

B.Sc. Final (Semester-V & VI)

Prospectus No. 2013123

संत गाडगे बाबा अमरावती विद्यापीठ
SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

PROSPECTUS

OF

The Examination for the Bachelor of Science
Semester-V, Winter-2012, and
Semester-VI, Summer-2013
& Onwards



2012

Price Rs...../-

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Published by
Dineshkumar Joshi
Registrar,
Sant Gadge Baba Amravati University
Amravati - 444 602

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I N D E X
B.Sc. Final (Semester-V & VI)
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SANT GADGE BABA AMRAVATI UNIVERSITY

SPECIAL NOTE FOR INFORMATION OF THE STUDENTS

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

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

- Ordinance No. 1 : Enrolment of Students.
- Ordinance No.2 : Admission of Students
- Ordinance No. 4 : National Cadet Corps
- Ordinance No. 6 : Examination in General (relevant extracts)
- Ordinance No. 18/2001 : An Ordinance to provide grace marks for passing in a Head of passing and Improvement of Division (Higher Class) and getting Distinction in the subject and condonation of defficiency of marks in a subject in all the faculties prescribed by the Statute NO.18, Ordinance 2001.
- Ordinance No.9 : Conduct of Examinations (Relevant extracts)
- Ordinance No.10 : Providing for Exemptions and Compartments
- Ordinance No. 19 : Admission Candidates to Degrees
- Ordinance No.109 : Recording of a change of name of a University Student in the records of the University
- Ordinance No. 138 : For improvement of Division
- Ordinance No.19/2001 : An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001.

Dineshkumar Joshi
Registrar
Sant Gadge Baba Amravati University

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

DIRECTION

No. : 16/2010

Date : 11/06/2010

Subject : Examinations leading to the Degree of विज्ञान स्नातक (Bachelor of Science) (Three Year Degree Course-Semester Pattern), Direction, 2010.

Whereas, University Grants Commission, New Delhi vide D.O.No.F-2/2008/(XI Plan), Dtd.31 Jan.2008 regarding new initiatives under the 11th Plan – Academic Reforms in the University has suggested for improving quality of higher education and to initiate the Academic Reform at the earliest.

AND

Whereas, the Academic Council while considering the above letter in its meeting held on 30.4.2008, vide item No.55 has resolved to refer the same to Dean's Committee, and the Dean's Committee in its meeting held on 19.07.2008 has decided to refer the matter to all Board of Studies.

AND

Whereas the recommendations of various Board of Studies in the faculty of Science regarding Upgradation and Revision of various syllabi and introduction and implementation of Semester Pattern Examination System at under graduate level was considered by the faculty of Science in its meeting held on 7.12.2009 and constituted a Committee of all Chairmen of Board of Studies and one member nominated by Chairmen of respective B.O.S. under the Chairmanship of Dean of faculty to decide the policy decision regarding semester pattern examination system.

AND

Whereas, the faculty of Science in its emergent meeting held on 11th May, 2010 vide item No.26, has considered, accepted and recommended to Academic Council, the policy decision regarding introduction of Semester pattern and the draft syllabi of B.Sc. Part-I (Semester-I & II) along with draft ordinance and other details. The recommendations of the faculty was approved by the Academic Council in its emergent meeting held on 28.5.2010, vide item No.35 D).

AND

Whereas, Ordinance No.143 in respect of Examinations leading to the Degree of विज्ञान स्नातक (Bachelor of Science) is in existence in the University as per annual pattern examination system.

AND

Whereas, new scheme of examination as per semester pattern is to be implemented from the Academic Session 2010-11 for Semester-I & onwards which is regulated by an Ordinance and framing of an Ordinance for the above examination is likely to take some time.

AND

Whereas, the admission of students in the semester pattern at B.Sc. Part-I (Semester-I) are to be made in the Academic Session 2010-11.

Now, therefore, I, Dr. Kamal Singh, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called, "Examinations leading to the Degree of विज्ञान स्नातक (Bachelor of Science) (Three Year Degree Course-Semester Pattern), Direction, 2010".
2. This direction shall come into force with effect from the date of its issuance.
3. (i) The following shall be the examination leading to the Degree of विज्ञान स्नातक (Bachelor of Science) in the faculty of Science-
 - (1) The विज्ञान स्नातक भाग-१, सत्र-१ व २ (B.Sc. Part-I, Sem-I & II) Examination;
 - (2) The विज्ञान स्नातक भाग-२, सत्र-३ (B.Sc. Part-II, Semester-III) Examination;
 - (3) The विज्ञान स्नातक भाग-२, सत्र-४ (B.Sc. Part-II, Semester-IV) Examination;
 - (4) The विज्ञान स्नातक अन्त्य, सत्र-५ (B.Sc. Final, Semester-V) Examination; and
 - (5) The विज्ञान स्नातक अन्त्य, सत्र-६ (B.Sc. Final, Semester-VI) Examination.
- (ii) The period of Academic Session shall be such as may be notified by the University.

4. (i) The theory examination of Semester-I & II shall be simultaneously conducted by the University at the end of Semester-II in Summer.
- (ii) The examination of Semester-III, IV, V & VI shall be conducted by the University and shall held by the end of each semester separately.
- (iii) The main examination of Semester-III & V and that of Semester-IV & VI shall be held in Winter and Summer respectively.
- (iv) The supplementary examination for Semester-I & II shall be held in Winter and that of Semester-III & V and Semester-IV & VI in Summer and Winter respectively.

That means the theory examination of all the Semesters shall be conducted by the University and shall be held as per the schedule.

Sr.No.	Name of the Examination	Main Examination	Supplementary Examination
1	Semester-I & Semester-II	Summer (Simultaneously)	Winter (Simultaneously)
2	Semester-III & Semester-V	Winter	Summer
3	Semester-IV & Semester-VI	Summer	Winter

5. Subject to their compliance with the provisions of this Direction and of other Ordinances in force from time to time, the following persons shall be eligible for admission to the examinations, namely:-
 - (a) A student of a College who has prosecuted a regular course of study for not less than one academic year prior to that examination;
 - (b) A teacher in a Educational Institution eligible under the provisions of Ordinance No.18, and
 - (c) A women candidate who has not pursued a regular course of study.

Provided that in the case of the persons eligible under clauses (b) and (c) an applicant to the examination shall have attended a full course of laboratory instructions in a College in the subject in which laboratory work is prescribed. The candidate shall submit a Certificate to that effect signed by the Principal of the college.

6. (I) **The Students passing H.S.C. Examination with Physics, Chemistry and Mathematics shall offer following subjects at B.Sc. Part-I Examination.**
 - (i) English and any one of the following languages Marathi, Hindi, Urdu, Sanskrit, and Supplementary English.
 - (ii) Three optional subjects atleast one subject from the following groups be selected.

Group A :- Chemistry, Industrial Chemistry, Petro-Chemical Science, Electronics, Mathematics.

Group B :- Physics, Geology, Statistics, Computer Science, Computer Application, Information Technology and Geography.

The Students passing H.S.C. Examination with Chemistry and Biology shall offer following subjects:-

- (i) English and any one of the following languages. Marathi, Hindi, Urdu, Sanskrit and Supplementary English.
- (ii) Chemistry.
- (iii) Two optional subjects from the following group be selected.

Group C : Botany, Zoology, Bio-Chemistry, Geography, Fisheries, Environmental Science, Microbiology, Geology, Food Science, Industrial Microbiology, Biotechnology and Apiculture.

For Vocational subjects sanctioned by U.G.C. there shall be following scheme of Combination of subjects :-

Students with Mathematics at H.S.C. Examination shall select two subjects from Group D and one from Group F.

Students passing with Biology, at H.S.C Examination. Shall select two subjects from Group E and One from Group F.

Group D : Physics, Chemistry, Mathematics, Electronics, Statistics Computer Science, Computer Application, Information Technology and Geology.

Group E : Chemistry, Botany, Zoology, Micro-Biology, Geology, Geography, Environmental Science, Industrial Microbiology and Biochemistry.

Group F : Biological Techniques and Specimen Preparation. Industrial Chemistry, Instrumentation, Computer Application, Seed Technology, Industrial Fish and Fisheries, Computer Maintenance, Biotechnology and other Vocational subjects proposed by U.G.C. from time to time shall be included in Group F.

The students passing HSC examination with Physics, Chemistry, Biology and Mathematics shall have the option of opting Bioinformatics subject with any one subject from Group-G and any one subject from Group-H.

Group G: Botany, Zoology, Bio-Chemistry, Microbiology, Industrial Microbiology, and Biotechnology.

Group H: Chemistry, Physics, Electronics, Statistics, Geology, Mathematics and Computer Science.

(II) The students passing H.S.C. examination (M.C.V.C. stream) with technical trades mentioned in column No.2 of the following table shall be eligible for admission to the B.Sc.Part-I course in the optional subjects mentioned in column Nos. 3 of the said table as per the scheme given in Group A to H.

TABLE

Sr. No.	M.C.V.C. group and trade	Subjects allowed for admission to B.Sc.Part-I (Any three from the following)
1	2	3
1	Para Medical Group Medical Laboratory Technician Trade	Botany, Zoology, Computer Application (Vocational), Microbiology, Biochemistry, Biotechnology (Regular/Vocational), Geology, Geography, Environmental Science, Seed Technology (Vocational), Industrial Fish & Fisheries (Vocational), B.T.S.P. (Vocational), Chemistry, Bioinformatics.
2	Agricultural Group Horticulture Trade or Crop Science Trade	Zoology, Chemistry, Computer Application (Vocational), B.T.S.P. (Vocational), Seed Technology(Vocational), Microbiology, Biochemistry, Biotechnology (Regular/Vocational), Geology, Geography, Environmental Science, Botany, Bioinformatics.
3	Fisheries Group Inland Fisheries Trade Fish Processing Technology Trade	Botany, Chemistry, Computer Application (Vocational), B.T.S.P.(Vocational), Industrial Fish & Fisheries (Vocational), Microbiology, Biochemistry, Biotechnology (Regular/Vocational), Geology, Geography, Environmental Science, Zoology, Bioinformatics, Appiculture.
4	Engineering and Technology Group Electronics Technology Trade	Physics, Computer Science, Geology, Geography, Statistics, Chemistry, Mathematics, Industrial Chemistry (Regular/Vocational) , Computer Application (Vocational), Electronics, Information Technology.

(III) In the case of विज्ञान स्नातक भाग-२ सत्र-३ व ४ (B.Sc. Part-II, Sem-III & IV) Examination:-

have passed not less than one academic year previously the विज्ञान स्नातक भाग-१, सत्र-१ व २ (B.Sc. Part-I, Sem-I & II) Examination of the University or an examination recognised as equivalent thereto, and

(IV) In the case of the विज्ञान स्नातक अन्त्य, सत्र-५ व ६ (B.Sc. Final, Sem-V & VI) Examination:- have passed not less than one academic year previously the विज्ञान स्नातक भाग-२, सत्र-३ व ४ (B.Sc. Part-II, Sem-III & IV) Examination of the University or an examination recognised as equivalent thereto;

7. Subject to his/her compliance with the provisions of this Direction and other Ordinances (pertaining to Examination in General) in force from time to time, the applicant for admission, at the end of the course of study of a particular semester to an examination specified in column (1) of the table below, shall be eligible to appear at it, if,

- he/she satisfied the condition in the table and the provisions thereunder.
- he/she has prosecuted a regular course of study in a college affiliated to the University.
- he/she has in the opinion of the Principal shown the satisfactory progress in his/her studies.

TABLE

Name of the Exam to appear	The student should have completed the Session / term satisfactorily	The student should have passed
1	2	3
B.Sc. Part-I (Sem-I & II)	Sem-I & II	Qualifying examination.
B.Sc.-II Semester-III	Semester-I & II	One half of the total head prescribed for Sem-I & Sem-II examination
B.Sc.-II Semester-IV	Semester-III	One half of the total head prescribed for Sem-I & Sem-II examination
B.Sc.-III Semester-V	Semester-III & IV	(i) passed the Sem-I & II examination and (ii) One half of the total head prescribed for Sem-III & Sem-IV examination
B.Sc.-III Semester-VI	Semester-V	(i) passed the Sem-I & II examination and (ii) One half of the total head prescribed for Sem-III & Sem-IV examination

(Note : For Calculating the Heads, the theory and the practical shall be consider as a separate head and on calculation fraction if any shall be ignored.)

8. Without prejudice to the other provisions of Ordinance No. 6 relating to the Examination in General, the provisions of Paragraph 5, 8, 10 and 31 of the said ordinance shall apply to every collegiate candidate.
9. The fee for the examination shall be as prescribed by the University from time to time.
10. Every examinee for the विज्ञान स्नातक भाग-२, सत्र-३ व सत्र-४ (B.Sc.Part-II, Sem-III & Sem-IV), Examination shall be examined in each of the three Science subjects in which he has been examined at the विज्ञान स्नातक भाग-१, सत्र-१ व २ (B.Sc. Part-I, Sem-I & II) Examination.
11. Every examinee for the विज्ञान स्नातक अंत्य, सत्र-५ व ६ (B.Sc.Final, Sem-V & VI), Examination shall be examined in each of the three Science subjects in which he has been examined at the विज्ञान स्नातक भाग-२, सत्र-३ व सत्र-४ (B.Sc. Part-II, Sem-III & Sem-IV) Examination.
12. An examinee who is successful at the विज्ञान स्नातक भाग-१, सत्र-१ व २ (B.Sc. Part-I, Sem-I & II) Examination, may offer an additional subject mentioned in Para (6) (iii) not offered by him at the विज्ञान स्नातक भाग-१, सत्र-१ व २ (B.Sc. Part-I, Sem-I & II) Examination, on his prosecuting a regular course of study for one academic year in that subject. Such an examinee shall not be permitted to take any other examination simultaneously with the examination in the additional subjects. The fee for the additional subject shall be as prescribed by the University from time to time.
13. The Scope of the subjects of all semester opted by the students shall be as indicated in the respective syllabi from time to time. The medium of instruction and examination shall be English except for the courses in Languages.
14. The maximum marks allotted to each subject and paper and the minimum marks which an examinee must obtain in order to pass the examination shall be as per Appendices A, B, C, D, E and F appended to this Ordinance.
15. The practical examination of all semesters shall be conducted annually. That means the practical examination shall be conducted as per following schedule.

Sr.No.	Semester	Examination
1	Semester-I & II	Summer
2	Semester-III & IV	Summer
3	Semester-V & VI	Summer

16. The scheme of awarding internal marks shall be as per **Appendix-G** appended with this Direction.
17. Successful examinees at the विज्ञान स्नातक अंत्य, सत्र-६ (B.Sc. Final, Sem-VI) Examination who obtain not less than 60% marks in aggregate of Sem-I, II, III, IV, V & VI Examination taken together shall be placed in the First Division, those obtaining less than 60% but not less than 45% in the Second Division, and all other successful examinees in the pass Division.

Explanation :

Division at the विज्ञान स्नातक अंत्य, सत्र-५ व ६ (B.Sc. Final, Sem-V & Sem-VI) Examination shall be declared on the basis of the marks obtained in the Science Subjects at the Sem-I, II, III, IV, V & VI Examination taken together.

18. There shall be no classification of successful examinees at the Sem-I to Sem-V Examinations.
19. An examinee successful in the minimum period prescribed for the examination, obtaining not less than 75% of the maximum marks prescribed in the subject shall be declared to have passed the examination with Distinction in the subject.

Explanation :

(1) Distinction shall be awarded only in Science Subjects including Mathematics.

(2) Distinction at the विज्ञान स्नातक अंत्य (B.Sc. Final) Examination shall be awarded on the basis of the marks obtained at the विज्ञान स्नातक भाग-१, सत्र-१ व २; विज्ञान स्नातक भाग-२, सत्र-३ व ४; व विज्ञान स्नातक अंत्य, सत्र ५ व ६ (B.Sc. Part-I, Sem-I & II; B.Sc. Part-II, Sem-III & IV, and B.Sc. Final-Sem-V & VI) Examination taken together.

(3) Distinction shall not be awarded to an examinee availing of the provision of the exemptions and compartments at any of the examination.

20. Provisions of Ordinance No18/2001 in respect of an Ordinance to provide grace marks for passing in a Head of passing and Improvement of Division (Higher Class) and getting Distinction in the subject and condonation of deficiency of marks in a subject in all the faculties prescribed by the Statute NO.18, Ordinance 2001 shall apply.

21. (A) The students who have passed B.Sc.Final examination of this University or any other statutory University shall be eligible to seek admission for studying practical of any other optional subjects offered for B.Sc. Degree for simultaneous study of complete three year course for that subject in one year and to appear simultaneously for all parts of examination leading to the degree of Bachelor of Science (additional) in that subject, subject to the following condition.

An examinee shall have attended full course of laboratory instructions in a College in the subject in which laboratory work is prescribed. An examinee shall submit a certificate to that effect signed by the Principal of the College.

(B) On securing not less than minimum marks prescribed for the subject / subjects shall be issued a certificate of having passed the examination in the additional subject/subjects as the case may be.

(C) The application for admission to the examination under (A) above shall be submitted to the Registrar not less than three months before the date of commencement of the examination.”

22. As soon as possible after the examinations the Board of Examination shall publish a list of successful examinees at the B.Sc Part-I, Sem-I & II; B.Sc. Part-II, Sem-III & IV and B.Sc. Final Sem-V & VI Examinations. Such list at the विज्ञान स्नातक अन्त्य (B.Sc. Final) Examination shall be arranged in three Divisions. The names of the examinees passing the examination as a whole in the minimum prescribed period and obtaining the prescribed number of places in First or Second Division shall be arranged in Order of Merit as provided in the Examinations in General Ordinance No. 6.
23. No Person shall be admitted to B.Sc Part-I, Sem-I & II; B.Sc. Part-II, Sem-III & IV and B.Sc. Final Sem-V & VI Examinations, if he has already passed the corresponding or an equivalent examination of any other Statutory University.
24. Successful Examinees at the विज्ञान स्नातक भाग-१, सत्र-१ व २ (B.Sc. Part-I, Sem-I & II) and the विज्ञान स्नातक भाग-२, सत्र-३ व ४ (B.Sc. Part-II, Sem-III & IV) Examination shall be entitled to receive a Certificate signed by the Registrar and successful examinee at the end of विज्ञान स्नातक अन्त्य सत्र-६ (B.Sc. Final, Sem-VI) Examination, shall on payment of the prescribed fees, receive a Degree in the Prescribed form, signed by the Vice-Chancellor.

Appendix-A

Examination Scheme
विज्ञान स्नातक भाग-१
(B.Sc. Part-I) (Semester-I)

Sr.No.	Subject	Examination Scheme						Total Theory, Pract. & Int.Ass.
		Theory				Practical		
		Max. Mar. Theory Papers	Max. Marks Int. Ass.	Total	Min pass marks	Max. Marks Practical	Min. Pass Mar.	
1	Compulsory English	40	10	50	18	--	--	50
2	Languages	40	10	50	18	--	--	50
3	Mathematics (Paper-I)	60	15	150	54	--	--	150
4	Mathematics (Paper -II)	60	15			--	--	
5	Science subjects excluding Mathematics	80	20	100	35	50	18	150

Grand Total of Semester-I : 450+100

Appendix-B

विज्ञान स्नातक भाग-१
(B.Sc. Part-I) (Semester-II)

Sr.No.	Subject	Examination Scheme						Total Theory, Pract. & Int.Ass.
		Theory				Practical		
		Max. Mar. Theory Papers	Max. Marks Int. Ass.	Total	Min pass marks	Max. Marks Practical	Min. Pass Mar.	
1	Compulsory English	40	10	50	18	--	--	50
2	Languages	40	10	50	18	--	--	50
3	Mathematics (Paper - III)	60	15	150	54	--	--	150
4	Mathematics (Paper - IV)	60	15			--	--	
5	Science subjects excluding Mathematics	80	20	100	35	50	18	150

Grand Total of Semester-II : 450+100

Appendix-C

विज्ञान स्नातक भाग-२, सत्र-३
(B.Sc. Part-II) (Semester-III)

Sr.No.	Subject	Examination Scheme						Total Theory, Pract. & Int.Ass.
		Theory				Practical		
		Max. Mar. Theory Papers	Max. Marks Int. Ass.	Total	Min pass marks	Max. Marks Practical	Min. Pass Mar.	
1	Mathematics (Paper -V)	60	15	150	60	--	--	150
2	Mathematics (Paper - VI)	60	15			--	--	
3	Science subjects excluding Mathematics	80	20	100	40	50	20	150

Grand Total of Semester-III : 450

विज्ञान स्नातक भाग-२, सत्र-४
(B.Sc. Part-II) (Semester-IV)

Sr.No.	Subject	Examination Scheme						Total Theory, Pract. & Int.Ass.
		Theory				Practical		
		Max. Mar. Theory Papers	Max. Marks Int. Ass.	Total	Min pass marks	Max. Marks Practical	Min. Pass Mar.	
1	Mathematics (Paper - VII)	60	15	150	60	--	--	150
2	Mathematics (Paper - VIII)	60	15			--	--	
3	Science subjects excluding Mathematics	80	20	100	40	50	20	150

Grand Total of Semester-IV : 450

विज्ञान स्नातक अंत्य सत्र ५
(B.Sc. Final) (Semester-V)

Sr.No.	Subject	Examination Scheme						Total Theory, Pract. & Int.Ass.
		Theory				Practical		
		Max. Mar. Theory Papers	Max. Marks Int. Ass.	Total	Min pass marks	Max. Marks Practical	Min. Pass Mar.	
1	Mathematics (Paper - IX)	60	15	150	60	--	--	150
2	Mathematics (Paper -X)	60	15			--	--	
3	Science subjects excluding Mathematics	80	20	100	40	50	20	150

Grand Total of Semester-V : 450

विज्ञान स्नातक अंत्य सत्र ६
(B.Sc. Final) (Semester- VI)

Sr.No.	Subject	Examination Scheme						Total Theory, Pract. & Int.Ass.
		Theory				Practical		
		Max. Mar. Theory Papers	Max. Marks Int. Ass.	Total	Min pass marks	Max. Marks Practical	Min. Pass Mar.	
1	Mathematics (Paper - XI)	60	15	150	60	--	--	150
2	Mathematics (Paper - XII)	60	15			--	--	
3	Science subjects excluding Mathematics	80	20	100	40	50	20	150

Grand Total of Semester-VI : 450

- Note :**
- 1 There shall be only one theory paper of each science subject other than Mathematics for every semester.
 2. Distribution of marks of practical within the limit of Max. Marks shall be as prescribed by the B.O.S. of the concerned subject.
 3. In absence of certificate for practical record book (Appendix-H), examinee shall not be allowed to appear for the practical examination.

Appendix-G

The internal assessment marks assigned to each theory paper as mentioned in **Appendix-A to F** shall be awarded on the basis of assignment, class test, attendance, project assignments, Seminar, Study tour, Industrial visit, Visit to educational institutions and research organization, field work, group discussion or any other innovative practice/activity. The marking scheme for each of the practice/activity shall be as under :-

Sr. No.	Semester	Practice/Activity	Details of marking scheme	Total marks for		
				Languages	Mathe- matics	Other Science Subjects
1	2	3	4	5	6	7
1	Semester-I & II	Assignment	Two assignments per theory paper	04	05	08
2	Semester-I & II	Class Test	Two class test (on passing test)	06	10	12
Total marks for Sem-I /II				10	15	20
3	Sem-III, IV, V & VI	Project Assignment	On latest developments in the subject in 100-200 words	--	03	04
4	Sem-III, IV, V & VI	Class Test	Two class test (on passing test)	--	08	10
5	Sem-III, IV, V & VI	Seminar, Study tour, Industrial visit, Visit to educational institutions, research organization, field work, group discussion or any other innovative practice/activity.	Any one of the activity with report of the activity.	--	04	06
Total marks of Sem-III/ IV/V/ VI				--	15	20

- Note :**
1. The concerned teacher shall have to keep the record of all the above activities till the passing out of that batch.
 2. At the beginning of each semester, every teacher shall inform his/her students unambiguously the method he/she proposes to adopt a scheme of marking for the internal assessment.
 3. Teacher shall announce the schedule of activity for Internal Assessment in advance in consultation with HOD/ Principal.
 4. Normally the teacher concerned may conduct three written tests spread periodically during the semester and award the marks on the test on passing of any two tests.
 5. The internal marks shall be displayed on the notice board before three weeks of the commencement of the theory examination. Grievances if any, of the student regarding Internal Assessment marks shall be settled by the Principal at college level in consultation with the concerned teacher.
 6. Final submission of internal marks to the University shall be before commencement of the theory examinations.

Appendix-H

CERTIFICATE

Name of College / Institution :-

Name of the Department :-

This is to certify that this Book contains the bonafide record of the practical work of Shri/Kumari/Shrimati

.....

of B.Sc.Part-..... (Semester-.....) during the Academic year

Dated :...../...../20.....

Signature of the Teacher
who taught the examinee

1.
2.

Head of the Department

(**Note :** In absence of certificate for practical record book (Appendix-H), examinee shall not be allowed to appear for the practical examination.)

Amravati
Date : 11/6/2010

Sd/-
(Dr.Kamal Singh)
Vice-Chancellor

Sang Gadge Baba Amravati University, Amravati

DIRECTION

No. : 37 / 2011

Date : 26.7.2011

Subject : Corrigendum to Direction No.16/2010 in respect of Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern)

Whereas, the Direction No. 16 of 2010 regarding Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern), Direction-2010 is in existence.

AND

Whereas, the existing provision regarding theory examination of Semester-I & II shall be simultaneously conducted by the University at the end of Semester-II in Summer as well as the practical examinations shall be conducted annually for each semester.

AND

Whereas, the Committee constituted by the faculty of Science, under the Chairmanship of Dean of the faculty in its meeting held on 28.6.2011 and 14.7.2011 has considered the issues regarding conduction of theory and practical examination of B.Sc. Semester-I to VI at the end of each semester, from the Academic Session 2011-12.

AND

Whereas, making amendments in the Ordinance for above examination is a time consuming process..

AND

Whereas, it is necessary to carryout the corrections to Direction No.16 of 2010 issued earlier as stated in para No.1 above, urgently.

Now, therefore, I, Dr.Mohan K.Khedkar, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called "Corrigendum to Direction No.16/2010 in respect of Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern)".
2. This direction shall come into force from the date of its issuance.
3. From the Academic Session 2011-12, theory and practical examinations of each Semester shall be conducted separately at the end of each semester.

Amravati
Date : 26/7/2011

Sd/-
(Dr.Mohan K.Khedkar)
Vice-Chancellor

DIRECTION

No. : 1 / 2012

Date :23.1.2012

Subject : Corrigendum to Direction No.16/2010 in respect of Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern)

Whereas, the Direction No.16 of 2010 in respect of Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern) in the faculty of Science is in existence.

AND

Whereas, corrigendum to Direction No.16 of 2010 in respect of Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern) was issued vide Direction No.37/2011 on dated 26.7.2011.

AND

Whereas, the Academic Council in its meeting held on 13.1.2012 vide item Nos.14 (5) (E) and 14 (5) (O) respectively has accepted to allow the students passing H.S.S.C. examination (M.C.V.C. stream) with Medical Laboratory Technician Trade for admission to B.Sc. Part-I under the group-"Chemistry, Environmental Science, Industrial Microbiology," and the recommendations of the Monitoring Committee under the Chairmanship of Dean, faculty of Science of its meeting dated 15.11.2011 regarding correction in marking scheme of Internal Assessment Marks at B.Sc. level.

AND

Whereas, as per decision of Academic Council, the above correction are to be carried out in Column No.3 against Sr.No. 1 under the table of sub-clause (II) of Para 6 and in Appendix-G of Direction No.16 of 2010 issued earlier for the Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern) in the faculty of Science for Summer-2012 examinations and onwards.

AND

Whereas, it is necessary to carry out the corrections in the above said Direction immediately.

Now, therefore, I, Dr.Mohan K.Khedkar, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called "Corrigendum to Direction No.16/2010 in respect of Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern) in the faculty of Science".
2. This direction shall come into force from the date of its issuance.
3. In Direction No.16/2010 in respect of Examinations leading to the Degree of (Bachelor of Science) (Three Year Degree Course – Semester Pattern) in the faculty of Science-

A) the words "Industrial Microbiology" after the word "Bioinformatics" in column No.3 against Sr.No.1 under the table of Sub-clause (II) of para 6 of Direction No.16 of 2010 shall be added.

B) in Appendix-G following corrections be carried out :

1. In column No.4, at Sr.No.1, the words "Two assignments" be replaced by the words "One assignment".
2. In column No.4, at Sr.No.2, the words & signs "Two Class Tests (On passing test)" be replaced by the words "One test".
3. In column No.4, at Sr.No.4, the words & signs "Two Class Tests (On passing test)" be replaced by the words "One test".
4. In column No.4, at Sr.No.5, the words "Any one of the activity" be replaced by the words "Any one of the activities".
5. The Note No.4 be deleted and substituted by the following para.

"The test with maximum 30 marks be conducted for the students and the marks be allotted based on the performance of the students as under-"

	Languages	Mathematics		Other Sci. subjects	
	Sem-I & II	Sem-I & II	Sem-III to VI	Sem-I & II	Sem-III to VI
For the score 24 and above.	06	10	08	12	10
From 18 to 23	05	08	06	10	07
From 11 to 17	04	06	04	07	05
From 0 to 10	00	00	00	00	00

6. The following Note be added at Sr.No.7 -

"The student who remain absent for internal assessment through out the semester, 'Zero' marks be given to him/her while posting the marks instead of writing "Ab" before his/her name."

