11. Determination of Phosphate
12. Identification and enumeration of bacteria from air and water.
15. Determination of available phosphorous by spectro photometric method.
17. Estimation of CO₂ 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 ì P.D. Sharma
2. Environmental Chemistry ð V.P. Khudesia
3. Environmental Chemistry ð B.K. Sharma
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.


Fixation of heterosis as an approach.

Apopomixes 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 sterility.

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'.

5. Industrial Chemistry ñ B. K. Sharma
6. Environmental Biology & Toxicology ñ P.D. Sharma
7. Environmental Toxicology ñ Mido,
8. Biochemistry- Leninger
9. Biochemistry- Satyanarayan
10. Environmental Engineering ñ S.S. Deswal
11. Water supply & Sanitary Engineering ñ Rangawala
12. Environmental pollution control Engineering ñ C.S. Rao, New age international publication
16. Shreve's Chemical Process Industries ñ George T. Austin
17. Environmental Chemistry ñ Chhatwal Anand
18. Plant Physiology ñ Salisbury & Ross
19. Non Conventional energy Resources ñ G.D. Rai
20. Experimental Methods For General & Environmental Chemistry ñ Dr. Anita Rajor
23. Environmental Sciences, Eldon D. Enger and Bradley F. Smith, WCB Publishers, Boston
25. Physico Chemical Examination of Water, Sewage, and Industrial Effluent, Pragati prakashan, Meerut
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-

Economics of hybrid seed production. Seed Planning.

Unit-IV: History and Objectives of Vegetable Breeding:

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 Lycopersicum 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.

Practicals:
Hybrid Seed Production:
(1) Studies on inflorescence, floral arrangement, floral morphology of some important crop plants: cotton, pigeonpea, pearlmillet, and maize.
Artificial emasculation and pollination studies in maize and cotton.

Studies on protogynous and protandrous nature of flowers in Pearl millet and Sunflower.

Studies on synchronisation problems in Pearl millet, 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.
4. Selfing and Crossing techniques in vegetables, cucurbits, solanaceeous 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:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Describe in details the floral biology of the specimen 'A' classify upto family level.</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Raise a nursery bed for the given vegetable sample and describe.</td>
<td>05</td>
</tr>
<tr>
<td>3</td>
<td>Identify and describe vegetable seeds, specimen and equipments A, B, C, D, E.</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Study of pollen germination in Sugar Solution.</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Submission of field report</td>
<td>05</td>
</tr>
<tr>
<td>6</td>
<td>Submission seed specimen and viva-voce.</td>
<td>05</td>
</tr>
<tr>
<td>7</td>
<td>Record book</td>
<td>05</td>
</tr>
</tbody>
</table>

**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.

**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.
Heterogeneity 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—the heritable and non-heritable characters.

Seed Quality Control Systems:
Seed legislation, seed certification.
Seed legislation.
Objectives of 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 and 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.

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 and 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
5. A Handbook of Seed Inspectors : Central Seed Committee Ministry of Agriculture.

**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  
Written examination ê ê ê . 80
Internal assessment ê ê ê . 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 Pices:**
Type study: *Scoliodon sarrokawah* (Dogfish) Habits and habitat, Excretory organs- 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: *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, Lamarckism.

Speciation - definition of species and mode of speciation. Allopatric and Sympatric speciation.


Unit VI: Adaptive radiations in mammals.

Evolution of Man - brief accounts of Parapithecus, Dryopithecus, Ramapithecus, Australopithecus, Homo erectus 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:**

23. 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.

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.
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 :- Amphioxus, 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

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Total Marks: 50
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BSc.II Semester IV

ZOYOLOGY

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:
   Marks Allotted
   Advanced Genetics and Animal Ecology.
   Written examination ê ê ê .. 80
   Internal assessment ê ê ê .. 20
   2) Practical: 50
   Total: ................ 150 Marks

ZOOOLOGY Paper 4 S
ADVANCED GENETICS AND ANIMAL ECOLOGY

UNIT I: Concept of genes.

UNIT II: Linkage - Types of linkage, linkage group, arrangement of linked genes, and significance of linkage.
Crossing over ï Mitotic and meiotic crossing over, Mechanism of crossing over, theories of crossing over ï Darlington’s theory, breakage and exchange theory, and copy choice theory. Types of crossing over ï 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


Kinds of twins: - Identical, Fraternal, Siamese twins. Significance of twins study

UNIT V: Ecology: concept and scope:
Abiotic factors:
Biotic factors:
Intra specific and interspecific associations, Predation, parasitism, Antagonism, commensalisms, mutualism, competition, (Gauze Principle).