Amravati
Date : 23/1/2012

Sd/-
(Mohan K.Khedkar)
Vice-Chancellor

**Syllabus Prescribed for B.Sc. Final Examination
Semester- V & VI**

1. Mathematics

**5S Mathematics - Paper – IX
(Analysis)**

- Unit I** : Riemann Integral. Integrability of continuous and monotonic functions. The fundamental theorem of integral calculus. Mean value theorems of integral calculus. Improper integrals and their convergence. Comparison and limit tests .
- Unit II** : Continuity and differentiability of complex functions. Analytic functions. Cauchy-Riemann equations. Harmonic and Conjugate functions. Milne Thompson method
- Unit III** : Elementary functions Mapping by elementary functions. Mobius transformations. Fixed points. Cross ratio. Inverse points and critical points. Conformal mappings.
- Unit IV** : Metric Spaces :Countable and uncountable sets. Definition & examples of metric spaces. Neighbourhoods. Limit points. Interior points. Open and closed sets. Closure, Interior & boundary points. Sub-space of a metric space. Cauchy sequences. Completeness. Cantor's intersection theorem. Baire category theorem.
- Unit V** : Compactness. Connectedness. Limit of functions. Uniform continuous functions. Continuity and compactness. Continuity and connectedness.

Reference Books :

1. R. R. Goldberg:Methods of Real Analysis, Oxford IBH publishing Co. New Delhi, 1970.
2. T. M. Karade, J. N. Salunke, K. S. Adhav, M. S. Bendre : Lectures on Analysis, Sonu Nilu Publication, Nagpur.
3. Walter Rudin: Principles of Mathematical Analysis, International students edition (Third edition)
4. T. M. Apostol :Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.,
5. S. Lang : Undergraduate Analysis, Springer-Verlag New York, 1983.
6. D. Somasundaram & B. Choudhari : A First Course in Mathematical Analysis, New Delhi. 1997.
7. Shanti Narayan : A Course of Mathematical Analysis, S. Chand & Co., New Delhi.
8. P. K. Jain & S. K. Kaushik : An Introduction to Real Analysis, S. Chand & Co. New Delhi, 2000.
9. R. V. Churchill and J.W.Brown, Complex Variables and Applications, 5th Edition, McGraw Hill, New York,1990
10. Mark J Ablowitz and : A.S. Fokas, Complex Variable Introduction and Application ,Cambridge University Press ,South Asian Edition ,1998.
11. Shanti Narayan : Theory of functions of Complex Variable,,S.Chand and Co. New Delhi.
12. E.T.Copton,:Metric Spaces, Cambridge University Press ,1968.
13. P.K.Jain and K.Ahmed ,:Metric Spaces ,Narosa Publishing House, New Delhi 1996.
14. G.F.Simmons :Introduction to Topology and Modern Analysis, McGraw Hill, New York,1963

**Semester V
5-S Paper - X
(Modern Algebra)**

- Unit I** : **Normal Subgroups:**
Definition, examples. Different characterizations of normal subgroups, Algebra of normal subgroups, Quotient group.
- Unit II** : **Homomorphism and Isomorphism:**
Homomorphism, Homomorphic image, Kernel of homomorphism, Isomorphism of groups, Fundamental theorem of homomorphism, Natural homomorphism.
- Unit III** : **Ring:**
Definition, Examples , Properties of ring, Commutative ring, Ring with unity, Zero divisor, Without zero divisor, Boolean ring, Cancellation laws in rings, Subring.
- Unit IV** : **Integral domain and field:**
Definition, examples, field, Subfield, Prime field, The field of quotients of an integral domain, Characteristics of a ring.
- Unit V** : **Polynomial rings:** Division Algorithm theorem, Unique factorization theorem for polynomials over a field, Polynomials over rational field, Gauss Lemma, The Eisenstein Criterion. Unique factorization domain (UFD) (only Definition).

Reference Books:

1. I.N.Herstein:Topics in Algebra, Wiley Eastern Ltd., New Delhi,1975.
2. N.Jacobson : Basic Algebra ,Vol. I and II W.H.Freeman,1980(Hindustan Publishing Co.

3. Shanti Narayan :A Text Book Of Modern Abstract Algebra, S. Chand and Co. ,New Delhi
4. K.B.Datta: Matrix and Linear Algebra, Prentice Hall of India Pvt.Ltd.New Delhi,2000
5. P.B.Bhattacharya, S.K.Jain and S.R.Nagpal : Basic Abstract Algebra (IInd Edition)Cambridge University Press Indian Edition,1997
6. K.Hoffman and R.Kunze :Linear Algebra ,II nd Edition Prentice Hall,Englewood Cliffs, New Jersey,1971.
7. S.K.Jain, A Gunawardhana and P.B.Bhattacharya : Basic Linear algebra with MATLAB, Key College Publishing (Springer-Verlag)2001
8. S. Kumaresan : Linear Algebra, A Geometric Approach,P Prentice Hall of India Pvt.Ltd.New Delhi,2000
9. Vivek Sahai and Vikas Bisht :Algebra, Narosa Publishing House ,1997.
10. D.s.Malik,J.N.Mordeson and M.K.Sen :Fundamentals of Abstract Algebra ,McGraw Hill International Edition 1997
11. T.M.Karade, J.N.Salunke, K.S.Adhav, M.S.Bendre :Lectures on Abstract Algebra.Sonu Nilu Publication.Nagpur(IInd Publication)

Semester VI
6 S - Paper XI
(Linear Algebra)

Unit I : Vector Space :

Definition and example of vector spaces. Subspaces. Sum and direct sum of subspaces. Linear span. Linear dependence, Independence and their basic properties.Basis , Finite dimensional vector spaces . Existence theorem for bases. Invariance of the number of elements of a basis set. Dimension.

Unit II : Linear Transformations

Linear transformation and their representation as matrices. The algebra of linear transformations. The rank nullity theorem. Change of basis.

Unit III : Dual Spaces

Dual space. Bidual space and natural isomorphism. Adjoint of a linear transformation. Eigen values and eigenvectors of a linear transformation.

Unit IV : Inner Product Spaces

Inner product spaces. Cauchy-Schwarz inequality. Orthogonal vectors. Orthogonal complements. Orthonormal sets and bases. Bessel's inequality for finite dimensional spaces. Gram Schmidt Orthogonalisation process.

Unit V : Modules

Modules, Submodules, Quotient modules. Homomorphism and Isomorphism theorems.

Reference Books:

1. I.N.Herstein:Topics in Algebra, Wiley Eastern Ltd., New Delhi,1975.
2. N.Jacobson: Basic Algebra ,Vol. I and II W.H.Freeman,1980 (Hindustan Publishing Co.)
3. Shanti Narayan :A Text Book Of Modern Abstract Algebra, S. Chand and Co. ,New Delhi
4. K.B.Datta:Matrix and Linear Algebra, Prentice Hall of India Pvt.Ltd.New Delhi,2000
5. P.B.Bhattacharya, S.K.Jain and S.R.Nagpal :Basic Abstract Algebra (IInd Edition) Cambridge University Press Indian Edition,1997
6. K.Hoffman and R.Kunze,:Linear Algebra ,IInd Edition Prentice Hall,Englewood Cliffs, New Jersey,1971.
7. S.K.Jain, A Gunawardhana and P.B.Bhattacharya:Basic Linear algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001
8. S. Kumaresan :Linear Algebra, A Geometric Approach,P Prentice Hall of India Pvt. Ltd. New Delhi,2000
9. Vivek Sahai and Vikas Bisht :Algebra, Narosa Publishing House ,1997.
10. D.S.Malik,J.N.Mordeson and M.K.Sen :Fundamentals of Abstract Algebra ,McGraw Hill International Edition 1997
11. T.M.Karade, J.N.Salunke, K.S.Adhav, M.S.Bendre :Lectures on Abstract Algebra.Sonu Nilu Publication. Nagpur (IInd Publication)

Semester – VI
6 S - Paper-XII (Optional)
(Graph Theory)

Unit I : Graph. Application of graphs, finite and infinite graphs, incidence and degree, isolated vertex, pendent vertex and null graph, isomorphism, subgraphs, walks, path and circuits, connected graphs and components, Euler graph, operation on graphs, Hamiltonian paths and circuits, travelling salesman problem.

Unit II : Trees, some properties of trees, pendent vertices in a tree, distance and centres in a tree, Rooted and binary trees, On counting trees, spanning trees.

Unit III : Fundamental circuits, Cutsets, Some properties of cutesets, all cuteset in a graph, fundamental circuits and cutsets, connectivity and separability, planer graphs, Kurutowski's two graphs, different representation of planer graph, detection of planarity.

Unit IV : Vector space associated with a graph, circuit and cutset subspaces, Orthogonal vectors and spaces, Intersection and join of W_F and W_S .

Unit V : Incidence matrix, Submatrix of $A(G)$, Circuit matrix, Fundamental circuit matrix B , Rank of B , an application to a switching network, cutset matrix, path matrix, adjacency matrix, the relationship among A_f , B_f and C_f

Reference Books:

1. Narsingh Deo: Graph Theory with Application to Engineering and Computer Science, Prentice Hall Of India, New Delhi.,
2. Richard Johnson- Baugh : Discrete Mathematics, Macmillan Publishing Company 886, Third Avenue New York 10022
3. Olympia Nicodemi : Discrete Mathematics, C.B.S. Publ. and Distributors 485, Jain Bhavan Bholanath Nagar Shahadara New Delhi-32 India
4. Frank Harare : Graph Theory , Narosa Publishing House , 307 , Shiv Centre D.B.C. Sector Ku Bazar New Bombay 400704,
5. S.A. Choudum: A first Course In Graph Theory, McMillan India Ltd. Mercatile House Magazine Street Bombay 10
6. E.L. LIU : Elements of Discrete Mathematics, McGraw Hill Book Company, New York
7. Seymour Lipschutz and Marc Lipson : Discrete Mathematics , TMH New Delhi (Schaum Outline series) IInd Edition.
8. J.N. Salunke : Boolean Algebra and Graph Theory Laxmi Publication Akot.

Semester VI
6 S – Paper XII (Optional)
(Special Theory of Relativity)

Unit I : **Review of Newtonian Mechanics:**

Inertial frames. Speed of light and Galilean relativity Relative character of space and time. Postulates of Special theory of relativity. Lorentz Transformations and its geometrical interpretation. Group properties of transformation.

Unit II : **Relativistic Kinematics:**

Composition of parallel velocities. Length contraction. Time Dilation. Transformation equation for components of velocities and acceleration of a particle and Lorentz contraction factor.

Unit III : **Geometrical representation of Space-Time:**

Four dimensional Minkowskian space-time of relativity. Time like, Light Like and space like intervals. Proper time. World line of a particle. Four vector and tensors in Minkowskian space-time.

Unit IV : **Relativistic Mechanics:**

Variation of mass with velocity. Equivalence of mass and energy. Transformation equations for mass, momentum and energy. Relativistic force and transformation equations for its components. Relativistic Lagrangian and Hamiltonian.

Unit V : **Electromagnetism:**

Maxwell's equation in vacuum. Propagation of electric and magnetic field strengths. Transformation equations for electromagnetic four potential vector. Transformation equations for electric and magnetic field strengths. Gauge transformation. Lorentz invariance of Maxwell's equations. Lorentz force on a charged particle.

Reference Books:

1. T.M. Karade, K.S. Adhav and M.S. Bendre: Lectures on Special Theory of Relativity , Sonu Nilu Publication, Nagpur
2. C. Molar : The Theory of Relativity, Oxford Clarendon Press, 1952
3. P.G. Bergman : Introduction to The Theory of Relativity, Prentice Hall of India, Pvt. Ltd. 1969
4. J.L. Anderson : Principles of Relativity Physics, Academic Press, 1967
5. V.A. Ugarov : Special Theory of Relativity, Mir Publishers, 1979
6. R. Resnick : Introduction to Special Relativity Wiley Eastern, Pvt. Ltd. 1972

Semester – VI
6 S – Paper XII (Optional)
(Mathematical Modelling)

Unit I : The Process of applied mathematics. Setting of First-order differential equations – Qualitative solutions Sketching.

Unit II : Difference and Differential Equation growth models. Singled species population models. Population growth – An age structure model. The spread of Technological innovation.

Unit III : Higher order linear models : A model for the detection of diabetes. Combat modes. Traffic models- Car-following models. Equilibrium speed distributions.

Unit IV : Non-linear population growth models. Prey-Predator models. Epidemic growth models. Models from political Science Proportional representation – cumulative voting, comparison voting.

Unit V : Applications in Ecological and Environmental subject areas. Urban waste water management planning.

Reference Books :

1. Vol. 1 Differential equation models, Eds. Martin Barun, C. S. Coleman D. A. Drew.
2. Vol. 2 Political and Related Models. Steven J. Brams, W. F. Lucas, P. D. Straffin (Eds.)
3. Vol.3 Discrete and System models. W. F. Lucas, F. S. Roberts, R. M. Thrall.
4. Vol. 4 Life Science Models. H. M. Roberts & M. Thompson.
5. All Volumes published as modules in Applied Mathematics, Springer-Verlag, 1982.

2 : PHYSICS
Semester-V
5S PHYSICS

Unit I : Origin of Quantum Mechanics (12 L)

1. Historical Background: Failure of classical wave theory in explaining Black body radiation and Photoelectric Effect; Compton Effect Qualitative explanation only
2. Assumptions of Planck’s Quantum Theory
3. Wave Particle Duality
4. Matter Waves: De Broglie Hypothesis, Davisson Germer experiment
5. Concept of Wave Packet, Phase velocity, group velocity and relation between them.
6. Heisenberg’s uncertainty principle: Different forms of uncertainty principle; Thought experiments: single slit diffraction and Gamma ray microscope

Unit II : The Schrodinger equation and its applications (12 L)

- 1) Wave function and its physical significance
- 2) Schrodinger time dependent equation
- 3) Separation in time dependent and time independent parts
- 4) Operators in quantum Mechanics
- 5) Eigen functions and Eigen values
- 6) Particle in one dimensional and three dimensional box (Energy eigen values)
- 7) Qualitative analysis of potential barrier Tunneling effect)
- 8) Simple Harmonic Oscillator (Qualitative analysis of Zero point energy)

Unit III : Atomic and Molecular Spectroscopy (12 L)

Vector Atom Model: Quantum Numbers, Stern Gerlach experiment; selection rules, l-s and j-j coupling, Types of spectra – Emission & absorption spectra.

X-rays: Continuous X-ray spectrum, Duane and Hunt’s law, characteristic X-ray spectra, Mosley’s law.

Raman Effect: stoke’s and anti-stoke’s lines, Quantum theory of Raman effect, Experimental arrangement for Raman Spectroscopy.

Unit IV : Nuclear Physics (12 L)

Detection of charged particles; G. M. counter, Binding energy and Mass defect, stability of nuclei

Alpha Decay: Range of Alpha particles, Geiger - Nuttal law and Gamow’s explanation of alpha decay (qualitative)

Beta decay: Types and Pauli’s Neutrino Hypothesis

Nuclear Fission, Nuclear fusion (concepts only), Nuclear reactors.

Unit V : Hybrid parameters- low frequency equivalent of CE amplifier & its analysis., Bais stability & thermal runaway (qualitative). General principles of amplifier classification, RC coupled amplifier, equivalent circuits & gain at low, medium & high frequency (qualitative), gain-frequency response. Noise & distortion in electronic circuits.

Unit VI : Feedback in amplifiers- negative feedback, advantages of negative feedback, positive feedback. Phase shift, Wein bridge, Hartley & Colpits Oscillators. Multi-vibrators – astable, monostable & bistable.

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.

1. To study RC coupled amplifier- variation of gain with load.
2. To study phase shift oscillator.
3. To study Wein bridge oscillator.
4. To study Hartley oscillator.
5. To study Colpits oscillator.
6. To determine 'e' by Millikan's oil drop experiment.
7. To determine 'e' by Thomsons method.
8. Determination of Rydberg's constant.
9. To study absorption spectrum of Iodine vapors.
10. To study Raman spectrum.
11. To identify elements in optical line spectrum.
12. To determine absorption coefficient of material for gamma rays.
13. To study phase & frequency by using CRO.
14. Determination of Hybrid parameters.
15. Study of monostable multivibrator.
16. Study of astable multivibrator.
17. Study of an amplifier - with & without feedback.

6S PHYSICS

STATISTICAL MECHANICS AND SOLID STATE PHYSICS

UNIT-I : Statistical Mechanics

Phase space, unit cell, microstates, macrostates, energy states, density of energy states, probability & thermodynamic probability, principle of equal a priori probabilities, most probable distribution, Boltzman entropy relation.

Maxwell Boltzman statistics, and its application to molecular speed distribution, Average speed, rms speed & most probable velocity.

UNIT-II : Distinguishable & indistinguishable particles, concepts of boson & fermions.

Bose – Einstein statistics : Thermodynamic probability, most probable distribution, application of BE statistics to black body radiation.

Fermi- Dirac distribution : Thermodynamic probability, Most probable distribution, Fermi function, Fermi energy & Fermi temperature.

UNIT-III : Crystallography

Solids: - Amorphous and Crystalline Materials; Unit Cell. Millar Indices, Reciprocal Lattice, Coordination Number. Types of Lattices: Diffraction of x-rays by Crystals. Bragg's Law: Determination of lattice parameters of NaCl crystal.

Defects in solids – points, line & plane defects.

UNIT -IV: Electrical Properties of Materials

Motion of electron:- Free electrons; conduction electrons, electron collision; mean free path, conductivity & Ohm's law; density of states; concept of Fermi energy.

Band structure : Electron in periodic potential, nearly free electron model (qualitative), energy band, energy gap, metals, insulators and semiconductors.

UNIT-V : Magnetic Properties of Materials

Atomic magnetic moment; magnetization vector; magnetic susceptibility; Dia -, Para-, and Ferromagnetic Materials; Classical Langevin Theory of dia and Paramagnetic Domains; Quantum Mechanical Treatment of Paramagnetism; Curie's law, Weiss's law;. Hysteresis and Energy Loss.

UNIT-VI : Superconductivity & Nano Technology

Superconductivity: Introduction to Superconductors; Critical Temperature; Critical magnetic field; Meissner –effect; Type I and type II Superconductors, Idea of BCS theory (No derivation), Cooper pair; Applications of superconductors.

Nano Technology: Introduction to nano size materials, brief History of Nano materials, Effect of reduction of dimensions on physical properties; quantum size effect; Applications of nano materials in different fields.

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.

LIST OF EXPERIMENTS:

- 1 To study crystal models and identification of crystal planes.
- 2 To study Characteristics of Photocell
- 3 To determine Planck's constant using photocell
- 4 To determine energy gap of semiconductor using four probe method.
- 5 To determine activation energy of Thermister.
- 6 To determine energy gap of semiconductor using reverse bias method
- 7 To study hysteresis losses in transformer core and plot B-H curve.
- 8 To measure magnetic susceptibility of solids.
- 9 To study thermo emf using thermocouple.
- 10 To Determination of temperature coefficient of resistance of platinum using platinum resistance thermometer.
- 11 To determine lattice parameter using X-ray diffraction pattern.
- 12 To determine half life period of radioactive substance by GM counter
- 13 Determination of dislocation density in alkali halide crystals.
- 14 Demonstrations- Any 4 demonstrations equivalent to 2 experiments
- 15 Mini project equivalent to 2 experiments.
- 16 Computer aided demonstrations (Using computer simulations or animations) (Any 2 demonstrations equivalent to 2 experiments)

REFERENCE BOOKS:

1. Thermodynamics and statistical mechanics-Brijlal Subramaniam
2. Statistical Mechanics – An Elementary Outline – Avijit Lahiri – Universities Press
3. Statistical and Thermal physics - By Lokanathan, R.S. Gambhir,
4. Fundamentals of statistical and thermal physics - By F.Reif
5. Perspectives of modern physics - By A. Beiser
6. Fundamental of Statistical Mechanics - By B.B. Laud
7. A primer of Statistical Mechanics - By R.B. Singh
8. Statistical Mechanics - By Gupta, Kumar
9. Solid State Physics, S.O.Pillai, 3rd Edition, New Age International (P) Ltd, Publisher, (1999).
10. Solid State Physics – By Kakani and Hemrajani, S. Chand Publication.
11. Solid State Physics - By Saxena, Gupta and Saxena, Pragati Prakashan.
12. Introduction to Solid State Physics, Charles Kittel, John Wiley and Sons, 7th Edition.
13. Solid State Physics, A.J.Dekker, Macmillan India Ltd, (1998).
14. Solid State Physics, R.K. Puri, V.K. Babbar, S. Chand Publication.
15. Problems in Solid State Physics, S.O. Pillai, New Age International (P) Ltd.
16. Solid State Physics, Palanyswamy.
17. Solid State Physics, David, Snoke, Pearson Publication.
18. Introduction to Nanoscience & Nanotechnology by K. K. Chattopadhyay and A. N.Banerjee, Publisher: PHI Learning and Private Limited
19. Nanotechnology, Rakesh Rathi, S Chand & Company, New Delhi
20. Nanotechnology: Principles and Practices by Sulbha K Kulkarni, Capital Publishing Co. New Delhi.

References :

1. IGNOU : Practical Physics Manual
2. Saraf : Experiment in Physics
3. S.P. Singh : Advanced Practical Physics
4. Melissos : Experiments in Modern Physics

3 : CHEMISTRY

The examination in Chemistry of Fifth 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-V (8 marks).

**Semester- V
5S Chemistry**

Total Lectures: 84**Marks: 80****Note:** Figures to the right hand side indicate number of lectures.**Unit I****14L****A) Coordination Compounds-I:**

Important terms namely-molecular or addition compounds, double salts, complex ion, ligand, coordination number, central metal ion etc. Werner's theory of coordination and experimental evidences on the basis of conduction data and formation of AgCl precipitate in case of cobaltamines. Sidgwick's electronic interpretation and its drawbacks. Effective atomic number rule. IUPAC rules for nomenclature of coordination compounds. Structural isomerism-ionization, linkage and coordination isomerism in complexes. Geometrical isomerism in octahedral complexes of type Ma_4b_2 , Ma_4bc , Ma_3b_3 , $M(AA)_2b_2$. Square planar complexes of type Ma_2b_2 and Ma_2bc . Optical isomerism in octahedral complexes of type $Ma_2b_2c_2$, $Mabcdef$, $M(AA)_3$, $M(AA)_2b_2$ and tetrahedral complexes of type $Mabcd$ and $M(AA)_2$. Optical isomerism in square planar complexes. VB theory as applied to structure and bonding in complexes of 3d series elements (Only 4 and 6 coordinated complexes). Inner and outer orbital complexes. Magnetic properties of complexes of 3d series elements. Limitations of VB theory.

[12]**B) Chelates:**

Definition, classification and applications of chelates in analytical chemistry.

[2]**Unit II****14L****A) Coordination compounds-II:**

Crystal field theory-postulates of CFT. Crystal field splitting in octahedral and tetrahedral complexes. Factors affecting the magnitude of crystal field splitting in octahedral complexes. Concept of CFSE. Distribution of electrons in t_{2g} and e_g orbitals. High spin and low spin complexes on the basis of Δ_o and pairing energy.

[5]**B) Electronic spectra of transition metal complexes:**

Introduction to spectra. Types of electronic transitions. Selection rules for d-d transitions. Spectroscopic ground terms. Term symbols. Calculation of ground terms. Spectra of octahedral d^1 and d^9 complexes. Orgel diagram for d^1 and d^9 octahedral complexes. Discussion of electronic spectrum of $[Ti(H_2O)_6]^{3+}$ complex ion. Spectrochemical series.

[6]**C) Stability of Complexes:**

Factors affecting stability of complexes. Stability of chelates with special reference to chelate effect. Stability constants-stepwise and overall. Thermodynamic and kinetic stability.

[3]**Unit III – Heterocycles and Organometallics****14L****A) Heterocycles:**

Introduction, 5 and 6 membered heterocycles, orbital picture of pyrrole and pyridine. Modern methods of synthesis. Electrophilic substitution in Pyrrole and Pyridine. Chemical reactions and orientation. Nucleophilic substitution in pyridine.

[6]**B) Organometallic Compounds:**

Introduction, methods of preparation and synthetic applications of organomagnesium, organolithium and organozinc compounds.

[5]**C) Retrosynthesis:** Retrosynthetic analysis and applications

a) Different terms used (Disconnection, synthon, synthetic equivalence, FGI, TM)

b) One group disconnection with examples

c) Retrosynthesis and synthesis of following target molecules:-

i) t- Butyl alcohol ii) Acetophenone iii) Cyclohexene iv) Crotonaldehyde

v) Cyclopentylmethanal vi) Benzoin vii) Benzyl benzoate

[3]**Unit IV****14L****A) Polymers:**

Introduction, types of polymers, addition and condensation polymers. Synthesis, properties and applications of:

1) Natural and synthetic rubber (Buna -S and Buna -N)

2) Synthetic fibers. Polyamides, Polyesters and Polyacrylates.

3) Plastics: Polyolefins and Polyurethanes.

[4]

B) Dyes:

Classification of dyes on the basis of structure and on the basis of mode of applications. Preparation and uses of Methyl orange, Congo-Red, Crystal Violet and Alizarin. [4]

C) Drugs:

Introduction, Preparation, Drug action and use of Aspirin, Paracetamol, Sulphanilamide and Sulphaguanidine. [3]

D) Pesticides:

Introduction, Classification (Insecticides, Herbicides, Fungicides and Rodenticides). Synthesis and uses of a) Malathion b) 2,4-dichlorophenoxy acetic acid (2,4- D). [3]

Unit V- Elementary Quantum Mechanics

14L

- (i) Limitations of classical mechanics. Planck's quantum theory (Postulates only). Photoelectric effect (Experiments, Observations and Einstein's explanation). Compton effect and its explanation.
- (ii) L de Broglie hypothesis of matter waves. de Broglie's equation. Heisenberg's uncertainty principle.
- (iii) Classical wave equation. Derivation of time independent Schrodinger's wave equation in one dimension and its extension to a three dimensional space. Well behaved wave function. Physical significance of the wave function (Born interpretation).
- (iv) Application of Schrodinger wave equation to a particle in one dimensional box and its extension to a three dimensional box. Concept of atomic orbitals.
- (v) Numericals.

Unit VI- Molecular Spectroscopy

14L

- (i) Electromagnetic radiation. Characterization of EMR in terms of wavelength (λ), frequency (ν), wave number ($\bar{\nu}$) and energy of photon ($h\nu$). Spectrum of electromagnetic radiations.
- (ii) Energy level diagram of a molecule indicating electronic, vibrational and rotational transitions.
- (iii) Condition for pure rotational spectrum (i.e. microwave active molecules). Selection rule for rotational transitions. Derivation of expression for moment of inertia of a diatomic rotor. Isotope effect. Applications of microwave spectroscopy for the determination of moment of inertia and bond length.
- (iv) Condition for exhibiting vibrational spectrum (i.e. IR active molecules). Selection rule for vibrational transitions. Vibrational energy levels of a simple harmonic oscillator. Zero point energy. Position of a spectral line. Determination of force constant of covalent bond.
- (v) Raman effect. Raman spectrum of a molecule. Condition for exhibiting Raman spectrum (i.e. Raman active molecules). Selection rule for rotational transitions. Pure rotational spectrum of diatomic molecule. Vibrational Raman spectrum of a diatomic molecule.
- (vi) Numericals.

Semester- V

5S Chemistry Practicals

Total Laboratory sessions: 21

Marks: 50

Unit I: Inorganic Chemistry Practicals

7 Laboratory sessions

1. Inorganic preparations:

- (a) Preparation of tetramine copper (II) sulphate.
- (b) Preparation of hexamine nickel (II) chloride.
- (c) Preparation of potassium trioxalatoaluminate (III).
- (d) Preparation of Prussian blue.
- (e) Preparation of chrome alum.
- (f) Preparation of sodium thiosulphate & dithionite.
- (g) Preparation of cuprous chloride.

} Comments on its VB structure, magnetic properties and colors.

Unit II- Organic Chemistry Practicals

7 Laboratory sessions

- 1) Estimation of acetamide.
- 2) Estimation of glucose.
- 3) Estimation of formaldehyde.
- 4) Estimation of nitro group.
- 5) Estimation of proteins.
- 6) TLC/Paper chromatography: Qualitative separation of mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).
- 7) Steam Distillation (Only demonstration)
 - a) Naphthalene from its suspension in water.
 - b) Clove oil from cloves

Unit III: Physical Chemistry Practicals

7 Laboratory sessions

- Expt. No. 1: To study conductometric titration of a mixture of strong and week acid (e.g. HCl + CH₃COOH) against a strong base (NaOH). (Standard oxalic acid solution to be prepared by the student).
- Expt. No. 2: To determine dissociation constant (K_a) of a week acid (e.g. CH₃COOH) by conductometry.
- Expt. No. 3: To study pH metric titration of a strong acid (e.g. HCl) against a strong base (e.g. NaOH) by computer simulation.
- Expt. No. 4: To study potentiometric titration of a strong acid (e.g. HCl) against a strong base (e.g. NaOH). (Standard oxalic acid solution to be prepared by the student).
- Expt. No. 5: To verify Lambert-Beer Law using KMnO₄/ K₂Cr₂O₇ solution.

Distribution of Marks for Practical Examination.

Time: 6 – 8 hours (One Day Examination)		Marks: 50
Unit – I	: Inorganic Chemistry (Exercise)	12
Unit – II	: Organic Chemistry (Exercise)	12
Unit – III	: Physical Chemistry (Exercise)	12
	Viva-Voce	07
	Record	07
Total:		50

Semester- VI
6S Chemistry

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

- Unit I : A) Kinetic Aspects of Metal Complexes: 14L**
Types of reactions of coordination compounds. Brief idea about substitution reactions. SN¹ dissociative and SN² associative mechanism of substitution in octahedral complexes. Labile and inert complexes. Factors affecting lability of complexes viz. arrangement of d-electrons (VB theory), size and charge on central metal ion and geometry of the complexes. Mechanism of substitution reactions in square planar complexes. [6]
- B) Analytical Chemistry:**
1. Colorimetry and Spectrophotometry:
Concept of λ_{max} . Beer-Lambert's law (only statements and final equation-no derivation). Calibration curve and its importance. Validity and limitations of Beer-Lambert's law. Verification of Beer's law. Block diagrams of colorimeter and spectrophotometer with brief description of each component and its function. Difference between colorimeter and spectrophotometer. Application of colorimetric and spectrophotometric technique for determination of concentration of metal ion [Example of determination of copper (II)].
- 2. Paper Chromatography:**
Definition and classification of chromatography. Principle of differential migration. Principle and technique of paper chromatography, R_f value and factors affecting R_f value. [8]
- Unit II : A) Organometallic Chemistry: 14L**
Definition, classification and nomenclature of organometallic compounds. Metal carbonyls-definition and classification. Preparation, properties, structure and bonding in mononuclear carbonyls- Ni(CO)₄, Fe(CO)₅ and Cr(CO)₆. Nature of metal-carbon bond in metal carbonyls. [5]
- B) Inorganic Polymers:**
Definition and classification. Silicones –preparation, properties applications, structure and bonding. Phosphonitrilic halide polymers- preparation, properties, structure and bonding in cyclic polymers. [5]
- C) Bioinorganic Chemistry:**
Essential and trace elements in biological processes. Role of Na⁺, K⁺, Mg²⁺ and Ca²⁺ ions in biological processes. Metalloporphyrins- Myoglobin and Hemoglobin and their role in oxygen transfer. [4]
- Unit III : A) Electronic Spectroscopy: 14L**
Introduction, radiation source, spectral range, types of electronic transitions, chromophore, auxochrome, bathochromic, hypsochromic, hyperchromic and hypochromic effects. Presentations of spectrum, applications to the structure determination of compounds like dines, aldehydes, ketones and aromatic systems. [5]
- B) Infrared Spectroscopy:**
Types of vibrational modes, stretching and bending, spectrum range, radiation source, presentation of IR spectrum, characteristic frequencies of various groups, Finger print region. Structure of organic compounds (IR spectra of simple compounds: H₂O, CO₂, CH≡CH, CH₃COCH₃). [5]
- C) Purification of Organic Compounds:** Sublimation, crystallization. Paper chromatography: Principle and R_f value. [4]
- Unit IV : A) Nuclear Magnetic Resonance Spectroscopy: 14L**
Introduction, origin of NMR phenomenon, spins of nucleus, spin angular momentum, energy states for proton in the magnetic field, absorption signals in the spectrum. Number of signals, Equivalent and Nonequivalent protons, nuclear shielding and deshielding, chemical shift, delta scale, integration wave, peak area and proton counting, spin-spin splitting, NMR spectra of simple molecules and structural analysis (ethyl bromide, ethyl alcohol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene, acetone and acetophenone, methyl ethyl ether). [5]
- B) Mass Spectrometry:**
Introduction, Theory, Instrumentation, Ion sources (EI, CI, FD, FAB) recording of mass spectrum, molecular ions, fragmentations. Determinations of molecular formula on the basis of mass spectra. [4]
- C) Quantitative Organic Chemistry**
Estimations of C, H, N, S and X (only principles and calculations), Determinations of empirical formula, molecular formula. Problems involving calculations, reactions and spectral data. [5]

- Unit V : Photochemistry** **14L**
- (i) Photochemical and thermal reactions.
 - (ii) Lambert's law (Statement and derivation). Beer's law (Statement and derivation). Reasons for deviations from Beer's law.
 - (iii) Laws of photochemistry- (a) Grotthus-Draper law (b) Stark-Einstein law.
 - (iv) Quantum yield of photochemical reaction. Reasons for high and low quantum yields. Experimental determination of quantum yield. Photosensitized reactions.
 - (v) Kinetics of photochemical decomposition of HI.
 - (vi) Fluorescence and Phosphorescence. Selection rule for electronic transitions. Internal conversion and Intersystem crossing. Explanation of Fluorescence and Phosphorescence on the basis of Jablonski Diagram.
 - (vii) Chemiluminescence and Bioluminescence (with examples).
 - (viii) Numericals.
- Unit VI : (A) Electrochemistry** **14L**
- (i) pH of a solution and pH scale. Determination of pH of solution using Hydrogen, Quinhydrone and Glass electrodes. Advantages and Disadvantages of these electrodes. pH metric titrations. Determination of pKa of a weak acid by pH metric titration.
 - (ii) Potentiometric titration. Advantages of Potentiometric titrations. Study of following potentiometric titrations- (a) Acid-Base (b) Redox (c) Precipitation.
 - (iii) Numericals. **[5]**
- (B) Nuclear Chemistry**
- (i) Composition of nucleus.
 - (ii) Shell model of the nucleus- Assumptions, Evidences for existences of magic numbers, Advantages and Limitations.
 - (iii) Liquid drop model of the nucleus- Assumptions, Similarities between nucleus and liquid drop, Advantages and Limitations. Explanation of nuclear fission reaction on the basis of liquid drop model.
 - (iv) Nuclear force and its explanations on the basis of meson theory.
 - (v) Representation of a nuclear reaction. Characteristics of a nuclear reaction. Difference between nuclear and chemical reactions. Calculation of Q-value of a nuclear reaction.
 - (vi) Characteristics of a nuclear fission reaction. Fission yield and Fission yield curve. Fission reaction as an alternative source of energy.
 - (vii) Characteristics of a nuclear fusion reaction. Thermonuclear reactions as a source of energy of sun and others star. Fusion reactions as a potential future source of energy.
 - (viii) Applications of radioisotopes in Industry, Agriculture, medicines and biosciences (at least two examples of each type).
 - (ix) Numericals. **[9]**

Semester- VI
6S Chemistry Practicals

Total Laboratory sessions: 21

Marks: 50

Unit I: Inorganic Chemistry Practicals

7 Laboratory sessions

1. Chromatographic separation of binary mixture containing Cu(II), Co(II) and Ni(II) ions by paper chromatography and determination of R_f values.
 2. Estimation of zinc (II) by complexometric titration.
 3. Estimation of hardness of water by complexometric titration.
 4. Colorimetric or spectrophotometric estimation of copper (II) in commercial copper sulphate sample as ammonia complex.
- [Note: Standard solutions are to be prepared by the students]

Unit II- Organic Chemistry Practicals

7 Laboratory sessions

- 1) Estimation of glycine.
- 2) Estimation of Ascorbic acid.
- 3) Determination of equivalent weight of an acid.
- 4) Determination of Iodine value of an oil.
- 5) Determination of equivalent weight of ester by saponification.
- 6) Estimation of free fatty acids in the oil.
- 7) Chromatographic separation of 2,4- DNP derivative of acetone and butanone-2 using toluene-petroleum ether (40-60^o).
- 8) Column chromatography (only demonstration)
 - a) Separation of fluorescence and methylene blue.
 - b) Separation of leaf pigments from spinach leaves.

Unit III: Physical Chemistry Practicals

7 Laboratory sessions

- Expt. No. 1: To determine solubility and solubility product of a sparingly soluble salt (e.g. BaSO₄) by conductometry.
- Expt. No. 2: To study potentiometric titration of ferrous ammonium sulphate (FAS) against K₂Cr₂O₇ solution.
- Expt. No. 3: To study potentiometric titration of KCl solution against AgNO₃ solution.
- Expt. No. 4: To determine dissociation constant (Ka) of a dibasic or tribasic acid by pH metry.
- Expt. No. 5: To determine specific rotation of the optically active compound by polarimeter.

Distribution of Marks for Practical Examination.

Time: 6 – 8 hours (One Day Examination)		Marks: 50
Unit – I : Inorganic Chemistry (Exercise)	.....	12
Unit – II : Organic Chemistry (Exercise)	.....	12
Unit – III: Physical Chemistry (Exercise)	.....	12
Viva-Voce	.....	07
Record	.....	07

		Total: 50

Books Recommended: (Common for Semester V and Semester VI)

- Principles of Inorganic Chemistry by Puri, Sharma and Kalia- S. Naginchand & Co., Delhi.
- Text book of Inorganic Chemistry by A.K. De, Wiley East Ltd.
- Selected Topics in Inorganic Chemistry by Malik, Tuli and Madan- S. Chand & Co.
- Modern Inorganic Chemistry by R.C. Agrawal, Kitab Mahal.
- Instrumental Methods of analysis by Chatwal and Anand, Himalaya Publishing House.
- Concise Inorganic Chemistry by J.D. Lee, ELBS.
- Inorganic Chemistry by J.E. Huheey- Harper & Row.
- Fundamental concepts of Inorganic Chemistry by E.S. Gilreath, McGraw Hill book Co.
- Modern Inorganic Chemistry by W.L. Jolly, McGraw Hill Int.
- Chemistry Facts, Patterns & Principles by Kneen, Rogers and Simpson, ELBS.
- Theoretical Principles of Inorganic Chemistry by G.S. Manku, Tata McGraw Hill.
- Inorganic complex compounds by Murmann, Chapman & Hall.
- Text book of Inorganic Chemistry by K.N. Upadhyaya, Vikas Publishing House, Delhi.
- Advanced Practical Inorganic Chemistry by Gurdeep Raj, Goel Pulishing House, Meerut.
- Co-ordination Chemistry by D. Banerjee, TMH Publication.
- Text book of Inorganic Chemistry by B.J. Joshi, P.J. Bahad, P.R. Mandlik, R.M. Kedar, C.B. Deshpande, V.V. Parhate published by Amravati University Chemistry Teachers Association with Bokey Prakashan, Amravati.
- Text book of Inorganic Chemistry by Bhadange, Pagariya, Deshmukh, Joshi, Bombatkar, Mandlik, Bokey Prakashan, Amravati.
- Organic Chemistry by R.T. Morrison & R.T. Boyd, 6th edition, PHI.
- Organic Chemistry by Pine, 5th edition.
- Organic Chemistry Vol. I, II and III by Mukharjee, Singh and Kapoor- Wiley Eastern.
- Organic Chemistry by S.K. Ghosh.
- Reaction Mechanism in Organic Chemistry by S.M. Mukharjee and S.P. Singh.
- Spectroscopy of Organic Compounds by P.S. Kalsi.
- Stereochemistry and mechanism through solved problems by P.S. Kalsi.
- Organic Chemistry by TWG Solomons, 4th edition, John Wiley.
- Hand Book of Organic Analysis by H.J. Clarke, Arnold Heinmen.
- Text book of Practical Organic Chemistry by A. I. Vogel.
- Text book of Organic Chemistry by P.R. Rajput, S.N. Bhosale, Y.K. Meshram, V.G. Thakre, Dr. S.P. Deshmukh, A.R. Mankar, published by Amravati University Chemistry Teachers Association with Bokey Prakashan, Amravati.
- Text book of Organic Chemistry by P.S. Kalsi published by Macmillan India Ltd., 1999, Delhi.
- Practical Organic Chemistry by F.G. Mann, B.C. Saunders, Orient Longman.
- Comparative Practical Organic Chemistry (Qualitative Analysis) by V.K. Ahluwalia and Sunita Dhingra, Orient Longman.
- Comprehensive Practical Organic Chemistry (Preparation and Qualitative Analysis) by V.K. Ahluwalia and Renu Agrawal, Orient Longman.
- Physical Chemistry: Walter, J. Moore, 5th edn., New Delhi.
- Physical Chemistry: G.M. Barrow, McGraw Hill, Indian Edn.
- Principles of Physical Chemistry: Maron and Prutton.
- Principles of Physical Chemistry: Puri, Sharma and Pathaniya.
- Physical Chemistry: P.W. Atkins, 4th Edn.
- Text book of Physical Chemistry: P.L. Sony, O.P. Dharma.
- Physical Chemistry: Levine.
- Practical Physical Chemistry: Palit and De.
- Practical Physical Chemistry: Yadao.
- Practical Physical Chemistry: Khosla.
- Laboratory Mannual of Physical Chemistry: W.J. Popiel.
- Practical Chemistry: Dr. S.B. Lohiya, Bajaj publication, Amravati.
- Text book of Physical Chemistry by S.B. Phadke, G.N. Chaudhari, S.S. Kabra, R.G. Bhangale, A.B. Patil, S.K. Rithe published by Amravati University Chemistry Teachers Association with Bokey Prakashan, 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. INDUSTRIAL CHEMISTRY (REGULAR/VOCATIONAL)

The examination in Industrial Chemistry (Regular/ Vocational) of Fifth 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-V (8 marks).

B.Sc. Part- III (Semester- V) **5S Industrial Chemistry (Regular/ Vocational)** **Chemical Process Economics, Heavy and Fine Chemicals**

Total Lectures: 84

Marks: 80

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

- Unit-I :** **[14]**
 Manufacturing of the following:- Ammonia, nitric acid, ammonium sulphate, ammonium nitrate, caustic soda, chlorine, ammonium phosphate, superphosphate, triple superphosphate with reference to following considerations:-
 i) Consumption pattern ii) Raw materials iii) Major engineering problems.
- Unit-II :** **[14]**
 Manufacturing of the following:- Lime, calcium carbide, silicon carbide, fluorine, sodium carbonate, sulphuric acid, hydrochloric acid, soda ash by Solvay process, urea with reference to following considerations:-
 i) Consumption pattern ii) Raw materials iii) Major engineering problems.
- Unit-III :** **[14]**
A) Essential Oils – Introduction, extraction methods of essential oils -: Steam distillation, solvent extraction, and expression.
 Uses of following essential oils- menthol, citral, camphor, turpentine.
B) Edible Oil – Manufacturing of Soyabean oil by solvent extraction process, refining of crude vegetable oil. Hydrogenation of vegetable oil (Dry and wet processes), saponification value, iodine value, acid value and ester value.
C) Manufacturing of soap, recovery of glycerin, cleansing action of soap.

Unit-IV : [14]
Fischer Tropsch synthesis with examples, chlorination of methane and its major engineering problems, manufacturing of mono, di, triethanolamines and its uses. Manufacturing of acetylene, ethylene, vinyl acetate, isopropanol, vinyl chloride with reference to following considerations:-
i) Raw materials ii) Major engineering problems iii) Uses.

Unit-V : [14]
A) Industrial gases- Introduction, Manufacturing and uses of following industrial gases - Oxygen and nitrogen, carbon dioxide liquification of CO₂ (Dry Ice).
B) Safety- Introduction, concern for chemical safety, hazards and their control in petrochemical industries, hazards in storage, handling and uses of chemicals.

Unit-VI : Process Economics [14]
A) Cost Estimation- Cash flow for industrial operations, cumulative cash position, factors affecting investment and production cost.
B) Interest- Simple and compound interest, nominal and effective interest
C) Depreciation- Introduction, service life, salvage value. Methods for depreciation- straight line method, declining balance method, sum of years digits method.
D) Profitability, profitability evaluation: Rate of return on investment and discounted cash flow method. Break even point.

5S Industrial Chemistry Practical List of Experiments

Unit I

- 1) Determination of acid value of edible oil.
- 2) Determination of saponification value of edible oil.
- 3) Determination of iodine value of edible oil.
- 4) To determine the strength of hydrogen peroxide solution.
- 5) To determine the strength of aniline solution.
- 6) To determine the strength of formalin solution.

Unit II

- 1) Preparation of 3- nitroaniline.
- 2) Preparation of 4- bromoaniline.
- 3) Preparation of 4- nitrobenzoic acid.
- 4) Preparation of soap.
- 5) Preparation of phthalamide.
- 6) Extraction of oil from oil seeds.

Distribution of Marks for Practical Examination

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

Books Recommended

- 1) Handbook of industrial chemistry – K.H. Davis and F.S. Berner Vol. I and II. CBS publishers and distributors New Delhi.
- 2) Shreves chemical process industries – George T. Austin. Mc GRAW HILL International Edition.
- 3) Industrial Chemistry- B.K. Sharma. Goyal publishing house.
- 4) Heavy organic chemicals- A.J. Garte. Pargmon Process U.K.
- 5) A Text book of Engineering chemistry- S.S. Dara.
- 6) Chemical process industries- S.C. Bhatiya. CBS publishers and distributors New Delhi.
- 7) Plant design and economics for chemical engineers. Max S. Peters, K.D. Timmerhaus. Mc GRAW HILL International Edition.

List of equipments/ Apparatus/ glassware's required for the B.Sc. Industrial Chemistry practical for a batch.

- | | |
|--|---------|
| 1. Melting point apparatus | 02 nos. |
| 2. Thermometer 0 to 360 ^o C | 10 nos. |
| 3. Thermometer 0 to 110 ^o C | 10 nos. |
| 4. Analytical balance | 02 nos. |
| 5. Weight box | 02 nos. |
| 6. Silica crucible | 20 nos. |
| 7. Sintered glass crucible | 20 nos. |
| 8. Measuring cylinder 100 ml | 05 nos. |
| 9. Separating funnels 250 ml | 05 nos. |
| 10. Burette 25 ml | 20 nos. |
| 11. Burette 50 ml | 20 nos. |
| 12. Volumetric flask 100 ml | 10 nos. |
| 13. Volumetric flask 250 ml | 10 nos. |
| 14. Round bottom flask with reflux Condenser | 10 nos. |

15. Beaker 100 ml	20 nos.
16. Beaker 250 ml	20 nos.
17. Beaker 500 ml	05 nos.
18. Burette Stand	20 nos.
19. Pipette 10 ml and 25 ml	20 nos.
20. Conical Flask 100 ml and 250 ml	20 nos.

Semester-VI
6S Industrial Chemistry (Regular/ Vocational)
Instrumental Methods of Chemical Analysis, Green chemistry

Total Lectures: 84

Marks: 80

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

- Unit-I :** [14]
A) Sampling procedures, sampling of bulk materials, techniques of sampling solids, liquids, gases. Collecting and processing of data.
B) **Errors-** Types of errors, nature and origin of error. Accuracy, precision, mean deviation, standard deviation, relative standard deviation and confidence limits.
- Unit-II :** [14]
Chromatography - Theories of chromatography- plate and rate theory, classification of chromatographic techniques.
Paper chromatography and TLC- Introduction, principles, types of migration parameter (R_f value). Experimental details, applications.
GLC and HPLC- Introduction, principles, instrumentation, apparatus and materials, column efficiency and selectivity, applications.
Liquid-Liquid partition chromatography and adsorption chromatography
- Unit-III :** [14]
A) **Column chromatography-** Principle, experimental details, column efficiency, factors affecting column efficiency, applications.
B) **Ion Exchange-** Classification of ion exchangers, ion exchange equilibria, ion exchange capacity, chelating ion exchanger, factors affecting the separation of ions and applications in analytical chemistry.
C) **Solvent Extraction-** Classification of solvent extraction systems, basic principles involved in extraction. Factors affecting extraction, techniques of extraction, applications of solvent extraction in industries.
- Unit-IV :** [14]
A) **Flame Photometry-** Elementary theory, instrumentation and experimental techniques, combustion flames and applications.
B) **I.R. Spectroscopy-** Principles, techniques, instrumentation and applications in chemical analysis of industrial materials.
C) **X-ray fluorescence-** Principles, techniques, flow sheet, applications for determination of heavy metals in environmental sample.
- Unit-V :** [14]
Dye- Introduction, classification of dyes- on the basis of mode of applications and on chemical constitutions. Acid dyes, basic dyes, sulphur dyes, pigment dyes. Dye intermediates. Preparation and uses of methyl orange dye, picric acid and aurine dye, indigo dye, congo red, crystal violet and alizarin dye. Non textile use of dye stuffs.
- Unit-VI :** [14]
Green Chemistry- Introduction, Goals of green chemistry, principles of green chemistry. Basic components of green chemistry research- Alternative starting materials or feed stock, alternative reagents or transformations, alternative reaction conditions and alternative final products or target molecules. Optimization of framework for the design of greener synthetic pathway. Green solvents, ionic liquids green fuels and E- green propellants, biocatalysis.

6S Industrial Chemistry Practical

List of Experiments :

Unit I

- 1) Separation of Cu⁺²-Ni⁺² ions by paper chromatography.
- 2) Separation of plant pigments xanthophylls, chlorophyll by paper chromatography.
- 3) Separation of dyes by T.L.C.
- 4) Estimation of sodium and potassium by flame photometry.
- 5) Separation of amino acids by paper chromatography.
- 6) To detect the impurities in organic compounds by T.L.C.

Unit II

- 1) Removal of hardness by ion exchange resins.
- 2) Separation of Cu⁺²-Ni⁺² ions by solvent extraction.
- 3) Separation of Co⁺²-Ni⁺² ions by ion exchange.
- 4) Preparation of picric acid dye.
- 5) To determine the capacity of an anion exchange and cation exchange resin by column method.
- 6) Separation of Fe³⁺ and Mg²⁺ by solvent extraction.

Distribution of Marks for Practical Examination**Time: 6 – 8 hours (One Day Examination)****Marks: 50**

Unit – I : (Exercise No. 1)	.....	15
Unit – II : (Exercise No. 2)	.....	15
Viva-Voce	.....	10
Record	.....	10

Total:		50

Books Recommended

- 1) Instrumental methods of chemical analysis – Gurudeep chatwal and Anand
- 2) Quantitative inorganic analysis – A.I. Vogel
- 3) Handbook of industrial chemistry – K.H. Davis and F.S. Berner Vol. I and II. CBS publishers and distributors New Delhi.
- 4) A Text book of Engineering chemistry- S.S. Dara.
- 5) A Text book of synthetic dyes- O.D. Tyagi, M. Yadav. Anmol publications Pvt. Ltd.
- 6) Chromatography- Shrivastava and Shrivastava.
- 7) Experiments in chemistry – D.V. Jahagirdar.
- 8) A text book on experiments and calculations in engineering chemistry – S. S. Dara.

List of equipments/ Apparatus/ glassware's required for the B.Sc. Industrial Chemistry practical for a batch.

1. Melting point apparatus	05 nos.
2. Thermometer 0 to 360 ^{0C}	10 nos.
3. Thermometer 0 to 110 ^{0C}	10 nos.
4. Analytical balance	05 nos.
5. Weight box	05 nos.
6. Silica crucible	20 nos.
7. Sintered glass crucible	20 nos.
8. Chromatographic jar	05 nos.
9. Separating funnels 250 ml	05 nos.
10. Burette 25 ml	20 nos.
11. Burette 50 ml	20 nos.
12. Volumetric flask 100 ml	10 nos.
13. Volumetric flask 250 ml	10 nos.
14. Round bottom flask with reflux Condenser	10 nos.
15. Beaker 100 ml	20 nos.
16. Beaker 250 ml	20 nos.
17. Beaker 500 ml	05 nos.
18. Burette Stand	20 nos.
19. Pipette 10 ml and 25 ml	20 nos.
20. Conical Flask 100 ml and 250 ml	20 nos.
21. Ion exchange column	01 no.
22. Flame photometer	01 no.

5. PETROCHEMICAL SCIENCE

The examination in Petrochemical Science of Fifth 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-V (8 marks).

Semester- V**5S Petrochemical Science****Total Lectures: 84****Marks: 80****Note:** Figures to the right hand side indicate number of lectures.**Unit-I : Basic concepts in polymerization****[14]**

- What are polymers
- How are polymers made
- Classification of polymers
 - Thermosetting and Thermoplastic
 - Homo and Co-polymers
- Methods of polymerization
 - Cationic
 - Anionic
 - Radical
- Polymerization techniques
 - Bulk
 - Solution
 - Suspension
 - Emulsion
- Examples of polymerization catalysts, Introduction to cross linking and agents

Unit-II: Ethylene (C₂) and propylene (C₃) polymers

[14]

- Chemistry (reaction mechanism, catalysts), properties, manufacture (Flow scheme, and operating variables) and applications of
 - High Density Poly-Ethylene (HDPE)
 - Low Density Poly-Ethylene (LDPE)
 - Poly propylene
- Introduction to Ethylene- Propylene co-polymers (EPM rubber)

Unit-III: C₄ based polymers

[14]

- Chemistry (reaction mechanism, catalysts), properties, manufacture (Flow scheme, and operating variables) and applications of:
 - Poly butylenes (Butyl rubber)
 - Di-iso butylenes
 - Poly butadiene
 - Poly isoprene
 - Poly chloroprene (Neoprene)
- Introduction to
 - Butadiene- Styrene co-polymers (SBR)
 - Butadiene- Acrylonitrile co-polymer (ABN)

Unit-IV: Vinyl and styrene polymers

[14]

- Chemistry (reaction mechanism, catalysts), properties, manufacture (Flow scheme, and operating variables) and applications of:
 - Poly vinyl chloride (PVC)
 - Poly vinyl acetate (PVA)
 - Polystyrene
- Introduction to co-polymers of styrene
 - Acrylonitrile-Butadiene-Styrene co-polymer (ABS)
 - Styrene-Acrylonitrile co-polymer (SAN)

Unit-V: Condensation polymers

[14]

- Chemistry (reaction mechanism, catalysts), properties, manufacture (Flow scheme, and operating variables) and applications of:
 - Nylon- 6
 - Nylon- 6,6
 - Phenol-Formaldehyde resin
 - Urea-Formaldehyde resin
- Introduction to
 - Nylon- 6, 10
 - Nylon-12
 - Nylon-11
 - Saturated polyesters
 - Unsaturated polyesters

Unit-VI: Waxes/Bitumen/Greases

[14]

- Petroleum Waxes
 - Types and Sources of waxes
- Paraffin waxes
- Microcrystalline waxes
 - Important properties of petroleum waxes
 - Manufacture of petroleum waxes
- Chilling and pressing process
- De-waxing with solvents
- MEK de-waxing process
 - Uses of petroleum waxes
 - Petroleum Jellies
- Bitumen
 - Bitumen
 - Asphalts
 - Chemical Structure of asphalt
 - Classes of Bitumen
 - Quality specification of bitumen
 - Uses of Bitumen
- Greases
 - Type of greases
 - Manufacture various type of grease
 - Properties, testing and uses of grease

5S Petrochemical Science Practical

List of Experiments

1. Preparation and melting point determination of Nylon-6
2. Preparation and melting point determination of Nylon-6,6
3. Preparation and melting point determination of polystyrene
4. Preparation and melting point determination of Phenol-formaldehyde resin
5. Preparation and melting point determination of urea-formaldehyde resin

Unit-V : Future of petrochemicals

[14]

- Integrated petrochemical complexes
- Energy crises and the petrochemical industry
 - Natural gas as petrochemical feedstock
 - Impact of heavy feedstocks on petrochemicals
 - Ecology and energy crisis
 - Coal as an alternative to oil
- Energy crisis and the industrial fuels
 - Natural fuels
 - Synthetic fuels
 - Hydrogen: Fuel of tomorrow
 - Bio-Fuels
- Trends in petrochemical industries

Unit-VI : Pollution control in petroleum refineries and petrochemical processing units

[14]

- Definition of pollution
- Kinds of pollution
- Air pollution
 - Sources of air pollution in refineries and petrochemicals manufacturing units
 - Air pollution control techniques and options
- Water pollution
 - Sources of water pollution in refineries and petrochemicals manufacturing units
 - Control of Water pollution
 - Indian standards for liquid effluents and Inland surface water (Most considerable characters like TSS, pH, TDS, BOD, COD, DO, Temperature, sulphates, chlorides, sodium.)
- Soil pollution
 - Sources of soil pollution in refineries and petrochemicals manufacturing units
 - Soil pollution control techniques

6S Petrochemical Science Practical

List of Experiments

1. Determination of purity of a chemical compound using TLC
2. Separation of a chemical compound using column chromatography
3. Determination of pH of soil (Soil near any chemical laboratory waste outlet).
4. Determination of B.O.D. of given sample
5. Determination of C.O.D. of given sample
6. Determination of D. O. of given sample
7. Use of UV-Visible spectrophotometer for determination of % transmission, O.D. Concentration and adsorption
8. Determination of hardness of given water sample
9. Extraction of oils from oil bearing seeds
10. Determination of given specific refraction and molar refraction of given sample using Abbe's refractometer
11. Determination of Calorific value of given sample

Distribution of marks for practical examination

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

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

List of books

1. Petroleum refining and petrochemicals, N.K. Sinha, Umesh Publications, Delhi
2. Advanced petrochemicals, Dr. G. N. Sarkar, Khanna Publications, Delhi
3. A text on petrochemicals, B.K. B Rao, Khanna Publications, Delhi
4. Introduction to petrochemicals, S. K. Maiti, Oxford-IBH Publications
5. Fuels and Combustions, Sameer Sarkar, Orient- Longman Ltd. Hyderabad
6. Catalysis and chemical processes, Ronald Pearce and William Patterson, Leonard-Hill Publication, Glasgow
7. Systematic experimental physical chemistry, S.W. Rajabhoj, Dr. T. K. Chondhekar, Anjali publications Aurangabad
8. Advanced Petroleum refining, G. N. Sarkar, Khanna Publications, Delhi
9. Petroleum refining technology, Dr. Ram Prasad, Khanna Publications, Delhi
10. Unit operations II, K.A. Gavane, Nirali prakashan, Pune
11. Modern petroleum refining processes, Dr. B. K. Bhaskarrao, oxford-IBH publication New Delhi
12. Chemicals from petroleum, A.L. Waddams, Murray, London
13. An Introduction to industrial organic chemistry, P. Wiseman, Applied Science, London
14. Modern Petroleum Technology, J.D. Hobson, Jon-Wiley Chester
15. Chemicals from synthesis gas, R.A. Sheldon, B. Reidel Publishing Company. Dordrecht

16. Text book of polymer, volume I, II, III, M.S. Bhatnagar, S.Chand Publi., Delhi
17. Dryden's outline of chemical technology, M. Gopalrao, Marshall Stings, East-west Publications
18. Shreve's Chemical process industries, J. Austin, Mc.GrowHill, New Delhi.
19. Petroleum processing handbook, edited by John J. Meketta-Marcel Dekker, Inc.-1992
20. Handbook of petroleum refining process, Robart A. Mayers, Mc.Graw-Hill, second edition-1996
21. Modern petroleum technology, Volume I Upstream by Rechar A. Dawe, 6th Edition IP-2002
22. Modern petroleum technology, Volume IIdownstream by Rechar A. Dawe, 6th Edition IP-2002
23. The chemistry and technology of petroleum, 2nd edition by James G. Speight-1991 vol. I & II
24. Petroleum refining technology and economics by J.H. Gary, G.E.Handwert, Marcel Dekker inc. 1987
25. Standard method for analysis and testing of petroleum and related product, IP-Volume II, Institute of Petroleum, London 1993 Vol. I, II
26. Environmental chemistry by S.S. Dara, S.Chand and Company pub., New Delhi
27. Pollution monitoring and control, Dr. Priya Rajan Trivedi,
28. Air pollution Vol. I-IV, A.C. Stern
29. NEERI manuals
30. Chemical Methods for Environmental Analysis, R. Rameth
31. Instrumental method of chemical analysis, Willard Merit and Dean.
32. Chromatography, Shrivastav and Shrivastav.