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:
2. Principles of Genetics ō S.K.Jain
3. Genetics ō P.K.Gupta

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 ō 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 ō syndrome, Klinefelter ō syndrome, Down ō syndrome
7. Detection of syndrome from chromosome spread picture.
8. Study of following human genetic traits and application of Hardy-Weinberg Principle to them ō 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.

<table>
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<tr>
<th>Topic</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Ecological: Estimations -/Analysis</td>
<td>10</td>
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<tr>
<td>Spotting. (2Spot from Sec.A &amp; 3 Spot from Section B of 2 Marks each)</td>
<td>10</td>
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<tr>
<td>Micro preparation.</td>
<td>05</td>
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<td>Genetic experiment -</td>
<td>10</td>
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<td>Class record</td>
<td>05</td>
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<tr>
<td>Viva - Voce</td>
<td>05</td>
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<tr>
<td>Submission of study tour report.</td>
<td>05</td>
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Total Marks : 50
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BSc. Part II, Semester III.
II. 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.

1) Paper-I: FISH BIOLOGY

<table>
<thead>
<tr>
<th>Mark Distribution</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Theory (Written)</td>
<td>80</td>
</tr>
<tr>
<td>Internal assessments</td>
<td>20</td>
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</tbody>
</table>

Total: 150 Marks

Paper 3S-FISH AND FISHERIES (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-penacaid 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 and management; harvesting of fry and fingerlings.


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 pitutary glands;
11. Preparation of extract; hypophysation.
12. Study of different hatchery system.
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. 10 Marks
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

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Total: 50 Marks
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REFERENCES
35. Project report on breeding of carps with ovarprim in India. Nandeesha, M.C. & Others. AFSIB, Mangalore.
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.

Paper-I: AQUACULTURE

1) Theory (Written) ……...80
Internal assessments ……...20
2) Practical: ……...50

Total: 150 Marks

PAPER-IVS 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-IV: Characteristics of brackish water. Brackish water resources of India. Existing culture practices in bheris, pokkali paddy fields and kharlards. 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
1) Collection and analysis of soil and water, samples for physicochemical characteristics;
2) Study of food cycle in a pond,
3) Collection and identification of fish food organisms.
4) Visits to farms to study different systems of aquaculture.
5) Maintenance of brood fish.
6) Preparation of Nursery, rearing and stocking ponds,
7) Identification of aquatic insects, weeds and predators and their control.
8) Water quality analysis,
9) Feed preparation and feeding. Identifications of seed of cultivable fish species.
10) Seed stocking.
11) Examination of plankton from culture ponds.
12) Fish growth, survival an production analysis.
13) Identification of important species of brackish water finishes and shellfishes and their seed.
14) Collection and rearing of brackish water shrimps and fishes.
15) Identification of cultivable species of prawns oysters, mussels, clams, sea weeds, etc.
16) 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. O₂ 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 carbon dioxide, alkaliity and ammonia, petri dishes, test tubes, etc.
REFERENCES

34. Project report on breeding of carps with ovaprim in India. Nandeesha, M.C. & Others. AFSIB, Mangalore.
38. Aquaculture of Fresh water Prawns/Macrobrachium species, Goodwin, H.J. and I.A. Hanson. United States Department of Commerce, NTIS.
41. Pond culture of the Malaysian Prawn, Macrobranchya 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.

1) Paper-I: LABORATORY TECHNIQUES
   Marks
   Theory (Written)  80
   Internal-assessments  20

2) Practical:
   50

Total: 150 Marks
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.
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
5. Work book on Limnology: A.D.Adoni, Publication MAB Committee, Department of Environment, Govt. of India.
7. Quantitative inorganic analysis: A.I.Vogel, ELBS publisher.

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BSc. Part II. Semester IV
BIOLOGICAL TECHNIQUES AND SPECIMEN PREPARATION

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

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<tr>
<td>Theory (Written)</td>
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<tr>
<td>Internal assessments</td>
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Total: 150 Marks

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 seicator and high speed centrifuge.
12. Enzyme action and factors affecting enzyme action
15. Isolation of proteins and DNA (as per theory)
17. Tissue culture techniques.

**DISTRIBUTION OF MARKS FOR PRACTICAL EXAMINATION**

Q 1. Estimation of glucose/proteins/DNA/chlorophylls. By Chromatography - Thin layer or paper

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Q 2. Soldering of wires

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Q 3. Enzyme action or Identification of blood group

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Q 4. Minor experiment on Electrophoresis or Tissue Culture

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Q 5. Practical record

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<th>Marks</th>
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Q 6. Viva-Voce

<table>
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<th>Marks</th>
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Total: 50
BOOKS RECOMMENDED

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 marks
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.
Unit IV : Estimation and Testing of Hypothesis

4.1 Point and Interval estimation & estimate of a parameter
4.2 Properties of estimator: - Unbiasedness, 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
5.2 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 χ² variates
6.5 Conditions for the validity of χ² test
6.6 Applications of χ² distribution: - Assumptions of χ²
   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

3) J.D. Gibbons : Non-parametric Statistical Inference.

List of Practicals :3S

1) Drawing random samples from Binomial & 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.
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 & χ²

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’s 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 Í Edworth, Dorbish Í 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 relationship method
   5.5.3 Ratio to Í trend and Ratio to Í 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
3) J.D. Gibbons : Non-parametric Statistical Inference.

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: Wilcoxon-Mann-Whitney test.
6) Non-Parametric Test: Run test and Median test
7) Non-Parametric Test: Kolmogorov- Smirnov Test
8) Computation of index number by simple aggregate and weighted average method.
9) Construction of price and quantity index numbers by Laspeyre's Passche's and Fisher's Method
10) Applications of time reversal test and factor reversal test
11) 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 ï 25
2) Biometrica tables Vol.I and Vol.II ï 05 each
3) Sevel figure logarithmic tables ï 10
4) Statistical Tables (Compiled ï 10
5) Random number tables ï 10
6) A mathematical typewriter ï 01
7) A duplicating machine ï 01
8) Personal Computer ï 05
9) Printer ï 01
10) Statistical posters and charts ï 01
11) Software packages, Like Statstast, 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. Program 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, Comparison 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 & HEADING,  BODY,  P,  BR,  HR, Heading tags, table tags, LINK, IMG, ROWSPAN, COLSPAN, MARQUEE,

BLOCKQUOTE, A, I, B, list tag, Attributes: align, background colour, text color.

Unit-VI: Style sheet: advantages of style sheet & applications of style sheet, CSS: Introduction, CSS styleset 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-dimensional, two-dimensional 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 templates.

Unit-III: Virtual Functions and Polymorphism: Introduction, Pointers to derived class, dynamic binding, definition 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-V: Document type Definition (DTD): Introduction, need of DTD, declaring elements, element content models, declaring attributes, attribute types: internal and external DTD, entities and their types.


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
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 Structures: IF--then, ENOZF, IF-- ELSE, nested if..Else, SELECT case, goto, II 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, Normalization: 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 Constraints, Displaying integrity Constraints.

Books
i) Guide to VB - Peternorton-Techmedia
ii) Mastering VB - Evangelous Petroutsos
iv) Introduction to DBMS: Majumdar & Bhattacharya
vi) Programming with SQL: Ivon Bayross

Practicals: Minimum 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 Programs: Programme structure, procedure & Functions, private and public procedure, variables 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-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: Ivon Bayross Systems for students
iii) Programming with SQL: Ivon Bayross
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
General Provisions/Instructions
Part A
(i) The Examination in Electronics of each semester shall comprise of one theory paper of 80 marks of three hours duration and internal assessment of 20 marks.

(ii) Theory paper of each semester shall comprise of six units. Each unit shall be completed in maximum 15 teaching periods of 48 minutes duration.
There shall be six questions of twelve marks each unit with alternate choice and One compulsory question (08 subquestions of 01 mark each) of 08 marks covering syllabi of all units (short answer type).

**PART B**

(i) The Practical examination of each semester of the B. Sc. (Electronics subject) shall be of 50 marks of 4 hours duration and shall be held at the end of each semester at the places as decided by the university.

(ii) Distribution of 50 marks assigned to practical for (Semester I to V) is as under-

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

- Total: 50 Marks

(iii) Project will be given to a group of not more than four students.

(iv) Teacher may adopt any innovative practice for demonstration of practicals on the aspects given.