**LIST OF APPARATUS AND EQUIPMENTS FOR A BATCH OF 20 STUDENTS FOR
B.SC. 5th and 6th semester
PETROCHEMICAL SCIENCE**

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

6 : GEOLOGY

Semester-V 5S- Geology

- UNIT I:** Attitude of bed. Clinometer and Brunton Compass and its use, Outcrop- its true and apparent thickness, width of outcrop, Outcrop in relation to topography and structure.
Erosional structures – Unconformity: Formation, Types and Recognition.
Outlier-Inlier, Onlap, Offlap, windows and Klippe.
- UNIT II:** Fold: Nomenclature or Parts, Classification – Genetic and Geometric, recognition of fold in field and map. Causes of folding.
Joints: Classification – Genetic and Geometric, Significance of Joints.
- UNIT III:** Interior of the earth as revealed by Seismic waves.
Isostasy – Airy’s Hypothesis, Pratt’s Hypothesis and Heisskinnan’s Hypothesis.
Geosyncline – Definition, Classification and evolution.
- UNIT IV:** Continental Drift – Evidences of drift.
Plate Tectonics – Types of plate margins, Causes of Plate Movement and Evidences- Sea Floor Spreading and Palaeomagnetism.
- UNIT V:** Hydrologic Cycle and its Components, Occurrence and distribution of Ground water, Water Table. Aquifer and its types – Confined, Unconfined and Semi-confined. Properties of Aquifer:- Porosity, Permeability, Storage Coefficient and Conductivity.
- UNIT VI:** Recharge and Discharge, Darcy’s Law and its validity, Cone of Depression, Influent and Affluent Seepages, Ground water Provinces of India

PRACTICALS:

1. Use of Clinometer and Brunton Compass.
2. Problems on Dip, Strike, Thickness of Beds and width of outcrop maps.
3. Completion of outcrop problems for conformable series and unconformity.
4. Elementary problems on determination of Aquifer Parameters,
5. Plotting of Ground water provinces on outline map of India.
6. Water table contour maps and its interpretation for groundwater structure.
7. Morphometric Analysis from topographic maps.
8. Field Work.

PRACTICAL EXAMINATION:

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

- | | |
|---|-----------|
| I. Problems on Dip, Strike, Thickness of Beds and width of outcrop maps. | 6 Marks |
| II. Completion of outcrop maps | 8 Marks |
| III. Problems on determination of Aquifer Parameters | 6 Marks |
| IV. Plotting of Ground water provinces on outline map of India. | 4 Marks |
| V. Water table contour maps and its interpretation for groundwater structure. | 6 Marks |
| VI. Morphometric Analysis from topographic maps. | 6 Marks |
| VII. Field Work. | 4 Marks |
| VIII. Practical Record and Viva Voce | 10 Marks |
| | 50 Marks. |

Semester-VI 6S- Geology

- UNIT I:** Stress – Strain and deformation, Interrelationship of Stress-Strain and Time, Mohr’s Circle, Determination of strain by using Initial Spherical Objects, Deformed Conglomerate and Bilateral symmetrical fossils.
- UNIT II:** Faults: Nomenclature or Parts, Classification – Genetic & Geometric, recognition of fault in field and map. Causes of faulting. Foliation and Lineation – kinds and origin.
- UNIT III:** Photo geology and Remote Sensing, Aerial Photographs and its types, Satellite Imageries. Methods of studying aerial photographs in the form of Stereo-pairs and Mosaic. Pocket and Mirror stereoscope, Overlap and Sidelap, Drift and Crab.
- UNIT IV:** Elements of Photorecognition:- Tone, Texture, Shape, Size, Pattern, Scale of Photograph and Vertical exaggeration. Guidelines for Lithological, Structural and geomorphic interpretation. Applications of Photo geology and Remote Sensing.
- UNIT V:** Prospecting and Exploration-Criteria and guides to ore search, Structural control of ore localization. Sampling methods- Channel, Chip, Muck, Car and Drill hole sampling. Coning and quartering. Calculation of grade and ore reserves.
- UNIT VI:** Surface geophysical methods- Gravity, Magnetic, Electrical and Seismic. Geochemical and Geobotanical Method- Geochemical cycles and dispersion.

PRACTICALS:

1. Drawing of Sections and interpretation.
2. Interpretation of Aerial Photographs and Satellite Imageries.
3. Laboratory exercises in solving exploration related problems.
4. Exercises on calculation of grade and ore Reserves.
5. Field Work.

PRACTICAL EXAMINATION:

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

I. Completion of Section maps (2 Nos.)	10 Marks
II. Interpretation of Aerial Photographs and Satellite Imageries.	10 Marks
III. Laboratory exercises in solving exploration related problems.	10 Marks
IV. Exercises on calculation of grade and ore Reserves	06 Marks
V. Field Work.	04 Marks
VI. Practical Record and Viva Voce	10 Marks
	50 Marks.

Text Books for Sem V & VI :

1. Bilings, M.P. (1997) Structural Geology. Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Park, R.G. (1989) Foundations of Structural Geology. Blackie, New York.
3. Gokhale, N.W.(2001) Theory of Structural Geology. Blackie, New York.
4. Gokhale, N.W.(1991) A Manual of Problems of Structural Geology. CBS Publishers.
5. Lahi, F.H. (1987) Field Geology, CBS Publishers.
6. Gokhale, N.W. (2001) A Guide to Field Geology. CBS Publishers.
7. Chipkonkar G.W.: Geological Maps, Dastane Ramchandra Publication, Pune
8. Valdiya, K.S. (1987) Environmental Geology - Indian Context, Tata McGraw Hill.
9. McKinsty, H.E. (1972) Mining Geology. Prentice- Hall Inc.
10. Arogyaswamy, R.N.P. (1995) Courses in Mining Geology. Oxford and IBH Publishing Co., New Delhi.
11. Bagchi, T.C., Sen Gupta, D.K. and Rao, S.V.L.N. (1979) Elements of Prospecting and Exploration. Kalyani Publishers, New Delhi.
12. Dobrin, M.B. (1952) Introduction to Geophysical Prospecting. McGraw Hill.
13. Pande, S.N. (1987) Principles and Applications of Photogeology . Wiley Eastern Limited.
14. Sabisin, F.F. (2000) Remote Sensing Principles and Interpretations. W.H. Freeman and Company, USA.
15. Lilesand, T.M. and Kiefer, R.W.(2000) Remote Sensing and Image Interpretation. John Wiley and Sons Inc., New York.
16. Drury, S.A. (1997) Image Interpretation in Geology. Chapman and Hall, London.
17. Todd, D.K. (1980) Ground Water Hydrology. John Wiley and Sons Inc. New York.
18. Karanth, K.R. (1989) Hydrogeology. Tata McGraw Hill Pub.Co.Ltd., New Delhi.
19. Nagabhushaniah, H.S. (2001) Groundwater in Hydrosphere (Groundwater Hydrology) CBS Publisher, New Delhi.
20. Karanth K.R. Groundwater, Assessment, Development and Management. Tata McGraw Hill Pub. Co. Ltd., New Delhi.
21. Raghunath : Ground Water Hydrology, New Age Publication, Pune
22. Dynamic Earth - Skinner Potter - Pub.John, Wiley.
23. Text Book of Physical Geology - G.B.Mahaptra- Pub. C.B.S., New Delhi.
24. Dynamic Earth – Patwardhan A.M., E E.E Publications, New Delhi.
25. Physical Geology – A. Holmes, Orient Longman Publications.
26. Concepts in Geology - Chakranarya, Kulkarni, Pub. Scientific Publication, Pune.
27. Dynamic Earth- Wiley, John Wiley and Sons, New York.
28. Radhakrishnan N. General Geology, V.V.P Pub, Vellore.
29. Text Book of Engineering Geology - Parbin Singh, Katson Publishing, Ludhina.

B.Sc. Final Year, Semester-V

7: BOTANY

The examination in Botany of fifth 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 4 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-V (8 marks).

5S - BOTANY

PLANT PHYSIOLOGY AND ECOLOGY

Unit - I: Plant Water Relations

- 1.1 Importance of water to plant life.
Imbibition , Diffusion, Osmosis, Plasmolysis.
- 1.2 Active and passive Absorption of water.

- 1.3 Ascent of sap - Root Pressure and Transpiration Pull Theory.
- 1.4 Transpiration - Types of transpiration, Stomatal movements, Mechanism of transpiration (Starch sugar hypothesis), Significance. Antitranspirant, Guttation.
- 1.5 Mineral uptake - Active uptake - Carrier Concept, Passive uptake - Ion Exchange.

Unit - II: Metabolism-

- 2.1 Photosynthesis - Introduction, Role of Light, Photosynthetic Apparatus and Pigments, Two Pigment Systems, Photophosphorylation, C3 and C4 cycle, CAM Pathway.
- 2.2 Respiration - Introduction, Mitochondria as a Respiratory centre, Types of Respiration - Aerobic and Anaerobic, Mechanism of aerobic respiration- Glycolysis, Krebs cycle, Electron transport system and Chemiosmotic ATP generation, Respiratory Quotient.

Unit - III: Metabolism and growth

- 3.1 Nitrogen Metabolism- Sources of nitrogen, Symbiotic nitrogen fixation, Role of Nitrate reductase.
- 3.2 Growth - Phases of growth, Growth curve, Physiological role of growth hormones (Auxins, Gibberellins, Cytokinins, Abscisic acid, and Ethylene).
- 3.3 Physiology of Senescence and Abscission.

Unit – IV: Plant responses

- 4.1 Photoperiodism - Concept of Florigen, Role of Phytochrome,
- 4.2 Vernalization- Concept and Significance.
- 4.3 Plant movement- Tropic (Phototropic and Geotropic) and Nastic (Epinasty, Hyponasty and Seismonasty)
- 4.4 Stress physiology- Concept, Types of stress, Water and Salinity stress.

Unit – V: Ecology and Environment:

- 5.1 Concept of environment, Concept and scope of ecology.
- 5.2 Ecological factors- Climatic- Light, Temperature and Water.
- 5.3 Atmosphere and its composition.
- 5.4 Edaphic factor- Process of soil formation, soil profile, soil biota and their role.
- 5.5 Ecological Adaptations - Morphological and Anatomical adaptation in Hydrophytes, and Xerophytes.

Unit – VI: Ecosystem:

- 6.1 Population Ecology- Natalty and Mortality, Community characteristics – Frequency, Density and Abundance
- 6.2 Ecological Succession - Hydrosere and Xerosere
- 6.3 Ecosystem – Definition, Structure and Function, Food chain, Food web, Energy flow model (Single channel model)
- 6.4 Types of Ecosystem- Pond ecosystem, Desert ecosystem.

LABORATORY EXERCISE :

Plant Physiology: Major experiment (Any Seven)

1. To study the effect of temperature and organic solvent on permeability of plasma membrane.
2. To study osmotic pressure of cell sap by plasmolytic method.
3. To determine water potential of plant tissue.
4. To determine the path of water (ascent of sap)
5. To determine the rate of transpiration by Ganong's photometer.
6. To determine rate of photosynthesis under varying quality of light and CO₂ concentration.
7. To study the rate of photosynthesis in terrestrial plants with the help of Ganong's Photosynthometer.
8. Separation of chloroplast pigments by paper chromatography/ solvent extraction method.
9. Separation of amino acids by paper chromatography method.
10. To determine R.Q. using different substrates.
11. To determine the rate of respiration by Ganong's respirometer.
12. To study antagonism of salts.
13. To study phenomenon of adsorption.
14. To study effect of IAA and Gibberellins on seed germination.
15. Test for secondary metabolites- Alkaloid, Phenolics, Tannin, Flavonoids and Lignin
16. To study Endo and Exo-osmosis by egg membrane osmoscope

Plant Physiology: Minor experiment- (Any Three)

1. To demonstrate fermentation.
2. To demonstrate exo and endosmosis
3. To demonstrate transpiration by Bell jar.
4. To demonstrate light is necessary for photosynthesis
5. To demonstrate anaerobic respiration in germinating seeds.
6. To demonstrate the evolution of CO₂ in respiration.
7. To demonstrate the phenomenon of nastic movement with help of *Mimosa pudica* / or *Biophytum sensitivum*.

Ecology: Major experiment (Any Three)

1. Study of morphological and anatomical adaptations in hydrophytes – *Hydrilla*, *Eichhornia*, *Typha*, *Vallisneria* and *Nymphaea* (any two)
2. Study of morphological and anatomical adaptations in xerophytes -*Asparagus*, *Nerium*, *Casuarina*, *Euphorbia*, *Cycas*, *Opuntia* (any two)
3. Study of community characteristics by quadrat method.
4. Determination of water holding capacity of different soils.
5. To determine the texture of different soils by sieve method.

Ecology: Minor experiment (Any Two)

1. To determine the porosity of soil.
2. To determine the transparency and temperature of water bodies.
3. Estimation of salinity of different water samples
4. Determination of pH of different soils and water samples by pH papers/ pH meter.
5. Study of meteorological instruments -Rain gauge, Hygrometer, Barometer

PRACTICAL EXAMINATION

Time: 4 Hours

Marks: 50

Q. 1- Physiology- major experiment-	15
Q. 2- Comment one Minor Physiology experiment-	5
Q. 3- Ecology major experiment.	10
Q. 4- Ecology minor experiment.	5
Q. 5- Viva – voce	5
Q.6- Class record.	5
Q. 7- Co-curricular Activity Report	5

Co-curricular Activity Report" which mean the report on the activity

Such as Study Tour, Industrial visit to Research Institute, Excursion Tour to be submitted by the students at the time of practical examination.

Books Recommended:

Plant Physiology and Ecology:

1. Curtis & Clark. : Introduction of Plant Physiology.
2. H.N.Shrivastav. : Plant Physiology
3. Devlin R.M. : Plant Physiology
4. Salisbury F.B and Ross C.W. (1992):. Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA.
5. William G. Hopkins. (1995): Introduction to Plant Physiology, Published by – John Wiley and Sons, Inc.
6. V.Verma : Plant Physiology Verlag, New York.Vol. II.
7. Mayer & Anderson.: Plant Physiology.
8. Lincoln Taiz and Eduardo Zeiger (2003). Plant Physiology (3rd edition), Published by Panima Publishing Corporation
9. Galston, A. W. 1989: Life processes in plants. Scientific American Library, Springer
10. Jain V.K.: Fundamental of plant Physiology. S. Chand Publication New Delhi.
11. Kocchar P.C.: Text Book of Plant Physiology.
12. Mohr, H. and Schopfer, P. 1995 : Plant Physiology 4th : Edition, Wordsworth
13. Moore, T.C. 1974: Research Experiences in Plant Physiology. A Laboratory Manual.
14. Mr./Mrs.Pillei : Plant Physiology New York, U.S.A.
15. P.S.Gill: Plant Physiology, S.Chand & Co. New Delhi, Edition - Pradip's, Botany
16. Purekar and Singh: Plant Physiology,
17. R. G. S. Bidwell (revised edn.)-Plant Physiology
18. Verma S.K. and Verma Mohit (2007). A.Text Book of Plant Physiology, Biochemistry and Biotechnology, S. Chand Publications.
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20. Galstone A.W. 1989. Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA..
21. Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York,USA.
22. Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi
23. Verma S.K. and Mohit Verma 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S. Chand Publications.
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29. Dash M.C. 1993. Fundamentals of Ecology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
30. Kumar.H.D. 1996. Modern Concepts of Ecology (3rd edition). Vikas Publishing House Pvt., Ltd. Delhi.
31. Kumar.H.D. 1997. General Ecology. Vikas Publishing Pvt. Ltd., Delhi.
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39. Chaudhari M.A. and Gupta K.K. 2009. Practical plant physiology. New Central Book agency Ltd. Kolkata.
40. Bendre: Practical Botany for B.Sc.III year. Rastogi Publications, Meerut.

**Semester-VI
6S Botany**

The examination in Botany of sixth 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 4 hours duration and carry 50 marks.

The following syllabi is prescribed on the basis of six 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 & one compulsory question covering all the syllabus of Semester-VI (8 marks).

SEMESTER VI – MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Unit-I : DNA the genetic material :

- 1.1 Historical account – Giffith's Expt, Hershy and Chase Expt.
- 1.2 DNA– Chemical composition and Double Helical model ,
- 1.3 DNA replication in Eukaryotes;
- 1.4 DNA Packaging - Nucleosome and Solenoid
- 1.5 Satellite, Repetitive DNA and Transposable element in plants (AC-DS system)

Unit-II : Gene Structure and Expression -

- 2.1 Concept of gene, Fine structure of Gene
- 2.2 Gene Expression –
Central Dogma, Types of RNA, Genetic code, Ribosome as a translation machine
- 2.3 Transcription in Eukaryotes – Mechanism of Transcription and RNA Processing
- 2.4 Translation in Eukaryotes.
- 2.5 Endomembrane system (Flow of Peptide)

Unit – III : Regulation of Gene Expression

- 3.1 Regulation of Gene Expression in Prokaryotes – Operon concept with special reference to Lac Operon
- 3.2 Regulation of gene expression of Eukaryotes – Britton Davidson Model
- 3.3 Protein Folding Mechanism and Structure (Primary, Secondary, Tertiary and Quaternary)
- 3.4 Protein Sorting – Targeting to proteins to organelles
- 3.5 Protein Trafficking

Unit-IV : Genetic Engineering -

- 4.1 Tools and techniques of recombinant DNA technology,
- 4.2 Restriction Enzymes – Nomenclature and Types
- 4.3 Cloning vectors – Plasmids, Phages, Cosmids
- 4.4 Gene Source- Genomic and c-DNA library
- 4.5 Gene Transfer Techniques –
Direct - (1) Chemical method, (2) Electroporation, (3) Gene gun method
Indirect – Agrobacterium mediated gene transfer
- 4.6 Gene Amplification - _Polymerase Chain Reaction (PCR)

Unit-V : Plant Tissue Culture -

- 5.1 Basic aspects of plant tissue culture
- 5.2 Laboratory Requirement –
Infrastructure,
Instruments (laminar air flow, autoclave, growth chamber),
Culture Media (MS Media),
Growth Hormone (Auxin, Cytokinin and Gibberellins)
Sterilization Techniques
- 5.3 Tissue Culture Technique - Cellular totipotency, differentiation and morphogenesis; Callus Culture;
Micro propagation

Unit-VI : Applications of Biotechnology -

- 6.1 Agriculture – Haploid plant production (Anther and Pollen Culture); Protoplast Culture and Somatic Hybridization; Transgenic Plant - BT Cotton, Synthetic seed. Salient achievements of crop biotechnology
- 6.2 Industry – Fermentation Technology- Bakery Products and Alcohol Productions.
- 6.3 Health Care – Edible Vaccines
- 6.4 Conservation – Cryopreservation, Genetically Modified Organisms: - Pros and Cons

LABORATORY EXERCISE

1) Molecular biology (Major) (Any Two)

1. Isolation of DNA by crude method
2. Estimation of DNA by Diphenylamine method
3. Estimation of RNA by Orcinol method

2) Molecular biology (Minor) (Any Two)

1. Demonstration of DNA Electrophoresis,
2. Demonstration of double helical model of DNA
3. Demonstration of AC-DS System in Maize kernel
4. Demonstration of Centrifugation

3) Biotechnology (Any Six)

1. Working Principle and application of Autoclave
2. Working Principle and application of Laminar Air Flow
3. Cleaning and Sterilization of Glassware
4. Sterilization of Explant
5. Inoculation of Explant
6. Demonstration of in vitro culture techniques – anther and pollen culture
7. Isolation of Protoplast by Mechanical Method
8. Isolation of Protoplast by Enzymatic Method
9. Demonstration of technique of Micropropagation
10. Preparation of Artificial Seed
11. Demonstration of hardening of tissue culture plant
12. Preparation of Tissue culture media
13. Pollen viability test.

Note: Visit to molecular biology, biotechnological research institute/industry

PRACTICAL EXAMINATION

Time : 4 hours.

Marks : 50

Que.1 : To perform given Molecular Biology experiment	15 Marks
Que.2 : Comment on minor molecular Biology Experiment	05 Marks
Que.3 : To perform given Biotechnology experiment	15 Marks
Que.4 : Comment on any one Biotechnology Experiment	05 Marks
Que.5 : Visit report	05 Marks
Que.6 : Class record/ and viva-voce	05 Marks

1. Pradip's Botany Vol. V, Biochemistry and Biotechnology- New Millenium Edition
2. Alberts, B.Bray, D.Lewis, J.Raff, M.Roberts, K. and Watson, I.D. 1999. Molecular Biology of Cell - Garland Publishing Co. Inc New York, U.S.A.
3. Gupta, P.K. 1999 : A Text book of Cell and Molecular Biology, Rastogi Publication, Meerut, India.
4. Wolfe, S.L. 1993. Molecular and Cell Biology. Wordsworth Publishing Co., California, U.S.A.
5. Faku, K. and Nakayama S. 1996. Plant Chromosomes. Laboratory Methods. CRC Press, Boca Raton, Florida.
6. Sharma, A.K. and Sharma, A. 1999. Plant Chromosomes : Analysis; Manipulation and Engineering. Harwood Academic Publishers, Australia.
7. Bhojwani, S.S. 1990. Plant Tissue Culture : Applications and Limitations, Elsevier Science Publishers, New York. U.S.A.
8. P.K.Gupta Biotechnology.
9. Lea, P.J. and Leegood, R.C. 1999. Plant Biochemistry and Molecular Biology. John Wiley & Sons, Chichester, England.
10. Old, R.W. and Primrose, S.B. 1989 : Principles of Gene Manipulation. Blackwell Scientific Publications, Oxford, U.K.
11. Vasil, I.K. and Thorpe, T.A. 1994. Plant Cell and Tissue culture, Kluwer Academic Publications, the Netherlands.
12. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics, Agrobios, Jodhpur, India.
13. Smith, R.H. 2000. Plant Tissue Culture; Techniques and Experiments. Academic Press, New York.
14. Satyanarayan- Biotechnology.
15. An introduction to industrial Microbiology- Dr. P.K. Sivakumaar & Dr. M.M. Joe & Dr. K. Sukesh- S. Chand publication.
16. Practical Biotechnology and plant tissue culture- Prof. Santosh Nagar & Dr. Madhavi Adhav- S. Chand Publication.
17. Modern practical Botany (Volume-III)- Dr. B.P.Pandey- S. Chand publication.
18. Molecular Biology and Biotechnology- K.G. Ramawat & Dr. Shaily Goyal- S. Chand publication.
19. Comprehensive Biotechnology- K.G. Ramawat & Shaily Goyal- S. Chand publication.
20. Botany for degree students - B.P. Pandey- S. Chand publication.
21. A Textbook of Biotechnology- R.C. Dubey- S. Chand publication

Semester-V

8 : Environmental Science

5S : Environmental Science

(Pollution control technology)

UNIT-I : General approaches of air pollution.

- A. Sampling- Ambient and indoor, techniques. Analysis - Cox, Nox, Sox, Spm. Air quality standards, emission standards.
- B. Integrated approach of air pollution control: City planning, zoning, source correction methods. National and International steps to control green house gases.

UNIT-II : Air Pollution control Techniques.

- A. Control devices : Gravitational settling chambers; cyclone separators; fabric filters; electrostatic precipitators; wet collectors and scrubbers. Combustion-flaring, thermal incineration, catalytic oxidation. Control of other gaseous pollutants-odour, VOCs, oxides of sulphur and nitrogen emissions.

- B. Auto Gaseous Emission Control - Control of auto-exhausts emissions. Use of after burners, catalytic converters, engine modifications; tuning, importance of good maintenance and driving habits. Alternative fuels.

Unit-III : Physico-chemical Waste Water Treatment Processes :

- A. (i) Physical Process - Screening, grit chamber, aeration, oil and grease removal, sedimentation, coagulation, flocculation.
(ii) Chemical Process - Neutralization, chemical precipitation, adsorption, demineralization.
(iii) Biological Process - Activated sludge process, trickling filter, UASB (upflow anaerobic sludge blanket).
B. Sludge - Origin, nature, type, characteristics, treatment and disposal.

Unit-IV : Solid Waste Disposal

- A. Management of municipal solid wastes (MSW): Sources, physical composition and characteristics.
B. Disposal methods; Open-dumping and sanitary landfills. Reduction, reuse and recycling of materials. Optional technologies for processing of MSW: Incineration, gasification, pyrolysis
C. Hazardous wastes: Sources and characteristics. Safe storage, transport. Treatment of hazardous waste-Stabilization. Disposal of hazardous wastes. Introduction to Biomedical waste-Concept & classification.
D. Radioactive waste: sources, classification, health and safety aspects. Management of radioactive wastes.

UNIT-V : Biomedical and Radioactive Waste Treatment

- A. Biomedical - Introduction, concept, classification, treatment and disposal (Pit, composting and Incineration).
B. Radioactive waste - Handling, storage and disposal.
C. Case Studies

UNIT-VI : Indoor Safety

- A. Definition and concepts: Precautions in the processes and operations involving explosives, flammables, toxic substances.
B. Health Safety : Respiratory personal protective equipment (RPPE) & non respiratory personal protective equipment (NRPPE). Selection, use care and maintenance of non respiratory protective equipment. NRPPE: head protection , ear protection , face and eye protection , hand protection, foot protection and body protection.

Practical – 5

1. Preparation of windrose diagram of an area.
2. Determination of NO_x, SO₂ in an ambient air .
3. Measurement of Smoke Density.
4. Elemental analysis of sludge.
5. Estimation of organic matter from soil/sludge.
6. Determination of CO₂ in the atmosphere by volumetric method.
7. Determination of energy content of plants by Bomb Calorimeter.
8. Determination of physical parameters of
i) well water ii) Industrial or given type of effluent iii) River Water iv) Sea wa
9. Determination of heavy metals (Fe/ Cr /Cu) by spectrophotometric methods from waste water.
10. Detection/ estimation of Cr(VI) in presence of Cr III
11. Determination of hydrocarbon from fuel gas using Orsat's apparatus
12. Determination of Chemical Oxygen Demand value for industrial waste effluent.
13. Determination of NO₂ from the atmosphere by colorimetric method using high volume sampler
14. Estimation of mixed liquor suspended solids (MLSS) in activated sludge.
15. Reduction of hardness by ion exchange method.
16. Estimation of fluoride in waste water.
17. Determination of energy content in biomass (Bomb Calorimetry).
18. Estimation of Na⁺ and K⁺ in water / effluent samples using flame photometer
19. Calibration of air sampling equipments.
20. Noise, illumination, ventilation and heat stress measurements - Industry.
21. Preparation of Material Safety Data Sheet for laboratory chemicals.

Note:

1. Visit to Drinking / effluent treatment plant.
2. Industrial visit

Distribution of practical Marks (Duration 6 hours)

- | | |
|------------------------------------|----|
| 1. Long Experiments (Water & air)- | 20 |
| 2. Short Experiment- | 10 |
| 3. Study visit- | 10 |
| 4. Practical record- | 05 |
| 5. Viva-voce- | 05 |

Total 50

Equipments :-

- 1) Flame photometer
- 2) Orsat Apparatus
- 3) COD Reflux assembly
- 4) High volume sampler
- 5) Bomb Calorimeter
- 6) Noise level meter
- 7) Lux meter.

Reference Books:

1. Environmental Sciences - Jackson and Jackson
2. Environmental Sciences - Tuckeer (1990)
3. Introduction to Environmental Chemistry – A.K.De
4. Pollution control in process industries – S.P.Mahajan. Tata McGraw Hill pub. New Delhi
5. Water and Waste water technology – M.J.Hammer, John Wiley A & sons, New York 1986.
6. Introduction to wastewater treatment process – R.S.Ramalho.
7. Current practices in Environmental Engineering. (Vol. I & II) Alam Singh and U.S. Sharma. International Book Traders, Delhi-1997.
8. Basic environmental technology : Jerry ;A. Nathanson.
9. Handbook of environmental management and technology : Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
9. Environment and Health – Anthony I. Rowland & Paul Cooper, 3rd edition -1989.
- 10 Air quality management by Stern, A.C. (Ed) 1974.
11. Air pollution theory by Crawford.
12. Land pollution , causes and control by Harrusson and Laxon.
13. Soil and water conservation engineering by Schwab, S.D. Frevert, R.K. Edminster, T.W. and Barns, John Willey and sons.
14. Standard Methods for the Examination of water and waste water (1984) APHA,

**Semester-VI
Environmental Science**

**6S : Environmental Science
(ENVIRONMENTAL CONSERVATION & MANAGEMENT)**

- Unit-I** : **A) Environmental Education:** Definition, need, principles and objectives of environmental education, Types of environment education (Formal & Non Formal), stages of environment education, current status of environment education in India.
B) Environmental Education & Awareness: Concept of environmental awareness, methods of environmental awareness, role of environmental education in awareness programmes, Role of NGO's in environmental education; environmental awareness thorough mass media.
- Unit-II** : **A) Mining Environment :** A)Types of mining, issues related with mining management, strategies for conservation of minerals.
Land Use Pattern, land degradation and land management.
B) Conservation of wetland, wastelands and mangroves
- Unit-III** : **A) Wild Life Management** - Wild life as a resource. Threats to wild life. Indian board for wild life (IBWL). WWF, Wild life institutes in India. Wildlife poaching. Wild Life Protection Act, 1972, Environmental Protection Act, 1986.
B) Biodiversity Conservation :
Need of conservation; National policy and goals; methods of biodiversity conservation - in situ conservation(sanctuaries, national parks and biosphere reserve); ex situ conservation(zoo, botanical gardens) convention on biological diversity (CBD) ,Biodiversity Act 2002.
- Unit-IV** : **Role of National and International Organization in Environmental Protection :**
A) IUCN, UNEP, Man and Biosphere Programme (M.B.P.), State Pollution Control Board . Ministry of Environment and Forest (MOEF) .
B) Environmental Impact Assessment - Concept, scope and objectives, EIS, Public participation in EIA, advantages and disadvantages of Public participation.
- Unit-V** : **A) Environmental Audit :** Definition, purpose, advantages, general approach to environmental audit.
B) Introduction to Remote Sensing : Study of Arial Photographs and Satellite Images. Geographical Information System (Concept and Advantages).
- Unit-VI** : **A) Sustainable Development:** Concepts and principles of sustainable development.
B) Statistical Methods : Mean, mode, media, standard deviation, tabulation of data, types of data, diagrammatic representation and graphical representation of data, regression analysis.

Practicals based on Papers :

A) Experiments on Biodiversity:

- 1) Determination of Shannon Weiner Species diversity index to terrestrial animal communities.
- 2) Determination of Margalef diversity index to terrestrial animal communities.

- 3) Determination of Kothe's Species Deficit index to aquatic organisms.
- 4) Photographic submission of flora and fauna.
- B) Experiments on Environmental Management :**
 - 1) Characterization of wasteland soil.
 - 2) Characterization of wetland water.
 - 3) Characterization of wetland sediments.
 - 4) Visit to nearby mine / quarry
 - 5) Survey of Environmental literacy in nearby community.
- C) Experiments on GIS & Remote Sensing:**
 - 1) Study of Satellite Images or Aerial Photographs.
 - 2) Study and Applications of GPS
 - 3) Marginal information of Topo sheet.
 - 4) Indexing of Topo sheet.
 - 5) To study the conventional signs and symbols from Topo sheet.
 - 6) Interpretation of Topo sheet.
 - 7) To study of conventional signs and symbols from weather map.
 - 8) Interpretation of weather map.
 - 9) Scale determination of aerial photograph.
 - 10) Mapping of the land use patterns with the help of aerial photographs.
 - 11) To study the change in land use pattern of an area with help of aerial photographs and survey if India Topo sheet.
- D) EXPERIMENTS ON EIA:**
 - 1) Evaluation of impact of refuses on soil quality.
 - 2) Impact of air pollutants on plants leaves.
 - 3) To examine the effects biofertilizers versus chemical fertilizers on root ramification and plant growth.
 - 4) To evaluate the impact of traffic density on environment.

Reference Books:

- 1) Environmental economics for sustainable development – Kumar
- 2) Ecology and economics: an approach to sustainable development – Sengupta
- 3) Environment, Development and sustainability – Bhaskar nath
- 4) Water technology management challenges and choices – A.K. Barua. Biodiversity and environment – S. K. Agarwal
- 5) The Biological Diversity Act. 2002 and Biological Diversity rules 2004 – National Biodiversity Authority India. 475, 9th South cross street, Kalpalocwar Nagar, Neelangarai, Chennai – 600041.
- 6) Biodiversity measurement and estimation – D. L. Hawks
- 7) Biodiversity conservation – Global agreements and national concerns. RAMSAR sites CBD, Quarantine, Regulation, National Forestry policy, Biodiversity Act, Wild life protection Act.
- 8) Environmental Problems and Solutions by Asthana D.K.
- 9) Environmental Management by G.N.Pande
- 10) Pollution Management in Industries by R.K.Trivedi.
- 11) Indian Economy in International Perspective, 1994: Gaur K. D, Meshram P. J. Shashidharan K.L. ed. Sarup and Sons publishers Ansari Road, Darya Ganj New Delhi.
12. Environmental Economics, 2001: Madhu Raj ; Sarup and sons publishers, New Delhi.
13. Environment & Social Issues, 2000: Sunit, Gupta Sarup and Sons Publishers, New Delhi.
14. Global Environment: Current Status, 2000: Sunit, Gupta Sarup and Sons Publishers, New Delhi.
15. Environmental economics for sustainable development accounting and valuation 2001: Some issue in modeling Kumar (Pushpam).
16. Environmental Crisis and Management: Sunit, Gupta Sarup and Sons Publishers, New Delhi.
17. Ecology & economics: An approach to sustainable development and sustainability: Bhaskar Naath, Luc Hens, David Pimental.
18. Environmental Remote sending By: Saumitra Mukharjee.
- 19 Hand Book of Env. Laws, Acts, Rules, Guidelines, Compliance and Standard Vol. 1 & 2: R. K. Trivedy Environmental Edition: 1st 1996.
20. Pollution control Acts, Rules and notifications issued there under: Central Pollution Control Board April. 1995.
21. Environmental Protection and the Laws: C. N. Mehta, 1991.
22. Legal aspects of Environmental Pollution and its Management: Ed. S. M. Ali, 1992.
23. International Environmental Policy Emergence and Dimensions: by L. K. Caldwell 1990.
24. Lal's Commentevis on water, Air pollution laws along with the environmental (Protection) Act and rules 1986, 3rd Rd. 1992: Law Publisher India.
- 25 Environmental Problems, protection and control Vol I & Vol II Ed: Arun Kumar.
- 26 Remote Sensing and Image Interpretation:-Tomas M.Lillesand and Ralph W.Keifer john Wiley and sons Inc.New York.
27. Introduction to Remote sensing:-James B. Campbell, Tylor and Francis Ltd.London.
28. Fundamentals of GISN:-Michael N.Demers..
29. Remote Sensing application in applied geosciences:-Sumitra Mukherjee, Milton Book Company.
30. Environmental Geography:-H.M Saxena, Milton Book Company.
31. Principles of Photogeology:-Singh.
32. Principles of Remote Sensing:-Currain.
33. Fundamentals of Photogeology:-S.N.Pandey.
34. Environmental Impact Assessment, L. W. Canter, McGraw Hill publication, New Delhi.
35. Proceedings Indo-US workshop on environment impact analysis and assessment (1980) NEERI, Nagpur.

- Unit-III :** Methods of seed health testing
Inspection of plants beyond the seedling stage
seed certification and tolerance limits of seed borne pathogens
Seed act in relation to Seed borne diseases
National and international cooperation in seed pathology
- Unit-IV :** Introduction
Methods of insect classification
Orders of insects of economic importance
Insect body & appendages
Life-cycle of insect
Economic entomology Important insect-pests of seed crops, their nature of damage and management
1. Cereal-paddy, maize and sorghum
2. Pulses-Kharif pulses-pigeonpeas, mung, Rabbipulses-chickpea, fieldpea linseed
3. Oil seeds-mustard, castor, linseed groundnut
4. Vegetables and dry fruits
- Unit-V :** Beneficial Insects
Type of beneficial insects and their role in seed production
Type of insect pollinators, their usage in crop pollination
Honey bees, their social structure and management(bee Keeping)
Insect control
Definition and methods of insect control
Cultural, mechanical, physical, quarantine
Chemical control/pre harvest sanitations spray
Insecticide formulation and preparation of Spray Solution.
Safe application of pesticide
- Unit VI :** Storage Entomology
Types of insect pests and mites in storage - Nature of damage and losses caused and factors influencing them Sources and development of infestation, Detection of infestation.
Fumigants and methods of fumigation Seed protectants and their impact on seed viability etc.
IPM strategies for important pests Plant Protection Equipments
Type of equipments & their principles Safe handling, maintenance and use of machines Rodents and their control in field and seed godowns

Practical :

Seed Pathology

1. Demonstration and handling of stereobinocular microscope
2. Symptoms of important seed borne pathogens
3. Visual examination of dry seeds for disease symptoms
4. Examination of suspensions obtained from washings of seeds
5. Viability test-space germination test and tetrazolium test.
6. Detection of important seed-borne bacteria-various methods.
7. Detection of important seed borne viruses various-methods.

Seed Entomology

1. External morphology of insect, type of mouth parts, antenna and legs.
2. Identification of important storage pests, stages of insects.
3. Detection of seed borne insects and estimation of infestation
4. Plant protection equipments, their safe handling and use.
5. Handling of bees for pollination.
6. Collection and submission of stored product pests visit to warehouses and godowns.

Practical Examination :

Distribution of Marks

Marks 50

1. Diagnosis of Symptoms of seed-borne pathogens..... 10
2. To Calculate the viability of seed by tetrazolium test..... 10
3. Study of mouth parts, antena and legs of given insect..... 05
4. Identify and describe the seed specimen & equipments A, B, C,D, E, 10
5. Submission of field report..... 05
6. Submission of seed specimen and viva-voce..... 05
7. Record book..... 05

Books Recommended :

1. Seed Pathology Vol-I & II P. Naergaard
2. Principles of Seed Pathology Vol-I & II V.K. Agarwal & J.B.Sinclair
3. Seed Treatment K.L. Jeffs.
4. Seed Technology - R.L. Agrawal
5. Introductory Mycology C.J.Alexopoulos
6. An introduction to fungi J.P. Srivastava
7. Systemic Fungicides R.W. Marsh
8. Fungicides in plant diseases control Y.L.Nene and P.N.Thapliyal
9. Destructive and useful insects by Metcalf and Flint
10. Insect Pollination of field crops by J.B.Free
11. Agricultural Entomology by A.S. Atwal
12. Plant Protection Equipments by O.S. Bindra

Seed Processing, Farm Management and marketing

- Unit-I** : Seed drying : Importance and advantage of seed drainage, moisture content recalcitrant orthodox-and methods of seed moisture measurement, theory of seed moisture measurement, theory of seed drying, specific gravity separators , adjustment of intended disc and intended cylinder separators.
- Unit-II** : Surface texture separation : The roll mill, parts of the machine, Separating action and the adjustments, cleaning roll mills. Seed treatment : Seed treatment equipment, slurry treater, mist-o-matic seed treater, parts of the machine, construction and operation, Labeling of treated seeds and related precautions, storage of treated seeds, machine operation, and seed users safety. Site selection for seed processing plant on a seed production farm, Layout of machines in a seed processing plant for efficient production and main movement, mechanical inquiry of seeds in post harvest phase, conservation of energy and production in seed processing, maintenance and repair of seed processing equipment. Seed conveyors and elevators, bucket elevators belt conveyors screen conveyors. oscillation conveyors, pneumatic conveyors, difference between a specific gravity separators and oscillating conveyors installation of bucket elevator, computing the required height of bucket elevators capacity determination of bucket elevators.
- Unit-III** : Packaging of seeds. bager weigher, bag closing, labelling and main taining lot identity, lot numbers, seed pellets, handling and stacking, maintenance of seed processing records. seed storage structures : construction, operation and maintenance, insulation storage aeration air conditioning, dehumidification and stacking, moisture and heat proofing of seed storage structures, seed storage management.
- Unit-IV** : Field of farm management, scope basic principles in farm management, decision making operation and control Decision making approaches ,Decision making based on production, cost and capital investment, cost analysis law of diminishing return, opportunity cost, most profitable combination of input and output.
- Unit -V** : Planning and management of crops, Building and machinery Important crops of India, concepts pertaining to various crop production operations viz tillage, irrigation, sowing plant protection, harvesting and threshing maintenance of soil fertility, weeds and their control, mixed cropping, multiple cropping and dry land farming Machinery selection and their management determination of field capacity and field efficiency, machinery adjustments. Consideration in farm buildings implement shed, storage structures.
- Unit -VI** : Farm Business : Farm business analysis, Farm size, factors affecting profit and economic size of farm, Budget and Record Keeping : Farm budgeting, procedure and use, Farm efficiency measures, farm records and their use. Acquisition and Management of Land Labour and Capital Farm Surveys- Data Collection analysis Marketing Basic concepts, supply and demand price equilibrium, seed transportation and storage cost and returns, cost of processing and packaging, marketing organization for seed marketing, seed markets in India, Structure and working. Seed market surveys, Projections of supply and demand for different kinds of seed in India-Seed pricing of Breeder/Foundation/Certified Seeds.

Practicals :

Seed Processing.

1. Visit to a seed processing and storage complex and familiarization with different machines.
2. Study of physical characteristics of different crop seeds and their shapes.
3. Determination of physical properties of seeds of different crops
4. Measurement of seed moisture content by direct and indirect methods of Dring.
5. Study of air screen cleaner cum grader
6. Study of specific gravity separator
7. Study of seed treatment machines
8. Study of seed packaging equipments.
9. Study of bucket elevator, screw conveyors and pneumatic elevators.

Seed farm management and marketing.

1. Identification of farm machines and their use
2. Determination of field capacity and field efficiency
3. Soil sampling fertility and moisture content
4. Calibration and adjustment of various farm machines
5. Cost analysis.
6. Farm planning and Budgeting
7. Record Keeping

Practical Examination :

Distribution of Marks :

Marks 50

1. Determination of physical properties of seeds of different crops	10
2. Identification of farm machine and their use	10
3. Study of operations of seed treatment equipment	05
4. Identify and describe equipments A,B,C,D,E,	10
5. Submission of field Report	05
6. Submission of seed specimen & Viva -voce	05
7. Record book	05

Books Recommended :

1. Hand book of Agriculture, Indian Council of Agricultural Research, Krishi Bhavan, New Delhi
2. Farm Power and Machinery Management, Vth edition, 10WA State, U.S.A. Hunt, D, 1968
3. Farm Management Decision, Operation Control. John E Kadlec, Prentice Hall, Inc Englewood, Cliffs, New jersey, U.S.A.
4. Fundamentals of farm Management S.S. Joshi and T.R. Kapur, Kalyani Publishers, India, Ludhiana.
5. Fundamentals of farm Management A.S. Kahlon and Karam Singh, Kalyani Awed Publishers PVT.Ltd. 13/14 Asaf Ali Road New delhi/Madras/Bombay/Calcutta/Bangalore.
6. Economics of farm Production and Management, V.T. Raju and DVS Rao, IBH Publishing Co Pvt.Ltd. New Delhi.
7. Agricultural Marketing in India, S.S. Achary Oxford and I.B.H., New Delhi.
8. Seed Technology - R.L. Agrawal

**B.SC. FINAL, SEMESTER-V
10 : ZOOLOGY**

There shall be the following paper and practical for B.Sc. Part-III Semester V 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 a compulsory theory paper of 3 hours duration, as stated below and a practical examination extending for five 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.

Theory -5 S-ZOOLOGY: (ANIMAL PHYSIOLOGY AND ECONOMIC ZOOLOGY)

	Marks Allotted
1) Written examination.....	80
Internal assessment.....	20
2) Practical:	50

Total:	150 Marks

**Paper 5 S-ZOOLOGY
(ANIMAL PHYSIOLOGY AND ECONOMIC ZOOLOGY)**

Max. Marks - 100 Total

Period - 75

UNIT I

Respiration:

Structure of respiratory organs: Gills and Lungs

Mechanism of respiration: regulation of ventilation in lungs, exchange of gases at respiratory surface,

Respiratory pigments in animals: Haemoglobin, Haemocyanin, Haemerythrin, chlorocruorin.

Transport of gases: O₂ and CO₂ transport, Neurophysiologic control of respiration,

Circulation:

Blood : Definition and its constituents, functions of blood.

Heart: Structure of human heart, pace maker, Cardiac cycle.

Blood coagulation factors, blood groups A, B, O system and Rh-factor.

UNIT II

Muscle Physiology:

Types of Muscles: striated, non-striated and cardiac muscles

E.M. Structure and **Chemical** Composition of striated muscle, Neuromuscular junction.

Mechanism of muscle contraction by Sliding filament theory

Physical and Chemical changes during muscle contraction: muscle twitch, tetanus, isometric and isotonic contraction, summation of Stimuli, all or none law, fatigue, rigor mortis.

UNIT III

Nerve Physiology:

Neuron: E.M. Structure of neuron and Types : Myelinated and non-Myelinated nerve fibres.

Conduction of Nerve impulse, Resting potential, initiation and propagation of action potential, Saltatory transmission, Neurotransmitters (Acetylcholine, dopamine, GABA, Serotonin, Epinephrine, Nor-Epinephrine), Synapse and synaptic transmission

Chemical co-ordination:

Endocrine system: Hormones and their physiological roles of- Pituitary, Thyroid, Parathyroid, Adrenal, Islets of Langerhan's, Hormonal disorders: Dwarfism, Gigantism, Acromegaly, Goiter, Myxoedema, Cretinism, Osteoporosis,

UNIT IV

Reproductive Physiology:

Estrous and menstrual cycle, hormonal control of reproduction in males and female, Structure and physiology of mammalian Placenta.

Homeostasis and conservative regulation:

Osmoregulation and ionic regulation in aquatic animals. Osmoregulation in terrestrial animals Ammonotelism, ureotelism and uricotelism. Thermoregulation in Poikilotherms and Homeotherms.

UNIT –V

Agricultural Zoology: Economic importance of Insects

Beneficial insects – Spider, Mantis, Ladybugs, Damsel bug, Mealybug destroyer, Soldier beetle, Green lacewing, Syrphid fly, Tachinid fly, Ichneumon wasp and Trichogramma wasp.

Harmful Insects – Stired food grain pests, their injuries and control

Pests of,– Cotton, Sugarcane and Jowar. Damage and Control

Economic importance of Rodents, Snakes, Owls and Bats.

Apiculture - Sericulture -

Unit –VI.

Aquaculture

Aquaculture–: definition, scope, importance and present status in India.

Fresh water fish culture: types of fish ponds:Nursary, rearing and stocking, design and construction of fish pond, fertilizers used for fish development.

Hatching Happs, Chinease Circular Hatchery, CIFE, Mumbai, hatching model, Induced breeding and hypophysation, Modern drugs used in fish breeding.

Freshwater system: monoculture, polyculture, integrated aquaculture, cage culture, pen culture . Fish products and byproducts: Fish liver Oil, Fish body oil, Fish manure, Fish leather

Practicals:

1. Detection of blood groups in human being.
2. Differential counts of blood.
3. Estimation of hemoglobin percentage with the help of haemometer.
4. R.B.C. count.
5. W.B.C. count.
6. Preparation of haemin crystals
7. Measurement of blood pressure.
8. Action of salivary amylase on starch.
9. Qualitative detection of digestive enzymes in cockroach and crabs.
10. Qualitative detection of nitrogenous waste products in fish (Ammonia, urea, uric acid) in fish tank water, frog tank water, bird excreta and urine of mammal.
10. Use of, kymograph unit, Respirometer.
11. Collection and identification of Insect Pests of local crops, and predator insects.
12. Life Cycles of Honey bee, Lac insect, Silk Moth.
14. Histological Slides of major organs of Respiratory systems, circulatory system, Nervous system, Different types of Muscles, Endocrine glands, testis, ovary, placenta.
15. Study of locally available fishes, Indian major carps, Exotic carps, Common carp.
16. Dissection of Digestive system, Urinogenital system, Pituitary Gland of locally available fishes

Distribution of marks for practical examination :

Time: 5 Hrs.

Marks

01. Physiological Expt.	
a) Major.....	10
b) Minor	05
02. Economic Zoology	
a) Spotting (A-E) Based On Unit V and VI	10
b) Description and Comments on Topic from Unit V and VI / Dissection	10
04. Class record duly signed by teacher in charge and certified by H.O.D.	05
05. Study tour diary and collection of animals.	05
06. Viva - voce	05

Total Marks

50

REFERENCES

1. Prosser and Brown : Comparative Animal Physiology
2. Histological Slides of Respirator systems, circulatory system, Muscles, Nervous system Endocrine glands, Gonads, placentae
3. Guyton : Physiology
4. Best and Taylor : Physiological basis of Medical practice
5. C Hoar, W.S.. General and comparative Physiology. Prentice Hall of India.
6. Lehninger. L.. Biochemistry. W.H. Freeman & co.
7. Nagabushnam, R.. Animal physiology. S.Chand & co.
8. Martin, D.W. P.A. Mayes and W.W. Rodwell.,Harper’s Review of Biochemistry lange Medical Publications.
9. Prosser, C.L. and F.A.Brown Comparative Animal physiology. W.B. Saunders.
10. Rama Rao, A.V.S.S.. Biochemistry. UBSPD.
11. Stryer. L. Biochemistry Wiley International
12. Verma, P.S. and V.K. Agarwal.. Animal physiology. S.Chand & co.
13. Wilson, J.A., Principles of Animal Physiology, Macmillan
14. Chatterjee, C.J; Human Physiology(Vol-I and II)
15. Economic Zoology, G.S. Shukla, V.B. Upadhyay (2006)
16. Text Book of Applied Zoology, Pradip. V Jabde (2005).
17. Mac E. Hadley: Endocrinology, Prentice Hall, International Edition, 2000

**B.SC. FINAL, SEMESTER-VI
ZOOLOGY**

There shall be the following paper and practical for B.Sc. Part-III Semester VI 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 a compulsory theory paper of 3 hours duration, as stated below and a practical examination extending for five 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.

Theory -6 S-ZOOLOGY : (MOLECULAR BIOLOGY AND BIOTECHNOLOGY)

		Marks Allotted
1)	Written examination.....	80
	Internal assessment	20
2)	Practical:	50

		Total: 150 Marks

**Paper- 6 S-ZOOLOGY
(MOLECULAR BIOLOGY AND BIOTECHNOLOGY)**

Max. Marks - 100

Total Period - 75

- UNIT – I :** Genetic material-definition, Experiments to prove DNA as genetic material:Griffiths transformation experiments with bacteriophage infections, Avery and co-workers experiments, and Hershey and Chase experiment. Chemistry and types DNA(A,B,Z)Mitochondrial DNA; Chemistry, types and function of RNA: mRNA, tRNA and rRNA and Non Genetic RNA.
- UNIT - II :** DNA replication: semi conservative method; experiment by Messelson and Stahl. Concept of genes, one gene one enzyme hypothesis, one gene one Polypeptide theory.; A brief account of Concept and action of cistron, split genes, overlapping genes, jumping genes, Genetic diseases: Spinocerebellar ataxia.
- UNIT–III :** Genetic code and its features, Protein synthesis-transcription and processing of mRNA, translation-different steps, Gene regulation: (promoter and operator), Operon models, and Lac-operon model of E.Coli. Genetic regulation in Eukaryotes-Britten Davidson Model.
- UNIT–IV :** Mutation: Definition-mutation theory of DeVries-different types of mutations, - molecular basis of mutation: substitution and frameshift mutations, chromosomal aberrations-structural(deletion, addition, inversion and translocation),numerical (euploidy and aneuploidy). Natural and induced mutations-significance of mutations. DNA repair process. Polymerase chain reaction (PCR). Southern, Northern and Western blotting techniques, DNA finger printing.
- UNIT – V :** Biotechnology:. Genetic Engineering: Recombinant DNA technology and gene cloning-enzymes in recombinant DNA technology, Splicing and cloning of genes, vectors (plasmid and phage vectors), gene Transfer. Somatic cell hybridization, hybridoma technology, and monoclonal antibodies. Practical applications and suspected hazards of biotechnology and genetic engineering in animals.
- UNIT-VI :** Immunology: Introduction to immune system: Innate and adaptive immunity, Types and production of immune cells ; Complement system. Humoral Immunity: Antigen and haptens, Antibody: types function, and production. Cell mediated immunity: T-cell receptors, T helper cell and lymphocyte activation Role of cytotoxic T-cell..ELIZA Technique RIA.

Practicals:

1. Microtechnique scope and importance.
2. Preparation of fixatives - Alcohol, Acetone, Formalin, Bouin's fluid, Cornoy fluid, Formal sublimate.
3. Collection, of various tissues of available animal for micro-technique,
4. Preparation of Alcoholic grades, dehydration and clearing of tissues,
5. Use and care of Oven,
6. Embedding and block making, trimming of block.
7. Use and Care of different types of Microtome.
8. Honing and stropping Knives
9. Section cutting and spreading,
10. Preparation of various stains -Borax carmine Acetocarmin, Aceto-orcein, Haematoxyline, eosin.
11. Staining of the sections, (Double Staining), mounting.
12. Camera Lucida. Use and Drawings
13. Oculomicrometer scale/ similar micro-measurements use
14. Models of PCR, Southern blotting.
15. Vital Staining of mitochondria by using Janus, Green B stain.
16. Extraction of DNA/ RNA from liver/ Spleen.
17. Methods for the microbiological examination of water and foods.

Distribution of marks for practical examination :

Time: 5 Hrs. Marks

01 Microtechnique.	
a) Trimming and Section cutting of the Paraffin blocks	05
b) Spreading of ribbons.	05
c) Staining of the given slide /	10
c) Use of camera Lucida/ Ocular micrometer scales	05
02. Biotechnology experiment.	10
03. Permanent slides submitted by the examinee (5 Slides)	05
04. Class record duly signed by teacher in charge and certified By H.O.D.	05
05. Viva - voce	05

Total Marks	50

REFERENCES

1. Friefelder. D. Microbial Genetics; Narosa Publishing, New Delhi.
2. Goodenough, U. Genetics. Saunders Coolege Publishing International, New York.
3. Klug, W.S. and M.R.Cummings. Concepts in Genetics; Charles E.Merrill Publishing Co. London.
4. Kumar, H.D. Molecular biology and biotechnology. Vikas Publishing House, New Delhi.
5. Lewin, B.. Gene VI . Wiley Eastern Ltd., New Delhi.
6. Rothwell, N.V. Human Genetics. Prentice Hall of India, New Delhi.
7. Sinnott, E.W.L.C.Dunn, and L.C.Dobzhansky, T. 1985. Principles of Genetics. Tata McGraw Hill. New Delhi.
8. Stern, C. Principles of Human genetics. S.Chand & Co. New Delhi.
9. Verma, P.S. and V.K. Agarwal.. Genetics. S.Chand & Co. New Delhi.
10. Balasubramania, D., Concepts in Biotechnology. Unversity Press (India) Ltd., Hyderabad.
11. Chopra, V.L and A.Nasim,. Genetic Engineering and Biotechnology. Oxford & I BH, New Delhi.
12. Dharmarajan, M. Genetic Engineering S.viswanathan & Co.
13. Dubey, R.C.1995. Text book of Biotechnology. S.Chand & Co.
14. Glick, B.R. J.J. and Pastermak. 1998. Molecular Biotechnology. SSM Press, Washington.
15. Gupta, P.K. Elements of Biotechnology. Rastogi Publications, Meerut.
16. Jogdand, S.N. Advances in Biotechnology. Himalaya Publishing, New Delhi.
17. Kumar, H.D.. A text book on Biotechnology. East West Affiliated Press Ltd.
18. Proter, D.G. Ethical scores for animal experiments. Nature 356: 101-102.
19. Primrose, S.M. Modern Biotechnology. Blackwell Scientific Publishers, Oxford.
20. Trevan, M.D. Biotechnology: The Biological principles. Tata McGraw Hill Publishing Co., New Delhi.
21. Trehan, K. Biotechnology. Wiley eastern ltd., New Delhi.
22. Vijayaraman, K.S.Chellammal and P.Manikili. 1998. Uyiriyathozhilnutpam. Chimeeraa, Tiruchy.
23. AM. Pearson & TA Gillett (1996) Processed Meats,
24. W.J. Stadelman, V.M. Olson, GA. Shemwell & S. Pasch S.
25. Egg and poultry meat processing,
26. Bremner (2002) Fish as Food, Vol 1 & 2, HA
27. Ivan Roitt: Essential Immunology (6th Ed.) Oxford, Backwill, Science publication London.
28. Elgert: Immunology understanding the immune system, John Willy & Sons, Inc. publication, New York.

B.Sc. Final year (Semester V)

11 : STATISTICS

The examination in Statistics of fifth semester will comprise of one theory paper each, internal assessment and practical examination. 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 4 hours 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 six lectures per week and six practical periods per batch per week. Each theory paper has been divided into six units. There shall be one question in every unit with internal choice (either or type) for each of 12 marks and one compulsory question covering entire syllabus of fifth semester of 8 marks.

5S-STATISTICS

Unit I : Statistical Quality Control

- 1.1: Importance of statistical methods in industrial research and practice.
- 1.2: Determination of tolerance limits.
- 1.3: General theory of control charts, causes of variation in quality, control limits, summary of out of control criteria.
- 1.4: Control charts for variables - \bar{X} bar and R Chart.
- 1.5: Control charts for attributes-np charts, p-chart and c-chart.

Unit II : Acceptance Sampling Plan

- 2.1: Problem of lot acceptance, stipulation of good and bad lots, producer's risk and consumer's risk.
- 2.2: Single sampling plans and their OC functions.
- 2.3: Double sampling plans and their OC functions.
- 2.4: Concept of AQL, LTPD, AOQL, average amount of inspection and ASN function.