(v) College/ Department may prepare laboratory manuals of experiments

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**3S-Electronics**

**Electronic Devices and Circuits**

**Unit I:** Hybrid-parameters & Cascaded amplifiers:
- Hybrid-parameters, transistor equivalent circuit of CE, CB, Analysis of small signal CE amplifiers. Concept of cascaded amplifier, Types of coupling, RC Coupled Amplifier, Single Tuned amplifiers,

**Unit II:** Power Amplifier:
- Classification of power amplifier, Class A, Class B, Class C and Class AB amplifiers, Class A - transformer coupled amplifier, Class-B push-pull amplifier (Construction, working and efficiency of each). Distortion, complementary symmetry Class-B push-pull amplifier.

**UNIT III:** Feedback amplifiers and Oscillators:
- 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, Crystal oscillator.

**UNIT IV:** Operational amplifier and applications:
- Difference amplifier(concept, construction and working), block diagram of operational amplifier, 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 V:** Advance applications 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 VI:** A/D and D/A converter:
- Need of A/D and D/A converter. D/A converter: R-2R ladder type, Weighted resistor, sample and hold circuit, IC ADC, DAC specification. A/D converter: Single and Dual slope, counter type, successive approximation type, specification, Numerical based on A/D and D/A Converter

**Books Recommended:**
1. Integrated Electronics by Millman Halkias
2. Principle of electronics by V.K.Mehta
3. Element of electronics by Bagde and Singh
4. Linear integrated Circuits by Ramakant Gaikwad
5. Digital principle and application by Malvino and Leach
6. Basic electronics by B.L.Thereja (S.Chand and Company)
7. Op-Amp Theory and application by Ramakant Gaikwad

**Practicals:** Minimum Ten experiments at least one on each of the following aspects.
1. CE, CB and CC amplifiers, cascaded amplifiers.
2. Power amplifiers.
3. Oscillators.
4. Op-Amp applications.
5. Op-Amp in Astable, Monostable and Bistable mode.
6. ADC and DAC converter

4S-Electronics
Communication Electronics & Microprocessor 8085

UNIT I: Modulation and Demodulation:

UNIT II: Fiber Optic Communication:
Introduction, advantages of OFC, types of fibers, internal reflections, numerical aperture, Optical Sources: Semiconductor injection LASER, LED, (power and efficiency characteristics). Optical detectors: Photo diode, PIN diode, Phototransistor. Optical fiber connection: Jointer and coupler, fiber alignment and joint losses, connector couplers.

UNIT III: Pulse Modulation and Digital Communication
Pulse Modulation, Sampling Theorem, PAM, PWM, PPM and PCM (Bandwidth of PCM, Quantizing Noise), application of PCM, Multiplexing Principles: TDM and FDM, Comparison of FDM and TDM.

UNIT IV: 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 of MOV and MVI instructions.

UNIT V: 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 such as programme for addition, subtraction, multiplication, division, finding maximum and minimum numbers etc.

UNIT VI: Interfacing:
Basic interfacing concept, memory mapped I/O and I/O mapped I/O Schemes, data transfer schemes. 8255PPI: block diagram, function of each block, Functional pin diagram, function of each pin, operating modes of 8255PPI, control word format in I/O and BSR mode, illustrative example.

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. Modern digital and analog communication system by B.P.Rathi
5. Communication electronics by N.D.Deshpande
6. Microprocessor and microcomputer By B.Ram
7. Microprocessor architecture, programming and application by Ramesh Gaonkar
8. Introduction to Microprocessor by A.P. Mathur

Practicals: Minimum Ten experiments at least one on each of the following aspects.
1. AM and FM (Transmitters and Receivers) TRF and superheterodyne receivers, collector modulator
2. OFC system.
5. Programming on microprocessor 8085.
6. Interfacing techniques.
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 marks).