Unit III : Basic Econometrics

- 3.1: Theory of consumer behaviour.
- 3.2: Utility functions.
- 3.3: Indifference curves.
 - 3.3.1 Cardinal approach
 - 3.3.2 Ordinal approach
- 3.4: Partial elasticities of demand.
- 3.5: Income distribution Pareto Curve
- 3.6: Concept of Auto regressive models.

Unit IV : Sample Surveys

5. J.M.Henderson & R.E.Quandt : Microeconomics.
6. A.A.Walter : An Introduction to Econometrics
7. Gupta S.C. and Kapoor V.K.: Fundamentals of Applied Statistics, Sultan Chand and Sons.
8. Murthy M.N.(1967): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
9. Sampath S. (2000): Sampling Theory and Methods, Narosa Publishing House.
10. Sukhatme B.V. (1984) : Sample Survey Methods and its Applications, Indian Society of Agricultural Statistics.
11. Des Raj (2000): Sample Survey Theory, Narosa Publishing House.
12. Singh D. Chaudhary F.S.: Theory and Analysis of Sample Survey Designs.
13. Primal Mukhopadhyaya: Theory and Methods of Survey Sampling, Prentice Hall.
14. Sukhatme P.V. and Sukhatme B.V. : Sampling Theory of Surveys with Applications.

List of Practicals: (5S Statistics)

1. Construction of control charts for variables.
2. Construction of control charts for attributes.
3. Drawing of OC curve for single sampling plan.
4. Drawing of OC curve for double sampling plan.
5. Drawing a random samples by Random number method.
6. Estimation of population mean and variance using simple random sampling.
7. Estimation of population mean and variance using various allocations of stratified random sampling.
8. Estimation of population mean and variance using systematic sampling.
9. Estimation of mean and variance using cluster sampling.
10. Calculation of various elasticities of demand.
11. Utility functions.
12. Estimation of single equation linear regression model.

Note : The above practicals may be performed by using various statistical softwares.

List of equipments and instruments required for a batch of students in U.G. statistics laboratory.

- | | |
|---|----|
| 1. Twelve digit desk model electronic calculators. | 20 |
| 2. Biometrica tables Vol.I and Vol. II | 02 |
| 3. Seven figure logarithmic tables | 10 |
| 4. Statistical tables (compiled) | 10 |
| 5. Personal computer with printer | 05 |
| 6. Random number tables | 10 |
| 7. Statistical poster and chart | 02 |
| 8. Statistical softwares like SPSS, SAS, MS Excel and R | |

B.Sc. Final year (Semester VI)

6S : STATISTICS

The examination in Statistics of sixth semester will comprise of one theory paper each, internal assessment and practical examination. 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 4 hours 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 six lectures per week and six practical periods per batch per week. Each theory paper has been divided into six units. There shall be one question in every unit with internal choice (either or type) for each of 12 marks and one compulsory question covering entire syllabus of fifth semester of 8 marks.

6S-STATISTICS

Unit-I : Linear Programming

- 1.1: Convex sets and their properties.
- 1.2: Definition of general LPP, mathematical formulation of LPP with examples.
- 1.3: Examples of LPP, problems occurring in various fields.
- 1.4: Slack, surplus and artificial variables.
- 1.5: Graphical and simplex method of solving LPP.
- 1.6: Concept of duality of LPP with examples.

Unit-II : Transportation Problem (T.P.)

- 2.1: Definition and example of a T.P., mathematical formulation of a T.P.
- 2.2: Existence of feasible solution to a T.P., matrix form of a T.P., the transportation table, loops in a T.P.
- 2.3: The initial basic feasible solution, transportation problems with non degenerate and balanced cases only.
- 2.4: Methods to find initial basic feasible solution to a T.P.
 - 2.4.1: The North-West corner rule
 - 2.4.2: The Row Minima method

- 2.4.3: The Column Minima method
- 2.4.4: Matrix Minima method
- 2.4.5: Vogel's Approximation method.

Unit III : Assignment Problem (A.P.) and Sequencing Problem and theory of games.

- 3.1: Definition and example of a A.P., mathematical formulation of a A.P.
- 3.2: Hungarian assignment algorithm.
- 3.3: Sequencing problem with n jobs and 2 machines.
- 3.4: Introduction to theory of games, two person zero sum games, the maximin - minimax principle.
- 3.5: Definition of a saddle point, games with saddle points.

Unit-IV : Analysis of Variance (ANOVA)

- 4.1 Introduction to ANOVA.
- 4.2: One way classification and its analysis.
- 4.3: Two way classification with one observation per cell.
- 4.4: Two way classification with multiple but equal number of entries per cell.

Unit –V : Design of Experiments

- 5.1: Introduction to design of experiments, need for design of experiments.
- 5.2: Fundamental principles of design of experiments:
 - 5.2.1: Replication
 - 5.2.2: Randomisation
 - 5.2.3: Local Control
- 5.3: Uniformity trials.
- 5.4: Analysis of Completely Randomised Design (C.R.D.).
- 5.5: Analysis of a Randomised Block Design (R.B.D.).
- 5.6: Comparison of C.R.D. with R.B.D. in terms of efficiency.

Unit –VI : Latin Square Design (L.S.D.) and Factorial Experiments

- 6.1: Concept and complete analysis of L.S.D.
- 6.2: Efficiency of LSD as compared with CRD and RBD.
- 6.3: Introduction of Factorial Experiments, it's purpose, need and advantage.
- 6.4: Definition of contrast and orthogonal contrast .
- 6.5: Analysis of 2^2 and 2^3 factorial experiments, computation of main effects and interaction effects, Yate's method (up to three factors).

References:

1. Gauss S.L. (1975): Linear Programming Methods and Applications, Mc Graw Hill.
2. Taha H.A.(1989): Operations Research: An Introduction, Macmillan Publishing Company.
3. Kantiswaroop, Manmohan, Gupta: Operations Research.
4. Goyal and Mittal: Operations research.
5. S.C.Gupta, V.K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand and sons.
6. Cochran W.G. and Cox G.M.(1957): Experimental Designs, John Wiley and Sons.
7. Das M.N. and Giri (1986):Design and Analysis of Experiments, Springer Verlag.
8. Goon A.N., Gupta M.K. , DasGupta B.(1986): Fundamentals of Statistics, Vol.II, World Press Calcutta.
9. Kempthorne O. (1965):The Design and Analysis f Experiments, Wiley Eastern.
10. Clark: Statistics and Experimental Designs.

List of Practicals : (6S Statistics)

1. Solution of LPP by graphical method.
2. Solution of LPP by simplex method.
3. Computation of initial basic feasible solution to transportation problem by various methods.
4. Problems on assignment problem.
5. Problems on sequencing problem with n jobs with two machines.
6. Problems on two-person zero sum games with saddle points.
7. ANOVA: One way classification.
8. ANOVA: Two way classification with one observation per cell.
9. ANOVA: Two way classification with multiple but equal number of observations per cell.
10. Analysis of completely randomised design.
11. Analysis of randomised block design.
12. Analysis of Latin square design.
13. Analysis of 2^2 and 2^3 factorial experiments arranged in RBD.

Note : The above practicals may be performed by using various statistical softwares.

List of equipments and instruments required for a batch of students in U.G. statistics laboratory.

1. Twelve digit desk model electronic calculators. 20
2. Biometrica tables Vol.I and Vol. II 02
3. Seven figure logarithmic tables 10
4. Statistical tables (compiled) 10
5. Personal computer with printer 05
6. Random number tables 10
7. Statistical poster and chart 02
8. Statistical softwares like SPSS, SAS, MS Excel and R

12 : COMPUTER SCIENCE

**5S-COMPUTER SCIENCE
RDBMS AND VISUAL BASIC**

- UNIT-I : Fundamental of DBMS :** Architecture of a database system,, data independence, database models; Relational Hierarchical, network; data dictionary.
- UNIT-II : Relational Model :** Relations, Domains and Attributes keys, E-R diagrams, Reducing E-R diagrams to tables, function dependency, Normalization Process, Normal forms : 1NF, 2NF, 3NF, 4NF, BCNF.
- UNIT-III: Introduction to SQL :** Components of SQL, data types, operators, DDL Commands : CREATE, ALTER, DROP, for tables & views. DML Commands : SELECT, INSERT, DELETE & UPDATE; Clauses : ORDER BY, GROUP BY and HAVING;
- UNIT-IV : Introduction to Visual Basic :** Visual programming, event driven programming, VB Environment : New Project window, property window, Form layout window, toolbar, menu bar, tool box, form window;
Managing Control : Form properties, pointer tool, label control, text box, command button, picture box, image control, event procedure.
- UNIT-V : Creating Menus :** Application wizard for menu, menu editor, creating menu, adding code to menus, data types & variables.
Operators : Conditional operators, logical operators, control structures : If-else, Nested If--else, select case, goto, do loop, for loop, nested for loop.
- UNIT-VI : Introduction to Internal Functions :** MsgBox(), named constant, default buttons, specifying icons. Input box(), title, caption; using check box and option button in form.
VB Programmes : Private and public procedure, passing data by reference and value, passing control as arguments.
Internal Functions : Numeric functions, data type functions, string functions, special functions.

Books Recommended :

1. An introduction to database system, C.J.Date - Narosa Publication.
2. Database Management System : Mujumdar and Bhattacharya- TMH.
3. Essential of Oracle - Tom Lewis.
4. Oracle the Complete Reference - Koch & Loney.
5. Visual Basic 6.0 in 21 days - Greg Perry, Techmedia.
6. VB Guide 6.0, Black Book, Peter Norton, Techmedia.
7. Mastering VB 6.0 , Evangelous Petroustos, BPB.

Practicals :

Group A - Minimum 8 Practical based on RDBMS.

AND

Group B - Minimum 8 Practical based on VB.

Study Tour : Study tour may be arranged to Computer Industry or Software development, Organisation or Software Technology Park or IT Park.

Software : Software's legal version based on syllabus.

- Hardware :**
- (1) A minimum 10 (Ten) Computer system per batch and with latest specification.
 - (2) Minimum 2 laser printer.
 - (3) Internet facility with Broad Band connections.

**B.SC. FINAL COMPUTER SCIENCE
SEMESTER-VI**

**6S-COMPUTER SCIENCE
PL/SQL AND ADVANCED VISUAL BASIC**

- UNIT-I :** Data Integrity, types of integrity constants.
Functions : Number Functions - AVG, MAX, MIN, SUM, COUNT, TO-NUMBER, GREATEST, LEAST, ABS, MOD, FLOOR, CEIL, TRUNC, SQRT, SIGN, SIN, COS, LOG, EXP.
Character Function : INITCAP, LOWER, UPPER, INSTR, LENGTH, LTRIM, RTRIM, LPAD, RPAD, SOUNDIX, DECODE.
Joins and Unions : Self, equi and outer join, unions and intersection.
- UNIT-II : PL/SQL :** Features and block structure, variables and constant, data types, control structure.
Cursor : Concepts of cursor, types, declaring, opening, using cursors, fetching data, closing a cursor, cursor attributes.
Transaction : Rollback, commit and autocommit, save point, rollback segment.

UNIT-III : Securities of Database : Users, creating users, roles, creating roles, types of privileges, GRANT and REVOKE command, data locks.

UNIT-IV : Dialog Box Control : Need for dialog box control, adding the dialog box control, producing the color dialog box control, handling the cancel button, producing the font dialog box, producing the open dialog boxes, producing file save dialog boxes, producing the print dialog boxes.

Mouse and Control : Mouse response, list box controls, combo box control, timer control, working with arrays, declaring arrays, multiple list boxes.

UNIT-V : Working with Forms : Form collections, accessing the form collection using the subscripts, the count property, uploading forms, placing text on forms, format with print, positioning the print method, multiple forms, placing tool bars on forms.

UNIT-VI : Working with Files : Open statement, file modes, locking the file, close statement, working with sequential access file, print# statement, input# statement, write# statement, working with random access file, put statement, get statement, defining user defined data types, file control, file related commands.

Books Recommended :

1. Database Management System, Mujumdar & Bhattacharya, TMH.
2. Oracle the Complete Reference, Koch & Loney, TMH.
3. Understanding Oracle, Perry and Latic, BPB.
4. Essential of Oracle 8, Tom Lewis.
5. Visual Basic 6.0, The Complete Reference, Noel Jerke, TMH.
6. Guide VB 6.0 Black Book, Peter Nortan Techmedia.
7. Mastering VB 6.0, Evangelos Petroustos, BPB.
8. Visual Basic 6.0 in 21 days, Greg Perry, Techmedia.

Practicals :

Group A - Minimum 8 Practical based on Unit-I, II, III.

AND

Group B - Minimum 8 Practical based on Unit-IV, V, VI.

B.Sc. Final Year

13 : COMPUTER APPLICATION/ INFORMATION TECHNOLOGY

Semester –V

Paper : 5S: Programming in C#

UNIT-I : Introduction to C # : Evaluation of C#, characteristics of C#, application of C#, difference between C++ and C#, Introduction to C# environment : The .NET strategy, the origins of the .NET technology, the .NET framework, .NET, .NET languages, benefits of the .NET approach, C# and .NET.

UNIT-II : Overview of C#: Programming structure of C#, editing, compiling and executing C# programs, namespace, comments, using aliases for namespace classes, using command line argument, maths function.

Literals, variables and data types : literals, variables, data types, value types, reference type, declaration of variables, initialization of variables, default values, constant variables, scope of variables, boxing and unboxing.

UNIT-III : Operators and expression : arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, Bitwise operators, special operators, arithmetic expressions, evaluation of expression, precedence of arithmetic operators, type conversions, operator precedence and associativity, mathematical functions.

Decision making and branching : if statement, if...else statement, nesting of if...else statement, the else if ladder, switch statement, the ?: operator, Decision making and looping : while statement, do statement, for statement, for each statement, jumps in loops.

UNIT-IV : Methods in C# : declaring methods, the main method, invoking methods, nesting of methods, methods parameters, pass by value, pass by reference, the output parameters, variable arguments list, method overloading, Arrays : 1-D array, creating an array, 2-D array, variable size arrays, the system, array class, array list class, String handling : creating strings, strings method, inserting strings using systems, comparing strings, finding substrings.

UNIT-V : Structures and enumeration: structures, structs with methods, nested structs, difference between classes and structs, enumerations, enumerator initialization, enumerator type conversion, common program errors, Classes and Objects : Basic principles of OOP's, class, objects, constructors, static members, static constructors, private constructors, copy constructors, destructors, member initialization, the this reference, nesting of classes, constant members, read only members, properties, indexers.

UNIT-VI : Interfaces : Multiple Inheritance : defining an interface, extending an interface, implementing interface, interface & inheritance, explicit interface implementation, abstract class and interface, Operator overloading : overloadable operators, need for operator overloading, defining Operator overloading, overloading unary operators, overloading binary operators, overloading comparison operator. Delegates and Events : Delegate, delegate seclaration, delegate methods, delegates instantiation, delegate invocation, using delegates, multicast delegates, events, Managing Console I/O operations : console class, console input, console output, formatted output, numeric formatting, standard numeric format, custom numeric format.

Text Books:-

1. Programming in C# : E. Balguruswamy
2. Mastering in C# : BPB Publication
3. Programming C# : TMH Publication
4. Programming C# : PHI Publication

Practical: Minimum 16 programs should be prepared on above syllabi.

13 : COMPUTER APPLICATION/ INFORMATION TECHNOLOGY

Semester –VI

Paper:

6S: Computer Graphics, Multimedia and Animation

- Unit-I** : **Overview of Graphics Systems:** Refresh Cathode-Ray Tubes (CRT), Raster-Scan Display, Random-Scan Display, color CRT monitor, Flat-Panel Displays, 3D viewing system, stereoscopic and virtual reality system, raster scan system, graphics monitor and workstations, Input Devices, keyboards, mouse, trackball and spaceball, joysticks, image Scanners, Touch panels, light pen, voice system
- Unit-II** : **Output Primitives:** Points and lines, line drawing algorithm, DDA algorithm, Bresenham's Line Algorithm, parallel line algorithm, loading the frame buffer, line function, circle generating algorithm, Attributes: line Attributes, line type, line width, pen and brush option, line color, curve Attributes, color and grayscale level, color tables, grayscale
- Unit-III** : Areas fill Attributes, character Attributes, basic transformation, matrix representation, composite transformation: translation, rotation and scaling
- Unit-IV** : **Introduction to Multimedia:** What is multimedia, multimedia and hypermedia, overview of multimedia, software tools: music, sequencing and notation, digital audio, graphics and image editing, video editing, Animation, multimedia authoring, file format: GGIF, JPEG, PNG, TIFF, EXIF, graphics, animation files, PS and PDF, Window WMF, Window BMP.
- Unit-V** : **Multimedia Compression:** IZW, DCT run length coding, JPEG MPEG, Hypertext, MHEG, Hypermedia, Document architecture, SGML, ooa Augmented and virtual reality and multimedia: Concept, VR devices, VR chair, CCD, VCR, 3D Sound System, head mounted display.
- Unit-VI** : Animation: Introduction, History of Animation, Anatomy study, Basic Sketching, Introduction to 2D animation, Animation with flash – Tweening, Motion tweening, Shape twining

Text Books:-

1. Computer graphics – C Version", Hearn D and Baker M.P , 2nd Edition, Pearson Education
2. Multimedia Computing, Communications and Applications , Ralf Steinmetz, Klara Steinmetz, Pearson education, 2004.
3. Multimedia in Practice: Technology and Application –Judith (PHI)
4. Fundamental of Multimedia by DREW-Pearson(Practical Approach)
5. Multimedia : Making it Work: T. Vaughan
6. Multimedia programming :Siamon J. Gibbs and Dionysios C. Tsihrizis, Addison Wesley, 1995.
7. Multimedia Graphics : John Villamil, Casanova and Leony Fernanadez, Eliar, PHI, 1998.

Practical: Minimum 16 programs should be prepared on above syllabi.

B.SC. FINAL, SEMESTER-V

14 : COMPUTER APPLICATION (VOCATIONAL)

5S- COMPUTER APPLICATION (VOCATIONAL)

JAVA and ASP Programming

- UNIT-I** : Object Oriented Programming Paradigm, Basic Concepts of OOPs, Benefits and applications of OOPs.
Introduction to JAVA : History, Benefits and Applications, features, Java environment, Java Byte codes, Java virtual machine, Security Platform independence and portability, Java Support System.
- UNIT-II** : Java character set, keywords, Identifiers, constants, variables, operators and expressions, separators, Data types, Type conversion and casting.
Java Statements : Assignment statements, control statements, structure of Java program.
Methods of Java programming : Application (main) and applet methods, simple Java program.

UNIT-III : Classes, defining a class, adding variables and methods, creating objects, accessing class members, constructors, the 'this' keyword, Garbage collection. The finalize() method, method overloading, static members, inheritance, method overriding, abstract methods and classes.

UNIT-IV : **HTML :** Introduction, Components, editor, entering Tags and attributes, Document structure tags : HTML, HEAD, TITLE, BODY tags; Text Formatting : Headings, BLOCKQUOTE, PRE, CODE, FONT tags, LIST tags : Unordered & ordered list, Table formatting tags; TABLE, TR, TH, TD tags; Anchor tags, Image tag.

UNIT-V : **ASP :** Introduction, Dynamic web pages, necessity, scripting languages : Server-side and client-side scripting, data types, variables, constants, operators, decision making and looping structure, functions, GET, POST.

UNIT-VI : **Object :** Introductions : Object terms - Instances & classes, properties, methods, events, encapsulation; Request object, request object collections : Form, Query string, Server variables collection; properties and methods; Response Object : Introduction, creating and managing output / information, content expiration and caching, redirection.

Books Recommended :

8. The Complete Reference JAVA2 by Herbert Schildt (Tata McGraw)
9. The Complete Reference JAVA by Patrik Noughton
10. Programming with JAVA - A Primer : By E.Balguruswamy (Tata McGraw)
11. Beginning ASP 3.0 : Chris Ulman, David Buser, Jon Drukelt, Shroff Publisher & Distributors P.L.
12. ASP3 Programming : Eric A Smith - Wiley Publication.

Practicals :

- 1) Computer Lab : Minimum 16 practicals based on above syllabus.
- 2) Softwares legal versions based on syllabus.

**B.SC. FINAL, SEMESTER-VI
COMPUTER APPLICATION (VOCATIONAL)
6S- COMPUTER APPLICATION (VOCATIONAL)**

ADVANCED JAVA AND ASP

UNIT-I : **Array :** Declaration and initialization of one dimensional and multidimension arrays, strings, different operations on arrays.

Packages : Introduction, Java API packages, creating accessing & using a package, adding a class to a package.

UNIT-II : **Multithreading :** Introduction, creating threads & multiple threads.

Error and Exception Handling : Introduction, Fundamental of exception handling, types of errors, types of exceptions, uncaught exception, using try and catch, multiple catch clauses, nested try statement, built-in exceptions, creating your own exception.

UNIT-III : Applet Programming : Applet basics, difference between applets and applications, writing applets, applet code, applet life cycle, creating an executable applet, and applet tag, running the applets.

UNIT-IV : **Cookies :** Introduction, creating, modifying and deleting, Applications Objects : Object Collection, object methods.

Session Object : Collection, properties and method.

UNIT-V : **Global.asa file :** Creating application event code and session event code, declaring object.

Error Handling : Types of error - Syntax error, logical error, ASP error, Debugging ASP script, using write and conditional tracing.

UNIT-VI : **ASP Components :** Server object, AD Rotator component, content linking component.

Introduction to Oledb and Odbc : Connection object and record set and field object command and parameter object.

Books Recommended :

1. Programming in JAVA : By S.S.Khandare (S.Chand)
2. Teach Yourself 'Java' in 2 Hrs : By Sams.
3. Java for You : By P. Koparkar
4. OOP with C++ by E.Balguruswamy.
5. Mastering HTML 4.0 - D.S.Ray, E.J.Ray, BPB.
6. Active Server Pages 3.0, N.Chare (Que)

Practical : Minimum 8 practical based on above syllabus.

Project : The student have to carry out a mini project work, with group of maximum 03 students at department and project report should be prepared of the same.

B.Sc. Final Year, Semester-V
15. 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.
- (iii) There shall six questions of twelve marks on 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) Distribution of 50 marks assigned to practical for semester VI is as under-
 - 1. Programming (Writing and execution) : 10 Marks
 - 2. Project (Experimental) : 10 Marks
 - 3. Project Report and Seminar : 10 Marks
 - 4. Record : 10 Marks
 - 5. Viva-voce : 10 Marks

Total : 50 Marks
- (iv) Project will be given to a group of not more than four students.
- (v) Teacher may adopt any innovative practice for demonstration of practicals on the aspects given.
- (vi) College/ Department may prepare laboratory manuals of experiments

Semester-V
5S-Electronics
Measuring Instruments

Unit I : Basic Instrumentation:

Block diagram of generalized instrumentation system, Concept of transducers (Primary and secondary, active and passive, analog and digital). Resistive transducer - potentiometer, Inductive transducer - LVDT, capacitive transducer (by changing distance), measurement of displacement using capacitive transducer (By changing dielectric).

UNIT II: Measurement of Temperature:

Thermocouple, Thermopile, Thermister, RTD, Total Radiation Pyrometer, IC DS 1621, IC LM34, IC LM35, Infrared Pyrometer,

UNIT III: Timer and PLL:

IC 555 timer: Block diagram and function of each block, application of 555 timer as astable, bistable and monostable multivibrator (construction, working and expression for time period).
PLL Block diagram and function of each block, concept of capture range, pull in time, lock in range, electrical characteristics, applications of PLL as FM demodulator, AM detector and frequency synthesizer.

UNIT IV: Display, digital Instrument and recorder:

Seven segment, 14 segment, dot matrix, 16x2 LCD display, advantage and disadvantage, Digital instrument: Digital frequency meter, Digital voltmeter (Ramp type), Digital capacitance meter (Block diagram and function of each block).
Recorder: Classification, necessity of recorder, XY recorder, magnetic tape recorder.

Unit V : Sensors and Actuators:

Sensors: Definition, Methods of fabrication of Sensors, Types of sensors (Mechanical, Thermal, Optical, magnetic, chemical)
Actuators: Definition, Working principles of Electromechanical, Electro thermal, Electro-optical and Electrochemical Actuators.

UNIT VI: Biomedical electronics:

Introduction, Type of electrode, EEG, EMG, ECG-block diagram and function of each block, X ray machine, instantaneous heart rate meter-systolic and diastolic blood pressure meter, EAR oximeter, pulse Oximeter, range gated pulse Doppler blood flow meter, Laser Doppler blood flow meter.

Books Recommended:

- 1. Electrical and electronics measurement and Instrumentation by A.K. Sawhney
- 2. Linear integrated Circuits by Ramakant Gaikwad
- 3. Biomedical instrumentation by R.S.Khandpur

Practicals: Minimum Ten experiments at least one on each of the following aspects.

1. LVDT , displacement measurement using C transducer , pot meter.
2. Temp measurement using thermister,RTD, LM34 ,LM35 .
3. Astable , monostable , bistable using IC555 .
4. FM demodulator ,AM detector using PLL .
5. 16 x 2 LCD display , seven segment display and other display devices .
6. Sensors and actuators and its applications .
7. ECG , EMG, EEG , heart rate meter ,oximeter etc .

Semester VI
6S-Electronics

Advance Microprocessor and Microcontroller

UNIT I : 8086 Architecture:

Block diagram of 8086 microprocessor, BIU and EU, operating modes of 8086, register of 8086-G.P.R,pointer and index register, segment register, concept of segmented memory, instruction pointer, status flag, pin diagram of 8086 microprocessor, physical and effective address.

UNIT II: Instructions and programming of 8086

Instructions: MOV, PUSH, POP, LEA, LDS, LES, Arithmetic & Logic Instructions. Addressing mode, 8086 instruction, Bus cycle, Programming: programs of data transfer, addition, subtraction, division, multiplication using various addressing mode.

Unit-III : 8051 Microcontroller Architecture :

Microcontroller Introduction, Difference between Microprocessor and Microcontroller, block diagram of microcontroller, CPU, registers, flags, PSW, PC, Data Pointer, SFR, SP, Internal RAM/ROM, External memory, I/O ports, counter & timers, interrupts.

Unit-IV: Instruction set of 8051 and Programming:

Addressing mode, Instruction set: Data transfer, arithmetic, logical operation, JUMP, Loop and CALL instructions. Assembly language programming examples: simple data transfer, arithmetic, logical and single bit.

Unit-V : 8051 Interfacing & Application

Basics of serial communication, interfacing with RS-232C, SCON and PCON registers, interfacing a DAC / ADC and waveform generation, interfacing to the 8255, interfacing LED, power reduction mode.

Unit-VI: Advance microcontroller:

Introduction to AVR, Arithmetic and logic Unit, program and data memories, downloadable flash program memory, SRAM data memory, general purpose register file, I/O register, EEPROM data memory, peripherals, Timers/Counters.

Books Recommended:

- 1) Microprocessor Architecture and application by Dougulus Hall.
- 2) Intel Microprocessor 8086 by Brey: PHI
- 3) The 8051 Microcontroller architecture, Programming & Applications- Kenneth J.Ayala (Penram international)
- 4) The 8051 Microcontroller and Embedded Systems.- M. A. Mazadi, J. C. Mazadi (Pearson Education, Asia)
- 5) Microprocessor, microcontroller & applications- U. S. Shah (Tech-Max Publication Pune).
- 6) Programming and Customizing the 8051 Microcontroller- Mike Predko (TMH, New Delhi).

Practicals: Minimum Ten programmes at least five on each of the following aspects.

1. Programming on 8086(using kit/PC)
2. Programming on 8051 and/or C language.

AND

Minor project based on μ P 8085, 8086, μ C 8051, AVR, ARM, Communication, sensors, power amplifier, code converters, Biomedical Electronics, Digital Electronics or any advance topic of Electronics (Construction and Report).

16 : BIOCHEMISTRY
Semester - V

The examination in Biochemistry will comprise of one theory paper and one practical. Theory paper shall be of three hours duration and shall carry 80 marks each. The internal assessment will carry 20 marks. The practical examination shall be of six to eight hours duration for one day and shall carry 50 marks.

The following syllabus is prescribed on the basis of 6 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 marks, one compulsory objective type question on whole syllabus of Semester-V carrying 8 marks.

Distribution of marks in practical shall be as follows:

- | | |
|------------------------------------|----------------------|
| 1) Two short experiments | - 20 marks (10 each) |
| 2) One long experiment | - 15 marks |
| 3) Viva-voce | - 08 marks |
| 4) Class work and practical record | - 07 marks |

Total - 50 marks

5S BIOCHEMISTRY
MOLECULAR BIOLOGY AND BIOTECHNOLOGY

UNIT-I : A) Basic Concepts of Genetic Information

- a. Nucleic acids as genetic information carriers, experimental evidence e.g. bacterial genetic transformation, Hershey-Chase Experiment,
- b. Central dogma of molecular genetics - current version, reverse transcription and retroviruses.
- c. Salient features of eukaryotic, prokaryotic and viral genomes; highly repetitive, moderately repetitive and unique DNA sequences.
- d. Basic concepts about the secondary structures of nucleic acids, 5' → 3' direction antiparallel strands, base composition, base equivalence, base pairing and base stacking in DNA molecule. Tm and buoyant density and their relationship with G-C content in DNA.
- e. Watson and Crick model, A, B and Z types of DNA, major and minor grooves, chirality of DNA.
- f. Structures and properties of RNA: Classes of RNA.

UNIT-II : DNA Replication

DNA Replication in prokaryotes-conservative, semiconservative and dispersive types, experimental evidence for semiconservative replication. DNA polymerases, other enzymes and protein factors involved in replication. Mechanism of replication. Inhibitors of DNA replication.

Transcription

Transcription in prokaryotes, RNA polymerase, promoters, initiation, elongation and termination of RNA synthesis, inhibitors of transcription, Reverse transcriptase, post-transcriptional processing of RNA in eukaryotes.

UNIT-III : Translation and Regulation of Gene Expression

- a. Genetic code : Basic features of genetic code, biological significance of degeneracy. Wobble hypothesis, gene within genes and overlapping genes.
- b. Mechanisms of translation : Ribosome structure, A and P sites, charges tRNA, f-met-rRNA, initiator codon, Shine-Dalgarno consensus sequence(AGGA), formation of 70S initiation complex, role of EF-Tu, EF-Ts, EF-G and GTP, non-sense codons and release factors, RF-1 and RF-2.
- c. Regulation of Gene Expression in prokaryotes : Enzyme induction and repression, operon concept, Lac operon, Trp operon.

UNIT-IV : Basic Concepts of recombinant DNA technology & Nucleic Acid Sequencing.

- a. r DNA technology, vectors.
- b. Nucleic acid hybridization.
- c. Sequencing : Restriction and modification system; sequencing of DNA and RNA.

UNIT-V : Basic Animal Biotechnology

- a. History of Development of Cell cultures. Importance of growth factors of the serum, primary cultures, secondary cultures. Transformed animal cells – established continuous cell lines, commonly used animal cell lines their origin and characteristics. Growth kinetics of cell in culture.
- b. Applications of animal cell cultures for studies on gene expression. Organ culture.

UNIT-VI : Basic Plant Biotechnology

- a. Tissue cultures, introduction and history. Media preparation and compositions. Totipotency and cell suspension culture. Use of growth regulators. Practical applications of tissue culture.
- b. In-vitro techniques in tissue culture. Induction of callus, ovary and ovule cultures, invitro pollination and fertilization. Practical applications of genetic transformation in plants.

Practicals :-

A) Molecular Biology :

- 1) Extraction of RNA
- 2) Estimation of RNA by Orcinol method.
- 3) Extraction of DNA
- 4) Estimation of DNA by Diphenyl method.

B) Biotechnology :

- 1) Immobilization of yeast cells.
- 2) Production of alcohol by utilizing immobilized yeast cells.
- 3) Estimation of alcohol by Iodometric method.
- 4) Development of plant tissue callus.

List of Books Recommended :

- 1) Molecular Biology of Gene (Latest Edition) by J.D.Watson Hopkins Robertis, Stertz, Weiner.
- 2) Genetics by Sandhya Mitra (TMH Publication)
- 3) Gene VII by Lewis (Oxford)
- 4) Gene Structure and Expression by John D. Hawkins (Cambridge)
- 5) Plant Biotechnology S.Ignacimuthu S.J. (Oxford & IBH)
- 6) Gene Structure by Hawkins (Cambridge.)
- 7) Biotechnology – Application & Research edited by Paul Chere misinoff and Robert Ouellete (Technomic Publications)
- 8) An Introduction to Plant Tissue and Cell Culture Emkay Publication.
- 9) Essentials of Molecular Biology : D.Freifelder
- 10) Plant Cell, tissue and organ culture (ed) J.Reinert & YSP Bajaj.

6S BIOCHEMISTRY
IMMUNOLOGY AND CLINICAL BIOCHEMISTRY

The examination in Biochemistry will comprise of one theory paper and one practical. Theory paper shall be of three hours duration and shall carry 80 marks each. The internal assessment will carry 20 marks. The practical examination shall be of six to eight hours duration for one day and shall carry 50 marks.

The following syllabus is prescribed on the basis of 6 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 marks, one compulsory objective type question on whole syllabus of Semester-VI carrying 8 marks.

Distribution of marks in practical shall be as follows:

- | | |
|------------------------------------|----------------------|
| 1) Two short experiments | - 20 marks (10 each) |
| 2) One long experiment | - 15 marks |
| 3) Viva-voce | - 08 marks |
| 4) Class work and practical record | - 07 marks |

Total - 50 marks

- UNIT-I :** **A) Immunology:** Concept of immunity classification, humoral and cellular immunity.
B) Antigen: Definition, factors determining antigenicity, complete antigen, types of antigens.
C) Antibodies: Definition, structure, classification, properties and differences.
- UNIT-II :** **Antigen - Antibody reaction:** Definition, mechanism and application of precipitation, agglutination, complement fixation and toxin - antitoxin reaction, ELISA, RIA.
- UNIT-III :** **A) Monoclonal Antibodies:** Hybridoma technology.
B) Complement: Components, Classical Pathway, Alternative Pathway.
C) Allergy and hypersensitivity: Cell and coombs classification, definition and description of I- IV types of hypersensitivity.
- UNIT-IV :** **Clinical Biochemistry:**
A) Basic concepts of clinical biochemistry. Definition and scope of clinical biochemistry in diagnosis. Brief review of units and abbreviations used expressing concentration and standard solution. Quality Control.
B) Manual versus automation in clinical laboratory, Analyzer-Semi and auto analyser.
- UNIT-V :** **A)** Collection and preservation of biological fluids (Blood, serum, plasma, urine and CSF).
B) Chemical analysis of blood, urine and CSF. Normal values for important constituents (in SI units) in blood (Plasma/serum) CSF and urine
C) Clearance test for urea and Creatinine.
- UNIT-VI :** **Clinical Enzymology:**
A) Definition of functional and non-functional plasma enzymes, isozymes and diagnostic applications of isozymes. Enzyme pattern in health and diseases with special reference to plasma lipase, amylase, choline esterase, alkaline and acid phosphatase, SGOT and SGPT, LDH and CPK.
B) Hypo and Hyper glycemia, glycogen storage diseases, lipid malabsorption and statorrhea, albinism.

Practicals :-

A) Clinical Biochemistry :

- 1) Glucose tolerance test
- 2) Liver function tests (SGPT/SGOT/Alkaline Phosphatase/Serum bilirubin)
- 3) Cardiac function tests (Serum Cholesterol, CPK, Triglycerides, LDL-Cholesterol, HDL-Cholesterol, LDH)
- 4) Kidney function tests (Blood urea, Serum creatinine, Serum Na⁺, K⁺)

B) Immunology :

- 1) Blood Grouping
- 2) HBsAg (Hepatitis/B/C)
- 3) Pregnancy test

List of Books Recommended :

- 1) Immunology by Roitt (Blackwell)
- 2) Cell and Molecular Biology : Darnell Lodish Baltimore.
- 3) Animal Cell Culture : Practical approach : R.J.Freshney.
- 4) Introduction to Practical Biochemistry by Plummer
- 5) Practical Manual in Biochemistry by Jairaman.
- 6) Text Book of Biochemistry and Human Physiology by J.P.Talwar.
- 7) Lehninger's Principles of Biochemistry (2000) by - Nelson, Cox, M.M.Macmillan, New York.
- 8) Text Book of Biochemistry by U.Satyanarayana.
- 9) Text Book of Biochemistry by Sucheeta Dandekar.
- 10) Practical Clinical Biochemistry by Hirowled Varle.

List of Instruments/Equipment/Glass-ware with specification required for B.Sc. first to final semesters :-

List of equipments shall be mentioned in the Prospectus of B.Sc.-III (Prospectus No.2011123), printed on Page Nos.39 to 43).

**B.SC. FINAL (SEMESTER-V)
17 : 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 following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper have been divided into 6 units. There shall be one question on each unit, will internal choice and for each of 12 marks and one compulsory question covering all the syllabus of semester V(8 marks).

**5S MICROBIOLOGY
(Environmental Microbiology and Bioinstrumentation)**

Unit-I : Microbial Associations and Air Microbiology

A. **Microbial Associations** : Definition and examples of positive(Mutualism, Commensalism, Synergism), negative (Antagonism, Competition, Parasitism) and neutral association.

B. Air Microbiology

- a) The atmosphere and its layers.
- b) Different types of microorganisms in air.
- c) Techniques for microbiological analysis of air:
 - i) Solid impingement devices
 - ii) Liquid impingement devices.
- d) Airborne diseases : Etiology, symptoms and prevention.
- e) Control of microorganisms in air.

Unit-II : Microbiology of Soil.

- a) Microorganisms in soil.
- b) Rhizosphere.
- c) Decomposition of plant and animal residues in soil.
- d) Definition, formation, function and microbiology of humus and compost.
- e) Biological Nitrogen fixation : Type of nitrogen fixing microorganisms, factors affecting and mechanism of symbiotic and non-symbiotic nitrogen fixation. Process of nodulation, nitrogenase complex, recombinant DNA and nitrogen fixation, legume inoculants.
- f) Cycles of elements in nature :
 - i) Carbon cycle : CO₂ fixation, organic carbon degradation.
 - ii) Nitrogen cycle : Proteolysis, amino acid degradation, Nitrification, Denitrification, Degradation of nucleic acids.
 - iii) Sulphur cycle
 - iv) Phosphorus cycle.
 - v) Biofertilizers, biological pest control.

Unit III : Water Microbiology

- a) Planktons : Definition, types, factors affecting growth of planktons, methods of enumeration, beneficial and harmful activities of planktons.
- b) Control of plankton problems
- c) Eutrophication and its control.

Unit IV : Assessment of Water Quality and Treatment

Bacteriological analysis of water:

- i) Significance of bacteriological analysis of water.
- ii) Collection and handling of water sample from various sources.
- iii) Indicators of excretal pollution.
- iv) Multiple tube dilution technique, MPN.
- v) IMViC classification of coliform.
- vi) Membrane filter technique for coliform and faecal Streptococci.
- vii)ICMR and WHO Bacteriological standards of drinking water.

Unit V : A) Water Treatment

- a) Self purification of water : Various zones and factors responsible for self purification.
- b) Treatment of water : Aeration, Coagulation, Flocculation, Sedimentation and Filtration.
- c) Slow and Rapid sand filters : Construction, mechanism of filtration, differences.
- d) Methods of chlorination : Plain, super chlorination, ammoniachlorine treatment, Break-point chlorination

B) Waste Water Treatment

- a) Aims of sewage treatment, composition of sewage.
- b) Municipal sewage treatment plant.
- c) Preliminary treatment (seiving and Grit chamber)
- d) Primary treatment(sedimentation)
- e) Secondary treatment (Aerobic)
 - i) Trickling filter
 - ii) Activated sludge process
 - iii) Oxidation pond
- f) Anaerobic sludge digestion
- g) Domestic sewage treatment by septic tank and Imhoff tank.
- h) Concept of COD, BOD.
 - i) Outline of bio-gas production

Unit VI : Bio-Instrumentation

- a) Spectroscopy- Definition, Principle, types (UV&IR) & its applications.
- b) Electrophoresis- Definition, Principle, types (Paper&Gel) & its applications.
- c) Chromatography- Definition, Principle, types (Paper&TLC) & its applications.
- d) Isotopic Tracer Techniques - Definition, Principle & applications.

Microbiology Practicals.

- 1. Bacteriological analysis of water and Waste Water.
 - a) Standard plate Count.
 - b) Multiple tube dilution technique (MPN for Coliform)
 - i) Presumptive test ii) Confirmatory test iii) Completed test.
 - c) IMViC test for coliform
 - d) Multiple tube dilution technique for faecal strepto cocci.
 - e) Membrane filter technique for coliforms & faecal streptococci.
 - f) BOD estimation.
 - g) Isolation of Bacteriophage from Sewage.
 - h) Determination of Chlorine demand and residual chlorine.
- 2. Study of Soil Microbiology
 - a) Enumeration of Soil microorganisms.
 - b) Isolation of Azotobacter from Soil.
 - c) Isolation of Rhizobium from Soil
 - d) Isolation of Antibiotic producers from soil
- 3. Effect of Ultra-violet/Filtration on micro-organism present in water
- 4. Separation of amino acids and sugars by paper chromatography.

Distribution of marks for Microbiology practical Examination:

1. Major Experiment	- 15 marks
2. Minor Experiment	- 10 Marks
3. Viva Voce	- 10 marks
4. Spotting	- 10 marks
5. Laboratory Journals	- 05 Marks

Total - 50 marks

List of Reference Books for 5S Microbiology:

- 1. Introduction to Soil Microbiology : Alexander Martin
- 2. Soil Microbiology : Subbaroa N.S.
- 3. Introduction to environmental Microbiology: Mitchell, Ralph
- 4. Sewage & Waste treatment : Hammer
- 5. Water Pollution : Zajic J.E.
- 6. Water Pollution Microbiology : Mitchell R.
- 7. Air Pollution : Perlins H.L.
- 8. Aquatic Microbiology : Stainer & Shewan
- 9. Introduction to Waste Water Treatment processes: Ramalhr R.S.

**B.SC. FINAL (SEMESTER-VI)
6 S. 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 following syllabi is prescribed on the basis of six lectures per week and 6 practical periods per batch per week. Each theory paper have been divided into 6 units. There shall be one question on each unit, will internal choice and for each of 12 marks and one compulsory question covering all the syllabus of semester VI(8 marks).

(Industrial Fermentation, Food Microbiology and Metabolism)

Unit- I : Fermentation in General.

- a) Definition and scope of Industrial microbiology and biotechnology.
- b) Important classes of industrial microorganisms.
- c) Fermentation :- Definition and types (batch and continuous, aerobic and anaerobic, surface and submerged fermentations)
- d) Production strains
- e) Screening :- Definition, Primary screening (crowded plate technique, auxonography, enrichment culture technique, use of indicator dyes), secondary screening.
- f) Scale up process :- Definition and significance.
- g) Inoculum buildup : Spore and vegetative inoculum.
- h) General layout of fermentation plant :- Fermentation equipment and its uses.
- i) Raw materials :- Composition and uses. Saccharine, starchy, cellulose raw materials, hydrocarbon and vegetable oils, nitrogenous material (corn steep liquor) .
- j) Antifoam agents.
- k) Sterilization of media :- Batch and continuous sterilization.
- l) Detection and assay of fermentation products.

Unit- II : Industrial Productions I:

Microorganisms, raw material, inoculums buildup, fermentation conditions, recovery, uses and mechanism of the following products.

- a) Ethyl-alcohol : From molasses and waste sulphite liquor.
- b) Beer.
- c) Wine (Red table and White table).
- d) Acetone- Butanol from corn.
- e) Citric acid
- f) Vinegar- Fring's process

Unit- III :Industrial Productions II:

- a) Baker's yeast : From molasses, Definition of compressed and active dry yeast.
- b) Single cell protein : From bacteria.
- c) Penicillin.
- d) Amylase : Bacterial and fungal.
- e) Vitamin B12.

Unit-IV : Microbiology of Milk

- a) Definition
- b) Composition and types of milk.
- c) Sources of microorganisms in Milk.
- d) Types of microorganisms in milk.
- e) Pasteurization of milk : LHT, HTST, UHT. Phosphatase test.
- f) Grades of milk.
- g) Concentrated milk and milk powder.
- h) Preparation of fermented milk products, butter and cheese.

Unit-V : Food Microbiology

- a) Sources of contamination of fresh food.
- b) Microbial spoilage of foods.
- c) Preservation of foods :- Low and high temperature, dehydration, high osmotic pressure, chemical preservation, radiations and canning.
- d) Fermented foods : Idli, pickles and sauerkraut.
- e) Food poisoning : Food infection and food intoxication.
- f) Indicators of food contamination as per WHO.

Unit-VI Enzymology and Metabolism

A Enzymology :

- a) Nature and Definition.
- b) Classification and nomenclature of enzymes.
- c) Terminologies used in enzymology :- Enzyme, active site, substrate, co-enzyme, cofactors, prosthetic group, poloenzyme, apoenzyme, activation energy, isoenzyme, allosteric enzyme, inhibitors, immobilised enzymes.

B Metabolism :

- a) General strategies of metabolism.
- b) EMP pathway, TCA cycle.
- c) Oxidative phosphorylation and Electron transport chain.

Microbiology Practicals:

1. A) Microbiological Examination of milk:
 - a) Plate count
 - b) Methylene blue reduction test (MBRT)
 - c) Phosphates test
 - d) Test for coliform bacteria
 - e) Estimation of fats in milk
 - f) Milk testing for AdulterationB) Demonstration of microbes in Curd.
2. A) Laboratory scale production, recovery and quantitative estimation of following products:
 - a) Ethyl alcohol. b) Citric Acid c) AmylaseB) Immobilisation of Yeast.
C) Production of Curd/ Pickle/ Cheese by microorganisms
D) Production of wine from grapes/ other raw material
4. Microbiological Examination of Vegetables, fruits and Fast Foods by
 - a) Plate Count
 - b) Test for Coliform bacteria.
 - c) Yeast & Molds.

Distribution of marks for Microbiology Practical Examination:

- | | |
|------------------------|------------|
| 1. Major Experiment | - 15 marks |
| 2. Minor Experiment | - 10 Marks |
| 3. Viva Voce | - 10 marks |
| 4. Spotting | - 10 marks |
| 5. Laboratory Journals | - 05 Marks |

Total - 50 marks

List of Reference Books for 6S Microbiology:

1. Food Microbiology : Frazier W.C. & Westhoff D.C.
2. Fermented Foods (Vol.7) : Rose A.A.
3. Industrial Microbiology : Prescott S.C. & Dunn C.G.
4. Industrial Microbiology : Miller B.M. & W. Litsky
5. Industrial Microbiology : A.H. Patel
6. Microbial Technology : Pepller H.J. (Vol. I & II)
7. Industrial Microbiology : Casida L.E.
8. Principles of Fermentation : Stanbury, Peter F. & Technology Allan. Whitaker
9. Outlines of Dairy Bacteriology : Sukumar De
10. Modern Food Microbiology : Jay, Mames M.
11. Principles of Industrial : Rhodes & Fletcher. Microbiology
12. Industrial Fermentation : Under Kofler & Hick. Vol. I & II
13. Dairy Microbiology : Foster Etal
14. Industrial Microbiology : Rose

BOOKS RECOMMENDED FOR PRACTICALS :

1. Microbes in Action : Seely, Wander Mark, Taraporewala, Bombay.
2. Manual of Microbiological : A.J. Salle, Methods
3. Microbiological Methods : Collins
4. Difco Manual.

**B.Sc. Final (Semester V)
18 : FOOD SCIENCE
5S. Food Science
Food Processing : I**

Unit-I : Cooking & Food processing :

Importance of cooking, objectives of cooking, Advantages & disadvantages of preliminary preparation of cooking; cooking term, (cleaning, peeling, & stringing cutting & grating, sieving, soaking etc.)
Food processing : Physical, functional & growth property of foods. Cleaning, sorting, & grading of foods.
Mixing of liquids & solids (powder), mixing equipment.
Classification of cooking method (moist heat method e.g. Boiling, steaming, poaching etc.
Dry heat: roasting, toasting frying advantages & disadvantages.
Microwave cooking: Information diagram, advantages & disadvantages
Solar cooking : figure, advantage & disadvantages.

Unit-II : Food quality & Hygiene

General principle of food hygiene in rural & urban areas in relation to food preparation, personal hygiene & food handling habits, place of sanitation in food plant. Sanitary aspects of building & equipment.
Food quality: sensory evaluation; selection of panel of judges, types of test, judging
Objective ; measurement of colour, measurement of texture. Food quality & safety:
Food quality describing: composition, appearance, flavour attributes.
Nutritional quality of food, its assessment, content & quality of nutrient.
Sensory quality & its evaluation, subjective & instrumental measurements of sensory attributes of colour viscosity & texture etc.

Unit III : Cereals and legumes processing

Structure, type, composition, quality characteristics & physiochemical properties of wheat, milling processes for different wheat, milling product (Atta, semolina and refined flour). Flour grades & their suitability for baked goods. Quality characteristics and rheological properties of wheat milling products & its assessment by product utilization.
Rice ; types, composition processed rice products (flaked, expanded & puffed rice)
Corn: types of corn, dry wet milling of corn. Starch & its conversion products. Processed corn products (popped corn, corn flakes etc.
Legumes: composition & properties of legumes, milling of different legumes. Sweet & savoury products from legumes in India.
Sprouted grains, palatability & Nutritional quality.

Unit-IV : Oil and fat processing;

Importance of processing, Sources, chemical composition, physical & chemical properties, functional and nutritional importance of dietary fats & oils, Processing of oil seeds for direct use & consumptions, processing of refined oils hydrogenation .

Unit-V : Bakery & confectionary:

Bakery products ; Ingredients, assessing quality, ingredients, products like bread, biscuit, cookies & cakes & pastries. Equipment uses for above.
Confectionary products: Hard boil candies, toffees, chocolates etc. Ingredients, equipments & process, product quality parameters,

Unit-VI : Food additives & food safety:

Introduction, definition, need of additives, types of additives like antioxidant, colouring agents, flavours, natural & synthetic, flour improver, leavening agents, nutrient supplements, non-nutritive sweeteners,
Speciality foods; Scope, importance on speciality food, health food, functional foods, infant food & baby food fortification & supplementary foods.

Practical: (semester V)

- 1) Carry out preservation of certain vegetables by dehydration.
- 2) Study the rehydration characteristic of dried vegetables.
- 3) Perform osmotic dehydration of certain fruits & vegetables by sugar & salt solution.
- 4) To determine the water absorption capacity of the wheat flour / Maida .
- 5) Assessment of market sample of wheat, rice & Pulses for conforming some PFA specifications
- 6) Storage studies of cereal & legumes grains.
- 7) Determination of gluten content in wheat flour.
- 8) Adulteration of edible fats & oils
- 9) Preparation of Bread & its assessment of sensory quality.
- 10) Preparation of cake & its assessment of sensory quality.
- 11) Preparation of candy & its assessment of sensory quality.
- 12) Preparation of toffee & its assessment of sensory quality.
- 13) Preparation of cookies & its assessment of sensory quality.

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

Book Recommended :

- 1) Food Science 3^r edition , B. Srilakahmi, New Age International publication .
- 2) Food Science & Nutrition , Sunetra Roday , Oxford.
- 3) Preservation of fruits & vegetables , Girdhari Lal, G. S. Siddappad & G. L. Tandon, Publication & Information Division Indian council of Agricultural Research.
- 4) Outline of food Technology , Harry W. Volonesecke, Agrobios.
- 5) A Hand book of Food & Nutrition , F. C. Blank; Agrobios.
- 6) Laboratory Techniques in Food analysis, D. person
- 7) Nutrition & Dietetics 2nd edition , Shubhangini A. Joshi; Tata Mc Graw-Hill Publishing Company Limited.
- 8) Foods, facts & Principle 2nd edition ;N. Shakuntala Manay ; New Age International .
- 9) Food Science 5th edition ;Norman N. Potter ;CBS
- 10) Fundamental of foods & Nutrition by R. Mudambi & M. V. Rajgopal
- 11) Outline of Dairy Technology by sukumar De- Oxford university press.
- 12) Food Microbiology by Adams & Moss
- 13) Industrial Microbiology by Prescott & Dum

B.Sc. Final (Semester VI)

6S. Food Science

Food Processing : II

Unit-I : Milk & milk products

Introduction; chemical composition, nutritional importance of milk and milk products. Fluid Milk: Testing quality, cooling, storage & transportation of liquid milk
Standardization and or processing (pasteurization, sterilization), Storage, packaging and distribution of liquids milks

Milk Products : composition, methods of preparation & production, quality or grading parameters, shelf-life of cream, butter & ghee, evaporated & condensed milk , skimmed, whole & instant milk powders

Ice- creams, fermented milk (curd, yogurt etc.) Milk products (cheeses, butter milk, lassie etc.) other milk products (khoa, casein, whey proteins) Milk and milks product based, sweetmeats (butfi, rasogolla, milk, cake, kalakand, etc.)

Unit-II : Fruits & vegetable processing:

Current status of production & processing of fruit and vegetables

Products : juices & pulp, beverages, concentrates & powders, squashes, beverages carbonated & its quality control. Fermented products (wine).

Jam, jelly, & marmalades; dried fruit, soup mixture; sauces & ketchups; puree & pastes; chutneys, & pickles.

Unit-III : Poultry, Meat & Fish processing:

Nutritional, safety/ health & hygienic considerations.

Egg; structure, composition , nutritional & functional characteristic of egg, grading spoilage, preservation of egg, solid products through drying & freezing.

Fish: types, care in handling processing of fish, freezing , canning, salting & drying of fish.

Unit-IV : Beverages ;

Introduction, Importance, Types of beverages, classification Example, composition, (coffee, cocoa,& chocolate, tea, its processing, composition, soft drinks, its ingredients, , different beverages, alcoholic beverage (wine , beer, etc.) , non alcoholic beverages, mineral water, carbonated, non beverages, and their processing methods.

Unit-V : Traditional and functional foods;

Fermentation ; basic concept of fermentation, dairy base fermented products, and its importance.
Production of bakers yeast, food yeas,t wine, beer, vinegar, organic acid (citric acid & lactic acid)
Oriented fermented products, soya sauce, pickles, fermented milk, cheeses.
Indian traditional sweet, papads, idli, dosa , dhokla etc.

Unit-VI : Spices:

Introduction , Method of classification , List of spices , sources , Medicinal importance ,
composition , properties of spices (antioxidant)
Role of spices in cooking . preparation of different masalas & keeping quality

Practical :Semester VI

- 1) Preservation of fruits and vegetables by pickling
- 2) Preparation of squash
- 3) Shelf life study of egg by using different preservation methods.
- 4) Determination of quality of milk (Lactometer, pH & acidity, fat content, Specific gravity
- 5) Preparation of certain dairy products (khoa, paneer, cream, shikhand etc.)
- 6) Preparation of tomato ketchup & its preservation.
- 7) Preparation of tomato purr & its preservation.
- 8) Preparation of pickles.(lemon, mango, onion, amla).
- 9) Preparation of jam & its preservation.
- 10) Preparation of Jelly & its preservation.
- 11) Preparation of squash & its preservation.
- 12) Preparation of different types of measles.

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

Book Recommended :

- 1) Food Science 3^r edition , B. Srilakahmi,New Age International publication .
- 2) Food Science & Nutrition , Sunetra Roday , Oxford.
- 3) Preservation of fruits & vegetables , Girdhari Lal, G. S. Siddappad & G. L. Tandon, Publication & Infromation Division Indian council of Agricultural Research.
- 4) Outline of food Technology , Harry W. Volonesecke, Agrobios.
- 5) A Hand book of Food & Nutrition , F. C. Blank; Agrobios.
- 6) Laboratory Techniques in Food analysis, D. person
- 7) Nutrition & Dietetics 2nd edition , Shubhangini A. Joshi; Tata Mc Graw-Hill Publishing Company Limited.
- 8) Foods, facts & Principle 2nd edition ;N. Shakuntala Manay ; New Age International .
- 9) Food Science 5th edition ;Norman N. Potter ;CBS
- 10) Fundamental of foods & Nutrition by R. Mudambi & M. V. Rajgopal
- 11) Outline of Dairy Technology by sukumar De- Oxfort university press.
- 12) Food Microbiology by Adams & Moss
- 13) Industrial Microbiology by Prescott & Dum

B.SC. FINAL SEMESTER-V

19 : 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-V (8 Marks).

**5S. INDUSTRIAL MICROBIOLOGY
(Industrial Biotechnology)**

UNIT I : TOOLS & TECHNIQUES OF GENETIC ENGINEERING:

- a) Preparation of pure samples of DNA.
- b) Enzymes in genetic engineering : Exo and endonucleases, restriction endonucleases, ligases, polymerases, DNA manipulating enzymes.
- c) Analysis of DNA fragment size :Agarose gel electrophoresis.
- d) Identification of DNA fragment : Southern Blotting
- e) Cloning vehicles – Plasmids, Cosmids & Bacteriophages.

UNIT II : GENE MANIPULATION AND EXPRESSION

- a) Methods of gene transfer : Transformation, transduction, electroporation, microinjection.
- b) DNA sequencing : Maxam and Gilbert technique, di-deoxynucleotide method, DNA chips.
- c) Polymarase Chain Reaction.
- d) Genomic DNA library, cDNA library.
- e) Identification of clones : Colony hybridization.

- UNIT III : GENETIC TECHNIQUES IN STRAIN IMPROVEMENT:**
Mutation and selection of different types of mutants e.g. Auxotrophic, antibiotic resistant, analogue- resistant mutants. Mutants resistant to feedback effect and toxic compounds. Isolation of revertant mutants (Ames Test)
- UNIT IV : HEALTH CARE INDUSTRIAL PRODUCTS**
a) Production of hormones- Insulin
b) Production of interferon
c) Production of vaccines – Recombinant Hepatitis vaccine.
d) Hybridoma technology & monoclonal antibodies.
e) Gene therapy.
f) SCP (Single Cell Protein)
- UNIT V : INDUSTRIAL PRODUCTS FROM ACTINO MYCETES**
a) Primary metabolides : Enzymes, vitamins, amino acids, siderophores.
b) Secondary metabolides : Antibacterial, antifungal, antiviral, insecticidal, anticancer, growth promoter herbicides, immunosuppressive.
c) Bioconversion products
d) Recombinant products
- UNIT VI : PROBIOTICS :**
a) Introduction to prebiotics, probiotics and synbiotics.
b) Types of probiotics,
c) Beneficial characteristics of probiotic microbes
d) Probiotic organisms and its role in human health.
e) Probiotic products - (i) Yogurt, (ii) Koji, (iii) Tofu, (iv) Kefir, (v) Yakult, (vi) Miso.