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

UNIT-V: a) Sources of atoms in purines and pyrimidine molecules.
   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 marks).
UNIT-I:  
1. General characteristics, nomenclature, IUB classification of enzymes.  
2. Definition with examples of holoenzymes, apoenzymes, coenzymes, cofactors, activators, inhibitors, activesite, metaloenzyme, marker enzyme, monomeric and oligomeric enzymes.  
3. Unit of enzyme activity, isoenzyme, multienzyme complexes, enzyme specificity.  
UNIT-II:  
1. Isolation, purification and crystallization of enzymes, test for homogeneity.  
2. Enzyme assay, factors affecting enzyme activity- Substrate concentration, enzyme conc., pH, temp.  
3. Derivation of Michaelis Menton equation for unisubstrate reaction, Km and its significance, Line Weaver Burk plot and its limitation.  
UNIT-III:  
1. Kinetics of zero and first order reaction.  
2. Significance of energy of activation and free energy.  
3. Reversible and irreversible inhibition, competitive, non-competitive and uncompetitive inhibition.  
4. Determination of Km and Vmax in presence and absence of inhibitors.  
UNIT-IV:  
1. Allosteric enzymes, role of cofactors in enzyme catalysis- NAD/NADP, FAD/FMN, Coenzyme- Q, Biotin, Cobamide, Lipoamide, TPP, THF, Pyridoxal phosphate.  
2. Role of metal ions in enzyme catalysis with special emphasis on coenzyme function.  
UNIT-V:  
1. Acid- base catalysis, covalent catalysis.  
2. Proximity and orientation effect, strain and distortion thesis.  
3. Mechanism of action- Lock and Key hypothesis, Induced fit model.  
UNIT-VI:  
1. Application of immobilized enzymes in industry.  
2. Production of glucose from starch, glucose- fructose syrup from sucrose.
3 S-Microbiology
Molecular Biology and Genetic Engineering

Unit I: Gene multiplication and expression
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) Outline 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.

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.
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.
   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 CaCl₂.

Distribution of marks

III Semester Microbiology practicals

<table>
<thead>
<tr>
<th>Practical</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major experiment</td>
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</tr>
<tr>
<td>Minor experiment</td>
<td>10</td>
</tr>
<tr>
<td>Viva-Voce</td>
<td>10</td>
</tr>
<tr>
<td>Spotting</td>
<td>10</td>
</tr>
<tr>
<td>Laboratory journal</td>
<td>05</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>50</td>
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Books Recommended For SEM-III:

2. Introduction to Genetic Engineering: - Nicholas
3. An Introduction to Genetic Analysis: - David Suzuki, Anthony. Griffiths
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.
12. Concept in biotechnology: - D. Balasubramanium

PRACTICALS:

   Methods.
4. Microbiological Methods : Collins
5. Difco manual

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.
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.
3. Text Book of Microbiology : Ananthnarayan R. & C.E. Panikar
5. Dorland's Pocket Medical Dictionary
6. Microbiology : Zinsser W.
7. Preventive & Social Medicine : Park & Park
9. Medical Microbiology : R. Anantnarayan

Bacteriology

(Helminthology)
13. Parasitology : K.D.Chatterjee

PRACTICALS:
4. Microbiological Methods : Collins
5. Difco mannal

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, Thermophilic, Thermoduric bacteria, Psychrotropic, Halophilic, 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 Actenomyces, 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.
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
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 - 20 marks (10 Each)
B) One long experiments - 15 marks
C) Viva voce - 10 marks
D) Practical records - 05 marks

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Total - 50 marks
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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, LT LT, 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:
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.

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 i.e definition and general strategy.
   c) Metabolic pathways i.e (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 layer)

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 Mushroom 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

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Total 50
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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 Voet, Judith Voet, Charlotte Oratt (john Wiley and Sons New York)
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).

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 osmotic 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

Unit III : Fermented milk products:
A) Introduction
B) Selection of food for manufacturing of fermented food products
C) Pasteurization of milk - LHT, HIT, UHT
D) Phosphatase test and its applications
E) Quality and grades of milk

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) Nutritional and therapeutic values of fermented milk products
H) Defects and spoilages of fermented milk products
I) Tests and standards for fermented milk products
J) Pathogens in fermented milk products

Unit V : Meat and Fishery Products:
A) Spoilage of fresh and Processed meat
B) Fermented sausage and country cured hams
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
1. Mean
2. Median
3. 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, X² test, t-test)
5. Different methods of data presentation with special reference to biostatical 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:

<table>
<thead>
<tr>
<th>Practical</th>
<th>Marks</th>
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<tbody>
<tr>
<td>Major experiment</td>
<td>10</td>
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<tr>
<td>Minor experiment</td>
<td>10</td>
</tr>
<tr>
<td>Viva-voce</td>
<td>10</td>
</tr>
<tr>
<td>Spotting</td>
<td>10</td>
</tr>
</tbody>
</table>

Laboratory Journal 05
Study tour report 05

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).
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.


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.


Unit V : Thermodynamics as applied to biological systems


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.
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
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
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TOTAL  50 Marks

REFERENCE BOOKS:
4. Practical Statistics for Experimental Biologists- Ward Law A.C.
10. Instrumentation measurements and analysis ï Nakara, Choudhari (Tata McGraw Hill)


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).

4S 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 hormone, erythropoietin)

Unit-V : Microbial Biotechnology II- Industry:
Batch and continuous fermentation.
Types of bioreactors (CSTR, Fluidized bed reactor, UASB).
Alcohol fermentation.
Penicilllin 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.
Biobleaching.
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:-
2. Introduction to Genetic Engineering:- Nicholas
4. Molecular Biology of the Cell: - J. D. Watson, D. Bray
5. The DNA Story: - J. D. Watson
6. Genes: - Pramod Kumar
7. Genetic Engineering and its Applications -Joshi P.
9. Concept in Biotechnology: - D. Balasubramanium
11. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York, 1988
15. Molecular Biology of the Cell: - J. D. Watson, D. Bray
18. Introduction to Genetic Engineering:- Nicholas
19. Molecular Biology of the Cell: - J. D. Watson, D. Bray
20. The DNA Story: - J. D. Watson
21. Genes: - Pramod Kumar
22. Genetic Engineering and its Applications -Joshi P.
24. Concept in Biotechnology: - D. Balasubramanium
26. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York, 1988
19. Genomes, TS. Brown
21. Industrial Microbiology by A. H. Patel
22. Industrial Microbiology by Casida.

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. Proteoglycans 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, Nomenclature 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 aminoacids
3. Preparation of buffers of different pH.

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

Distribution of Marks for Practicl Examination:

<table>
<thead>
<tr>
<th>Time: 6 Hours</th>
<th>Marks 50</th>
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<tbody>
<tr>
<td>1. Section I (Practical experiment)</td>
<td>15</td>
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<tr>
<td>2. Section II (Practical Experiment)</td>
<td>15</td>
</tr>
<tr>
<td>3. Viva Voce</td>
<td>10</td>
</tr>
<tr>
<td>4. Practical Record</td>
<td>10</td>
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</tbody>
</table>

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


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.
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.
5. Identification of RH factor.
6. To perform Antibiotic sensitivity test by Multiple disc method.

Distribution of Marks for Practicil Examination:

<table>
<thead>
<tr>
<th>Time: 6 Hours</th>
<th>Marks 50</th>
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<tbody>
<tr>
<td>Section I (Practical experiment)</td>
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<tr>
<td>Section II (Practical Experiment )</td>
<td>15</td>
</tr>
<tr>
<td>Viva Voce</td>
<td>10</td>
</tr>
<tr>
<td>Practical Record</td>
<td>10</td>
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</table>

23. APICULTURE
3SAPICULTURE

Paper III (Entomology & Bee Pathology)

Unit – I: 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: Genera of bees, honeybees, geographical distribution, nesting behavior, castes & division of labor, general organization of Trigona.

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.  

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)
4. Internal anatomy;  
a. Hypopharynx 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 spiracles 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  

Field Visit :- (One visit at least within the state and One visit at least 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

4S 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.

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

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.
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

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TOTAL  50
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List of Reference Books for the subject Apiculture
(Semester III & IV):-

5. Investigation of Indian Honey bee Product -
8. The Chemistry and Technology of Waxes, Reinhold publication Corp.,N.Y.
32. (The) Illustrated Encyclopaedia of Beekeeping 1985, R.J.Morse
and T. Hooper, Alphabet and Image Ltd., Shareborne, Dorset, UK.


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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.
   - Environmental 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.

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.

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. **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, manwildlife conflicts.

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.
     - Disaster management: floods, earthquake, cyclone and landslides.

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.

(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.

LIST OF REFERENCES:-
2) Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad - 380 013, India, Email : mapin@icenet.net (R)
4) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
6) De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7) Down to Earth, Centre for Science and Environment (R)
9) Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural Histroy Society, Mumbai (R)
18) Survey of the Environment, The Hindu (M)
20) Dr. Deshpande A.P., Dr. Chudiwale A.D., Dr.Joshi P.P & Dr. Lad A.B. : Environmental Studies, Pimpalapure & Company Pub., Nagpur.
21) डी. शिल्प घरपूर्णे : पर्यावरणशास्त्र, पिंपलपुरे ऑंडेव कंपनी पंक्तिसार पंक्ति, नागपुर।

(M) Magazine
(R) Reference
(TB) Textbook
26) Environmental Chemistry and Pollution Control, Dasganu Prakashan, Nagpur : Dr.N.W.Ingole, Dr. D.M.Dharmadhikari, Dr.S.S.Patil.

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