Practicals:

1. Isolation of genomic DNA
2. Isolation of plasmid DNA.
3. Cultivation of yeasts and bacteria for single cell protein
4. Antibiotic sensitivity test
5. Isolation of antibiotic resistant mutants.
6. UV induced auxotrophic mutants production and isolation of mutants by replica plating technique.
7. Ames test for detecting potential carcinogenes.
8. Cultivation of actino mycetes.
9. Screening for antagonism
10. Preparation of Koji.

Distribution of marks for Industrial Microbiology Practical Examination:

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

B.SC. FINAL (INDUSTRIAL MICROBIOLOGY) SEMESTER-VI

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-VI (8 Marks).

**6S. INDUSTRIAL MICROBIOLOGY
(Tissue Culture and Industrial Waste Management)**

- UNIT I : ANIMAL TISSUE CULTURE**
- 1) Introduction, Definition of terms – Tissue culture, Cell culture, Organ culture. Primary, Secondary, Continuous & Established Cell lines.
 - 2) Culture media for animal cells.
 - 3) Primary Cell Culture Methods - Mechanical disintegration, Enzymatic disaggregation, primary explant technique.
 - 4) Uses of Cell lines.
 - 5) Cell culture products
- UNIT II : PLANT TISSUE CULTURE**
- 1) Introduction – Terms used in plant tissue culture, types of tissue culture : callus, organ, cell, protoplast, suspension (batch and continuous).
 - 2) Media used in Plant Tissue Culture, media constituents : Composition and preparation.
 - 3) Callus Culture - Isolation & Culturing techniques.

- 4) Regeneration
 - a) shoot regeneration
 - b) somatic embryogenesis
- 5) Types of plant tissue culture
 - a) Anther culture
 - b) Ovary culture
 - c) Meristem culture
 - d) Embryo culture

UNIT III : PROTOPLAST CULTURE, SOMATIC HYBRIDIZATION & TRANSGENIC PLANTS

- 1) Protoplast isolation, culture & regeneration.
- 2) Somatic hybridization : Protoplast fusion, selection, identification and applications of hybrid cells.
- 3) Transgenic Plants :-
 - a) Resistance to biotic stresses : Insect resistance, virus resistance, fungal and bacterial disease resistance.
 - b) Resistance to abiotic stresses : Herbicide resistance (Glyphosate, Phosphinothricin, sulphonyl urea).
- 4) Improvement of crop yield and quality, Commercial transgenic crop plants.

UNIT IV : WASTE MANAGEMENT

- 1) Composition of Sewage, Need for waste water treatment
- 2) Physical, Biological & Chemical methods for treatment of industrial effluents
- 3) Solid waste management (outline).
- 4) Biogas production.
- 5) Composting

UNIT V : BIOREMEDIATION

- 1) Bioremediation, biodegradation, xenobiotics, recalcitrant compounds.
- 2) Types of bioremediation : In situ and Ex situ with advantages and disadvantages.
- 3) Role of microbes in -
 - a) Degradation of crude oil
 - b) Bioleaching of metals
 - c) Recovery of metals
 - d) Biodegradation of pesticides and herbicides.
- 4) Genetically engineered microbes in bioremediation.

UNIT VI : ENTREPRENEURSHIP

Basic regulations of excise. Survey the demand for a given microbial product, feasibility of its production under the given constraints, project preparation for financial assistance, different funding agencies. Subsidies for various projects, patenting the product.

Practicals

- 1) Preparation of various media for Tissue culture.
- 2) Development of Callus Culture.
- 3) Plant Regeneration from Callus Culture.
- 4) Organogenesis from different types of Explants.
- 5) Isolation and culture of plant protoplast.
- 6) Estimation of DO of different industrial effluents.
- 7) Estimation of BOD of different industrial effluents.
- 8) Estimation of COD of different industrial effluents.
- 9) Visit to Industrial effluent treatment plant, Dairy; Food processing industry etc.
- 10) Study tour.

Distribution of marks for Industrial Microbiology Practical Examination:

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

List of books recommended for 5S and 6S:

- 1) Old, S.B. Primrose. (1994) Principles of Gene Manipulations, Blackwell Scientific Publications.
- 2) Brown T.A. Gene Cloning- An Introduction, Chapman and Hall India.
- 3) Brown (1991) Essential Molecular Biology – A practical Approach Vol I & II, Oxford University Press.
- 4) Freshney, R.I (ed), 1992, Animal cell culture: A practical approach (2 nd ed), Oxford University Press, New York.
- 5) Freshney, R.I 1987, Culture of animal cells: A Manual of basic techniques (2 nded), Alan R. Liss, New York.
- 6) Paul, J., 1975, Cell and Tissue culture (5th ed) Livingstone, Edinburgh.
- 7) Bhojwani, S.S., (ed) 1990, Plant Tissue Culture: Application and Limitations, Elsevier, Amsterdam.
- 8) Street, H.E., 1977, Plant cell and Tissue Culture, Blackwell, London.
- 9) Davar R.S, Principles and Practice of Management.
- 10) Jain and Agarwal, Production Management and Industrial Organization.
- 11) Sherlekar, S.A., Marketing / Management.
- 12) Satyanarayan, Biotechnology.

B.Sc. Final (Semester - V)

20 : Biotechnology (Regular/Vocational)

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-V (8 marks).

5S : Biotechnology (Regular / Vocational)

ANIMAL CELL BIOTECHNOLOGY

- UNIT I :** Major types of tissues- Epithelial, Muscle, Connective, Nerve, Blood. Structure and organization of cells in various tissues, Origin and lineage. Junctions between cells – Tight junctions, Adherens junctions, Gap junctions, Desmosomes. Extracellular matrix – structural proteins, specialized proteins and proteoglycans.
History of development of cell cultures – Contributions of Ross Harrison, Alex Carrel, Charles Lindbergh, Ian Wilmut.
- UNIT II :** Design and Layout of the laboratory, Functioning of Equipments: Various incubators, biosafety cabinets, Sterilizers, Refrigerators and freezers, inverted microscope, Deionizers and water purification systems, CO₂ incubators, Colony counters, Flow cytometer. Laboratory safety and Biohazards, ethics and good laboratory practices (GLP).
- UNIT III :** Introduction to the balanced salt solutions and simple growth medium, Chemical, physical and metabolic functions of different constituents of culture medium, Gas phase, buffering and Osmolality of medium. Role of serum and supplements. Selection of medium and serum, Serum free medium.
- UNIT IV :** Type of tissue culture: Disaggregation of tissues for primary culture – Primary explants technique, Enzymatic disaggregation, Mechanical disaggregation, Physical methods of cell separation.
Established cell line- Commonly used animal cell lines, Origin of cell culture, characteristics of cells in culture. Plating efficiency. Characterization of cell lines – karyotyping, Isozyme analysis. Cryopreservation.
- UNIT V :** Applications of animal cell culture – Production of viral vaccines, growth factors, Erythropoietin, Interleukins. Studies on gene ex-pression, Transfection of animal cells: selectable markers, antibiotic resistance, Somatic cell fusion- HAT selection, production of monoclonal antibodies.
- UNIT VI :** Specialized Techniques: Mass culture techniques – Suspension culture, Continuous culture, Monolayer culture – Roller culture, Spiral propagator, Micro-carriers, Establishment of Synchronous cultures, Culture of Amniocentesis.

Practical :

1. Preparation of balance salt solution.
2. Preparation of TPVG and filter sterilization.
3. Separation serum and filter sterilization.
4. Dissociation of cells from primary tissue.
5. Dissociation of cells from culture vessels.
6. Enumeration of cells using Hemocytometer.
7. Estimation of viability of cells by dye exclusion method.
8. Preparation of primary culture from chick embryo.
9. Maintenance and subculturing of cell lines.

Equipments :

1. Autoclave
2. Incubator
3. Laminar flow
4. Balance
5. Centrifuge
6. Inverted Microscope
7. Quartz Distillation unit
8. CO₂ incubator
9. Magnetic stirrer
10. Water bath
11. Hot air oven

Books Recommended:

1. Freshney, R.J.: Culture of Animal Cells, Wiley-Lissz
2. Masters, J.R.W (ed.): Animal Cell Culture – Practical Approach, Oxford Uni. Press
3. Sudha Gangal: Principle and practice of animal tissue culture, Universities Press, India
4. Freshney, R.J.: Animal cell culture- Practical Approach.
5. Gupta P .K.: Elements in Biotechnology.

Semester-V : Animal Cell Biotechnology

Distribution of Practical Marks :

1. Major Experiment	12 Marks
2. Minor Experiment	08 Marks
3. Spotting	05 Marks
4. Viva Voce	10 Marks
5. Practical Record	10 Marks
6. Study tour / visit	05 Marks

Total 50 Marks

**B.SC. FINAL (SEMESTER-VI)
20 : BIOTECHNOLOGY (REGULAR / VOCATIONAL)**

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-VI (8 marks).

**6S : Biotechnology (Regular / Vocational)
PLANT BIOTECHNOLOGY**

- UNIT-I :** Growth : Terminology and definitions, methods of measuring growth and differentiation. Growth curves and growth analysis, Geotropism, Phototropism, Apical dominance, Effect of environmental factors on growth: Photoperiod, Radiation energy, (Intensity, Wavelength), transpiration and nutrition.
- UNIT-II :** Plant Growth Substances: Hormone concept, Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid. Physiological effect of hormones, Mechanism of action of plant growth substances, Use of plant growth substances in agriculture and horticulture.
- UNIT-III:** Plant Tissue Culture – Introduction and history, Practical applications of tissue and organ cultures, Equipments and other requirements, Commercialization of tissue culture: Design of typical tissue culture laboratory and its management. Media preparation and composition.
- UNIT-IV :** In vitro techniques in tissue culture: Beginning of in vitro culture. Clonal multiplication of elite species (Micropropagation) from axillary bud, shoot tips, protocorms (Orchids), meristem culture. Hardening of tissue cultured plants. Induction of callus, ovary and ovule culture. Embryo rescue, embryo culture and its applications. Somaclonal variation and its applications, Pollen and anther culture, Endosperm culture and triploids
- UNIT-V :** Single cell suspension cultures and their applications in selection of variants/mutants. Transport processes in plant cells and tissues, Protoplasmic membrane, General transport law, active and passive transport across the membrane. Protoplast isolation and regeneration,
- UNIT –VI :** Somatic hybridization - Markers for selection of hybrid cells, Hybrids, cybrids, application of somatic hybridization, protoplast and tissue culture for genetic manipulation of plants, various methods of genetic manipulations (electroporation, gene gun, Agrobacterium mediated, etc.), practical applications of genetic transformation of plants.

Practical :

1. Bioassay of Indole acetic acid using coleoptiles.
2. Bioassay of Gibberellic acid using barley seeds.
3. Initiation and maintenance of callus culture of soybean.
4. Bioassay Cytokinin using soybean callus.
5. Study of growth parameters in callus culture.
6. Initiation and growth study of suspension culture.
7. Initiation of shoots from apical or axillary bud
8. Induction of shoot initiation by modulating hormone balance.
9. Induction of root initiation by modulating hormone balance.
10. Single cell suspension culture from carrot.
11. Generation of somatic embryo from suspension culture of carrot.
12. Induction of Agrobacterium infection in any dicot leaf and maintenance of resultant callus.

Equipments :

1. Autoclave
2. Incubator with illumination and temperature control
3. Laminar flow
4. Balance
5. Centrifuge
6. Microscope
7. Quartz Distillation unit
8. Magnetic stirrer
9. Water bath
10. Hot air oven

Semester-VI : Plant Biotechnology

Distribution of Practical Marks :

1. Major Experiment	12 Marks
2. Minor Experiment	08 Marks
3. Spotting	05 Marks
4. Viva Voce	10 Marks
5. Practical Record	10 Marks
6. Study tour / visit	05 Marks

Total 50 Marks

Book Recommended :-

- 1) Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture : (Ed.) J.Reinert and Y.S.P. Bajaj
- 2) Plant Tissue Culture : Application and Limitations : S.S.Bhojwani
- 3) Plant Cell Culture : A Practical Approach (IRL Press) : R.A. Dixon and Geonzales
- 4) Introductory Plant Physiology : G.Ray Noggle and George J.Fritz (Prentice Hall of India Pvt.Ltd.)
- 5) Introduction to Plant Biotechnology : H.S.Chawla

**B.SC. FINAL (SEMESTER-V)
21 : BIOINFORMATICS
5S : BIOINFORMATICS
Paper V (Methods in Bioinformatics)**

UNIT-I : Introduction to Database :

Importance of Database, Types of Database, Data Models, Data Abstraction, Test Databases. Database Design (DBMS & RDBMS), Data Security, Data Warehousing, capture and Analysis, Data Management and Architecture.

Microarray Database, Enzyme Database, Biodiversity Database.

UNIT-II : Biology and Computer Science :

Structural Organization of genome. *In silico* analysis of primary structures of nucleic acid sequences. Representing sequence Data , a program to store a DNA sequence, DNA Fragments, Transcription : DNA to RNA Nucleic Acid Sequence databanks : GenBank, Genomic Databases. Repositories : EST and STS, Limitation of Computation Analysis.

UNIT-III : Mutations, Randomization and genetic code :

Random number generators. A program using randomization. A program to simulate DNA mutation generating random DNA analyzing DNA. The genetic code. Hashes data structures and algorithms for biology. Translating DNA into proteins. Reading DNA from files in FASTA format reading frames. Database Similarity Searches : BLAST, FASTA, PSI-BLAST, BLAST-2

UNIT-IV : Restriction Maps and Regular Expression :

Regular expression restriction maps and restriction enzymes Perl operations GenBank, GenBank files, GenBank libraries, separating sequence and annotation, parsing annotations indexing GenBank with DBM. Biological Databanks : Introduction to Biological databanks, Protein Sequence databanks : PDB, SRS, SWISSPROT

UNIT-V : Protein Data Bank :

The Organization of proteins. *In silico* analysis of primary structures of proteins, Protein Tertiary structure prediction methods: Homology modeling, fold recognition, Abintio Method. Comparison between and tertiary structure. Files and Folders PDB files parsing PDB files controlling other programs.

UNIT-VI : HMM (Hidden Marcov Model) : Introduction to HMM, its application in sequence alignment and structure prediction, based Softwares (HMMER and HMMSTR) obtaining BLAST String Matching and Homology, BLAST output files, parsing BLAST output presenting data bioperl.

Practicals :

1. Downloading primary structure of nucleic acids and proteins.
2. Protein Sequence comparison and analysis
3. Properties of primary structure of proteins using online tools.
4. *In silico* analysis of nucleic acids and proteins tools.
5. Installing perl and command lines arguments.
6. Access to Gene and Protein data bank.
7. Prediction of secondary structure of proteins.
8. Visulazation of tertiar structure of proteins in Rasmol or Cn3d.
9. Accessing existing databases on www.
10. Homology search tools like BLAST.
11. Database Searches : NCBI, DDBI, EMBL, Uniprot.
12. Parremire sequence alignment – BLAST.
13. Downloading and installing software/plugs in windows.
14. Spreadsheet Applications : (Database Management Sorting Records, finding, adding, deleting.)

Distribution of Practical Marks :-

- | | |
|--|----------|
| (1) To perform one major experiments : | 15 Marks |
| (2) To perform two minor experiments : | 15 Marks |
| (3) Viva-voce: | 10 Marks |
| (4) Practical Record: | 10 Marks |

Total 50 Marks

List of Equipments :-

Quantity

- | | |
|---|--------------------------------------|
| 1) Computer Terminals :- Pentium-IV with latest configuration | 8 computers for batch of 16 students |
| 2) Printer CDMP : Configuration :- 24 pin, 132/80 columns | 02 Nos. |
| 3) C++ Software (Compiler or Interpreter) | 01 |
| 4) Perl Language Compiler | 01 |
| 5) Broad Band Internet Connection | 01 |

Recommended Books :-

- (1) Baldi P. and Hatfield G.W. (2002), DNA Microarray and gene expression. Cambridge University Press, U.K.
- (2) Bowtell D. and Smbrook J. (2003), DNA Microarray : A molecular cloning manual. Cold Spring Harbour Laboratory, New York.
- (3) Hastie T. Tibshirani R. and Friedman J. (2001), Elements of statistical learning : Data mining, inference and prediction, Springer, New York.
- (4) Johnson R.A. and Wichern D.W. (1998), Applied Multivariate statistical analysis, 4th Edition, Prentice Hall, New Jersey.
- (5) Lentner M. and Bishop T. (1993), Experimental design and analysis, 2nd Ed., Valley Book Company, Verginia.
- (6) Li W.H., (1997), Molecular Evolution, Sinaur and Associates, New York.
- (7) Smyth G.K., Throne N.P. and Wettenhall J. (2003) Limma : Linear Models of Microarray data user's guide. Walter and Eliza Hall Institute of Medical Research, Australia.
- (8) Snedecor G. and Cochran W. (1989), Statistical Methods. 8th Ed. Iowa State University Press Iowa.
- (9) Weller J.I. (2001), Quantitative trait loci analysis in animals, CABI Publishing, London.
- (10) Myers E.W. (1997), Computational Methods in genomic research Plenum Press, New York.
- (11) NCBI : National Centre for Biotechnology Information (1993), Manual for NCBI software development tool kit version, 1.8. National Library of medicine, National Institute of Health, Washington.
- (12) Branden C. and Tooze J. (1991), Introduction to Protein Structure, Garland Publication, New York.
- (13) Bushman F. (2002), Lateral DNA transfer : Mechanism and consequences. Cold Spring Harbur Laboratory Press, Cold Spring Harbur Laboratory, New York.
- (14) Durbin R., Eddy S., Krogh A., and Mitchison G. (1998) Biological sequence analysis : Probabilistic models of proteins and nucleic acid, Cambridge University Press, U.K.
- (15) Li. W. and Graur D. (1991) Fundamentals of Molecular Evolution, Sinaur Associates, Sunderland, Massachusetts.
- (16) Dayhoff M.O. (1978), Atlas of Protein sequence and structure, Volume 5, National Biomedical Foundation, Gergetown University, Washington.
- (17) Waterman M.S. (1989), Sequence Alignment. In mathematical methods for DNA sequences. CRC Press, Boca Raton, Florida.
- (18) Von Heijne G. (1987), Sequence Analysis in molecular Biology – Treasure trove or trivial pursuit, Academic Press. San Diego.
- (19) James Tisdall, 2001, “Beginning Perl for Bioinformatics”, O'Reilly & Associates (2001), Learning Perl, 3rd Edition.
- (20) Bioinformatics and Functional Genomics – Jonathan Persner (3) S.C.Rastogi, Namita Mendirata, Parag Rastogi, “Bioinformatics concepts skills and application, CBS Publisher.
- (21) D.Baxevanis and F.Oulette, (2002), “Bioinformatics : A practical guide to the analysis of genes and proteins”, Wiley.
- (22) Arthur M. Lesk, (2002), “Introduction to Bioinformatics”, Oxford University.

Semester-VI

6S : BIOINFORMATICS

Paper VI (Advanced Bio-computing)

UNIT-I : Object Oriented Programming using C++ :

Introduction to OOPS, features, structure, data types and user defined database, Constants, variables, operators, control statements, creating and writing functions, inline functions and function overloading.

UNIT-II : Classes & Objects :

Data abstraction, encapsulation, data hiding, defining class, member functions and data members, creating objects, accessing class members, constructors, destructors, array of objects, pointer to objects, operator overloading, inheritance and its types.

UNIT-III : RDBMS ORACLE 9i :

Architecture, Database models : Relational, Hierarchical, Networks; data dictionary, DMI operations, Domains and attributes, normalization process, Normal forms : 1NF, 2NF, 3NF, 4NF, BCNF. SQL : Components of SQL, data types and operators. DDL Commands : CREATE, ALTER, DROP, for tables and views. DML Commands : SELECT, INSERT, DELETE, UPDATE, BREAK & COMPUTE.

UNIT-IV : Functions

Number, Character, Concatenating functions, joins, unions, data integrity and constraints. PL/SQL : Features, Block structures, variables, constants, data types, control structures, cursor, concept, type, opening, declaring, classify and cursor attributes. Transactions : Rollback, commit, save point, Rollback segment.

UNIT-V : Features of SQL form of SQL report :

Users, Roles and Privileges : Concept, creating users, system and object privilege, GRANT privilege, REVOKE privilege, passing on privileges, creating roles.

UNIT-VI : Perl and Programming :-

Low and long learning curve. Perl's benefits. Installing Perl on computer. Perl program peration text editors. Finding help. Individual approaches to programming Edit-Run-Revise (and Save) An environment of programs, programming strategies. The programming process using the Perl. documentation calculating the reverse complement in Perl Proteins, files and arrays reading proteins in files arrays scalar and list context. Subroutines scoping and subroutines command-line arguments and arrays. Passing data to subroutines modules and libraries of subroutines fixing bugs in code.

Practicals :-

Minimum 18 experiments based on theory paper Advanced Bio-computing covering all aspect of syllabus.

Distribution of Practical Marks :-

(5) To perform one major experiments :	15 Marks
(6) To perform two minor experiments :	15 Marks
(7) Viva-voce:	10 Marks
(8) Practical Record:	10 Marks

Total 50 Marks

List of Equipments :-

	Quantity
1) Computer Terminals :- Pentium-IV with latest configuration	8 computers for batch of 16 students
2) Printer CDMP : Configuration :- 24 pim, 132/80 columns	02 Nos.
3) C++ Software (Compiler or Interpreter)	01
4) Perl Language Compiler	01
5) Broad Band Internet Connection	01

Recommended Books :

- 1) Object Oriented Programming with C++ : E.Balaguruswamy
- 2) Programming with C++ : R.S. Nisar Ali
- 3) Mastering C++ : Venugopalan.
- 4) C++ Programming : Ravi Chandran
- 5) Understanding Oracle : Perry and Latic – BPB
- 6) Essentials of oracle 8 : TOM Lewis.
- 7) An Introduction of Data Base Systems : C.J.Date – Narosa
- 8) Programming with C++ : Robert Lafore
- 9) Oracle Press Introduction to oracle (TMH)
- 10) Oracle Unleashed (Sams)

B.SC. FINAL (SEMESTER-V)

22 : APICULTURE

5S : APICULTURE

Paper V (Cytogenetic & Bee breeding)

- Unit-I :**
- A. Cytology in General: Cell and its structure and function, Cell division, Cell membrane, mitochondria, endoplasmic reticulum, lysosome, Golgi apparatus, nucleus. Elementary principles of heredity, Applications of genetics to bee improvement.
 - B. Inbreeding and heterosis, mass selection of superior genotypes. Examination of matings among superior genotypes is isolated apiaries.
 - C. Progeny testing methods for bees. Elementary analysis. Scope and limitations of instrumental insemination for bees.
- Unit-II :**
- A. Bee breeding: General methods of breeding and selection, mitosis and miosis, applicability of individual methods for bees.
 - B. Organization of breeding apiaries: Acquisition of colonies from their natural nests. Their transference to movable frame of standard hives.

Location of different types of breeding apiaries duly related to their functions. Equipment and tools for bee breeding programme. Special apiary management problems for bee breeding programme.

- Unit-III :** Selection Criteria : General Criteria- Particular criteria to meet the demands of local habitats, Desirable and undesirable characters. Quantitative and qualitative characters. Differential components subscribing to higher yield and better performance -Honey yield , Body size, Tongue reach , frequency of egg laying and hatching, percentage Temper, Steadiness , Discretion, Absconding, Swarming, Parsimonious habit , Hive sanitation , Disease resistance.
- Unit-IV :** A. Individual colony records: Pedigree records system adapted for maternal living age of bees. Periodicity for observation and recordings. Providing uniform conditions for valid comparison of pedigrees.
B. Evaluation of Individual colony records : Tabulation of individual colony records. Apiary averages for characters susceptible to environmental influences. Grouping of individual colonies.
- Unit-V :** Assigning of maternal pedigree number for selection: Rearing of pedigree queen bees. Migration for queen rearing programme. Distribution of individual groups to isolated apiaries for maximizing superior mating and minimizing inferior mating. Available resources. Advance provisioning for implementing the programme.
- Unit-VI :** Transport of sealed queen cells: Preparation of mating nuclei with sealed queen cells or virgin queens, Special management problems for organizing mating yards. Provision of adequate population or pedigree drones, single and multiple mating, mating signs. Re-migration of stocks, Progeny testing. Equalization of colony strength through upgrading or downgrading for equal starts for pedigree and unselected controls.

Practical Course PR-5 :

1. DNA isolation from honey bee
2. Study of permanent stained slides (Meiosis)
3. Polytene Chromosome isolation and staining
4. Morphometric study of different species of honey bee.
5. Phylogenetic study of honey bee using sequences from NCBI
6. Mutation study using UV rays in honey bee larvae.
7. Estimation of tongue reach.
8. Demonstration of equalization of colonies.
9. General methods of bee breeding and selection.
10. Organization of breeding apiaries.
11. Study of mitosis in onion root tip.

Distribution of Marks : 4 Hrs.

- | | |
|--|----------|
| 1. DNA isolation of Honey bee / Tongue reach estimation. | 15 Marks |
| 2. Polytene Chromosome Isolation and staining / study of mitosis, stages in onion root tip | 15 Marks |
| 3. Morphometric study of honey bees | 05 Marks |
| 4. Practical Record | 05 Marks |
| 5. Field Diary | 05 Marks |
| 6. Viva-voce | 05 Marks |

Total Marks 50 Marks

List of Equipments :

1. Centrifuge
2. Vernier caliper
3. Bee coloney hives
4. UV source
5. Equipments for tongue reach estimation
6. USB digital camera with dimensional software

**B.SC. FINAL (SEMESTER-VI)
5S : APICULTURE
Paper VI (Management, Marketing & Extraction)**

- Unit-I : Apiary management**
- A. A. Apiary selection and establishment of bee colonies and bee management. Establishment of Apiary. Choice of apiary site, consideration of climatic conditions like wind, light, rain temperature .
B. How to handle colony. Recognition of easier of a colony. Capturing of a natural colony. Hiving of the colony and maintenance. Survey and location of colony. Collection of honey -**hygienically**.
C. Approach to colony, method of handling bees (periodic inspection). Reorganization of queen, her age, health, egg laying, behavior of honeybees. Brood and food condition.
- Unit-II : Special Management**
- A. Special Management for practice - Seasonal management, variation in management, pattern related to regional differences.
B. Method of recording humidity, Temperature and other meteorological data, use of thermometer, barometer, rain gauge, anemometer and other simple meteorological instruments.
C. Production of comb honey. Commercial beekeeping management. Maintenance of technical record. Laying worker causes and remedial measures. Topography evaluations of the place. Drainage of rain water. Availability of water. Observation on competition between crops, crops & weeds & insect pollinations.

D. Migratory Beekeeping: Survey, packing transporting, pollination service.

Unit-III : Queen Rearing : In nature, need and scope of artificial methods of queen rearing, various methods of preparing various mating nuclei and distribution of mating nuclei, packing bees, introduction of queens and packages, clipping and making queens.

A. Drone breeding, queen cells formation, laying workers. Feeding, uniting dividing, of colonies. Sanitation, cleaning, observation of colonies for diseases. Routine forage and other activities.

B. Swarming: Its purpose, period of growth, various methods of swarm control and prevention. Desertion: Its causes and methods of prevention

Unit-IV : **Marketing of honey & bee wax**

A. Quality control & purity standard.

B. Organization of marketing of honey & bee wax.

C. Production, consumption & promotion for domestic, industrial market. Problems of marketing of honey & bee wax. Scope of marketing indigenous market for industrial & domestic purpose. Scope of marketing for export of honey. Future strategy.

D. Accounts and book keeping.

Unit-V : **Beekeeping laws and regulations**

A. Import restrictions on bee colonies package bees, queens, etc. in various countries, quarantine laws governing bee disease notifications in major honey producing countries.

B. Regulations, protecting bee populations against indiscriminate spraying.

C. Rules regarding honey house, processing, bottling packing, adulterations.

D. Laws governing standards on beekeeping equipments.

E. Laws governing standards on beekeeping products. International law. Legislation affecting beekeeping in general in various countries.

Unit-VI : **Extension of Honey Bee Keeping:**

A. Principles of Extension work with reference to Indian conditions and economy place of beekeeping in rural economics, beekeeping as agro-industry, and economics of the Industry: a glance of beekeeping in India and abroad.

B. Commission's co-operative Organization, Model bye-laws, Role of co-operative movement in the propagation of Beekeeping in this country Registered Industries Commission.

Field study:

1. Market survey for honey bee products.

2. Study of different bee colonies (rock bees, florea & trigona species)

Practicals :-

1. To isolate and study pollen from freshly extracted honey

2. Extraction of wax from comb.

3. To study technique for mounting of wax foundation sheet to frame.

4. To monitor internal bee colony hive temperature and humidity.

5. To study properties of propolis.

6. To study physical properties of squeezed honey.

7. Protocol for packing of bee products.

8. Methods of colony handling

9. Bee recognition with respect to sex, age, and brood.

10. Determination of humidity temperature and other meteorological factors,

11. Use of thermometers, rain gauge, anemometer.

12. Queen rearing and drone breeding.

13. Market survey technique

14. Costing of apiary products, quotations

15. Storage and packing of apiary products

16. Use of Computer in maintenance of stock quotations, etc.

Distribution of practical marks : 6 Hrs.

1. Practical based on apiculture management

A. Methods of Colony handling 05 Marks

B. Determination of meteorological factor 05 Marks

C. Bee recognitions 05 Marks

2. Preparation of order/Bill of apiary products. OR

Processing of Assorted data by using computers 15 Marks

3. Spotters, based of Syllabus of the paper 10 Marks

4. Certified practical record 05 Marks

4. Viva-voce 05 Marks.

Total 50 Marks

List of Equipments-

1. Queen grafting kit.

2. Thermometers

3. Wax extraction unit.

4. Wax foundation sheet
